Saving our contemporary scientific and technical heritage with a safeguarding methodology

YVES THOMAS & CATHERINE CUENCA

Abstract

Science and technology have never known such advances as in the last 60 years. Consequently, the ideas and objects from the people that have made the events and milestones of scientific evolution in their university research laboratories deserve to be carefully stored, despite the sheer mass, diversity and no doubt redundancy of information. One method of doing this consists of safeguarding information selectively and virtually in multimedia databases, which can be consulted via web sites devoted to our modern scientific and technological heritage.

These multimedia items include descriptions and photos of instruments, patents, coursework notes, prototypes, but also videos of interviews with researchers, and explanatory animations, all of which can be used to create coursework in scientific culture for master degrees, to create exhibitions on start up companies from recent innovations, to reconstitute the history of a research laboratory, to make collections of objects performing a common function but that are geographically distant, to describe the career of an exceptional researcher, and so on.

Work of this kind has been started locally, at the University of Nantes, for the last 10 years or so, and the methodologies developed have spread to several other regions in France, under the supervision of the Paris museum of scientific invention, the Musée des Arts et Métiers.

This report aims to describe the different objectives, the methodologies used, the results obtained, the successes and challenges, the advantages and limitations, the outcomes and the international potential of such a project.

Introduction

What does it mean when we speak of our "contemporary scientific and technical heritage"? It is the instruments, machines, tools, prototypes, systems, patents, documents, processes, written or spoken interviews of the last 60 years, which has been an intense period of scientific and technological revolution. Yet, when we talk about heritage, we are really talking about material and virtual objects, which are waiting to be rescued and preserved. These objects present difficulties as they are often opaque, lacking in aesthetics, unremarkable, complex and complicated to explain. Furthermore they tend to proliferate and so require selection criteria. One example of this could be the different types of electronic microscopes (confocal, sweeping, transmission, atomic force, force modulation), but there is an endless list of similar examples: various radiological devices (gamma camera, scanner, MRI, PetScan), underwater observational systems, dating from the first submarines to underwater robots, astronomical observation systems from optical telescopes to satellite-borne electronic telescopes, and of course, computers, from the unwieldy unusable ENIAC of 1946 to today's powerful compact personal computers.

From these few examples, we can see the short-fallings of classical methods of conservation and traditional museology. Our ten years of effort to save this heritage brings a vital question to the fore: what resources and methodologies do we need to use to preserve these types of objects and to bring value to them once preserved?

But before we look more closely at that question, let us try to characterize the last half century of scientific and technological achievements to understand the task ahead of us.

Contemporary techno science

Contemporary science has dramatically altered in scope, expanding from the infinitely small to the infinitely large.

In the 1960s, the observation and understanding of phenomena were carried out on a scale of micrometers, but today, these same procedures occur on a scale of nanometers and angstroms, on an atomic and subatomic level. Scientific observation has been enriched with digital simulation and miniaturization engineering, which have caused an extraordinary boom in microelectronics, in molecular biology and in the synthesis of new materials. Microelectronics in turn created micro-computing, digital telecommunications and control command systems. Molecular engineering led to genome sequencing and genetic engineering. Material engineering led to innovations in products with specific characteristics and performances.

On the other extremity of the scientific spectrum is what is commonly known as Big Science, particularly devoted to space and nuclear research, with bodies such as NASA and the European Space Agency, the American Department of Energy, CERN in Geneva and not forgetting ITER in Cadarache. This Big Science is characterized by gigantic installations (the Los Alamos and Brookhaven accelerators in the USA, Troitsk in Russia, the Large Hadron Collider at CERN in Geneva, the ITER fusion reactor in Cadarache) where researchers from a multitude of domains and from the whole world over work together. Science is globalized, a task made easier by powerful computer networks.

For economic reasons, the Big Science phenomenon remains limited and concentrated, but it now has repercussions on standard research laboratories as their trustees seek to expand, by external growth and mergers, and to create multi-disciplinary and multiple approach scientific environments. This does not stop the inventions or discoveries outside of Big Science from being mostly individual, but the innovations that result from it and their derivatives are by nature largely collective, as they involve manufacturing and production technicians and engineers, sales and marketing services, trainers and strategic planners.

In the same vein, science and technology have come closer together, in a sort of cross-pollination process. Research and industry have developed closely together in scientific or industrial parks, and other Silicon Valley type installations, and startups or spin-offs are closely linked, hence the increasingly common term of ‘techno science’. These techno sciences have rapidly entered into common usage, with everyday life affected by microelectronics, micro-computing, plastics and composite materials, which are all around us in housing, cars, workplaces, community and leisure centers.

We can see that the material artifacts of this type, stemming from the techno scientific innovations of the last 60 years, always have a complex history and context (HALLEUX 2008). We should not separate these objects from the men and women really involved in creating and using them. By contributing their written and spoken memoirs, these people may make up an indispensable immaterial heritage to complement the real objects.

A first step is to ensure that the scientific instruments, and concrete research and innovation artifacts from the second half of the 20th century do not disappear forever from labs and research departments. Secondly, it is vital to interview the growing number of research professionals who helped in the creation of these labs and worked in them, and who are one by one retiring from professional life. The same applies to the engineers who contributed to the major works in computing, aeronautics, and the space industry among others.

Our project

Following a first experimentation at University of Nantes in 1996 (CUENCA-BOULAT 1997), a mission for developing a documented inventory was created in 1999 in our region of France, where four universities are located. A regional program to preserve contemporary scientific and technical artifacts was launched on an experimental basis. Under the supervision of a scientific committee its primary objective was to safeguard technical objects but also the accounts given by inventors and users of those objects, in a multimedia format. We developed simultaneously a database of several thousand objects, and DVD-Roms that narrate the stories of research and researchers, in the disciplines of acoustics, the rubber industry, cardiology, organic chemistry, embryology, process engineering, electrical engineering, nuclear medicine, micro-encapsulation, marine environments, neuro imaging, plant bacteriology, intellectual property, nuclear magnetic resonance, botany and renal transplantation (CUENCA, THOMAS & BALLE 2005).

As soon as sufficient internet data flow could be made available, we placed all these results on a website, dedicated to cultural professionals, teachers and the general public[1] and an initial study of the use of these multimedia products has been carried out.

Fig. 1 - This web site www.patstec.fr should have an international version soon.

Fig. 2 - In this multimedia product, 17 researchers tell the stories of their successes, mistakes, changes in direction and talk about their instruments and innovations.

In 2003, to continue this pioneering program, the government's minister for research appointed the Musée des arts et métiers in Paris to carry out a national conservation mission, to safeguard the contemporary scientific and technical heritage of higher education institutes, research centers and companies (THOULOUZE 2005). The aim of this is to encourage regional initiatives within a national network and to give advice and expertise towards the creation of contemporary science and technical museums. The national mission seeks to preserve the living memory of research, by collecting scientific instruments that testify to public and private research, including the major documentation associated with that, from workers in higher education, research and industry.

This greatly diverse heritage in its entirety will be a major tool to help the general public understand the knowledge, techniques and innovations involved and provide a basis for introducing young people to careers in these domains.

[1] This site can currently be viewed at www.patstec.fr (accessed December 13, 2010).

Today the national database is made up of more than 5,000 records (CUENCA 2005), enriched with more than 20,000 photos, videos, texts or animations. Partnerships have also been set up with companies such as EDF and Essilor and with CERN in Geneva. The national mission is becoming a European one, which will involve several major museums, and several universities in the hope of creating an international, multicultural site.

Some methodology

Without going into too much detail of the preservation methodologies currently developed and applied, let us look at some basic principles that must be respected.

- A practical community has to be developed as close as possible to the objects that need preserving. This may involve networks of retired researchers interested in the project and networks of working researchers, as laboratory correspondents. This community can also promote awareness among the users of objects and organize temporary or permanent exhibitions.
- As with any large project, a project head must be appointed, to coordinate, organize, fix objectives and mobilize human resources and funding.
- It is important to build a scientific council around a preservation project, as it ensures that the process will be consistent and of high quality. It is important to cover the main scientific domains (such as physics, chemistry, biology, engineering, astronomy), but also to involve scientific and technical historians, and, for promoting the work, sociologists and marketing specialists.
- Historical preservation occurs in several stages: creating researcher awareness, finding objects and connected parts, sorting through objects, collating and tagging, documenting catalogued objects and interviewing the people that know about them.
- The safeguarding process must make full use of today's information technologies: obviously digital collaborative working environments, but also knowledge management and e-learning.
- Catalogue entries of artifacts and 'actors' must contain the item name, a brief, precise non-encyclopedic description of it, its location and associated items: remember that any recent instrument is generally but a part of a whole, and any researcher has always had co-workers.
- Interviews with researchers must be carried out along two main guidelines: firstly, scientific explanations must be clear, concise, and instructive, and secondly, the interviewee should be encouraged to be natural and emotive in order to tell the story of his or her discoveries or of a laboratory in the most interesting and efficient way.

Creative usage through ICT

We previously developed the idea that objects only have interest and meaning when they are accompanied by the words and explanations of the men and women who have used or created them or made them evolve. To bring value to these preserved artifacts, digitized works must be created, involving the authors and players. Generally speaking, these works do not yet exist and have to be created from scratch. A digital conservation bank has to be created to safeguard this knowledge but also to display and debate it in a pedagogical and aesthetic aim.

Through 'researcher stories' developed and stored in multimedia products, we mean to tell what happened, backed up by the objects used or created, and in doing so, show the roles played and work undertaken by researchers and their relative importance in the advancement of knowledge and sometimes in economic development.

And by telling the 'research lab stories', again through multimedia products, we wanted to explain how innovative individuals and teams of divergent skills can work together over time, using increasingly

Fig. 3 - A success story: M. and G.J. Martin contributed to create the Eurofins company that today involves more than 5,000 people worldwide.

effective instruments, in order to reach goals set by watchful scientific committees. These digital history books, from which you can easily access videos, are a powerful tool, showing the real players involved in these stories and using this realism to emphatically explain and persuade.

In contributing to a real exhibition (but through the use of digital panels), on the 50th anniversary of Essilor's Varilux glass, we wanted to explain that between the individual discovery of progressive lenses and the actual commercial success of that innovation, there were decades of collaboration between numerous specialists in manufacturing, instrumentation, advertising and management. We can imagine that a three-dimensional virtual exhibition online could be a fascinating way to extend such a 'real' exhibition, with room for improvements and updates.

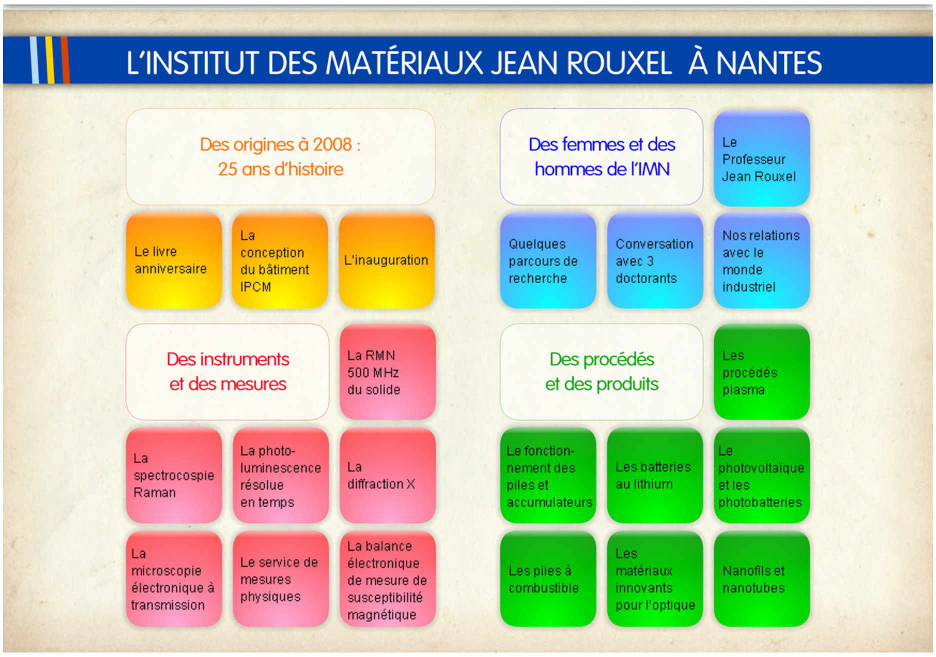

Fig. 4 - This is the cover page of the history of a research laboratory: the Institute of Materials in Nantes (France). There are four parts: a historical one, administrative and scientific, recounting 25 years; staff members (the founder, some key researchers, and young doctoral students); instruments and their evolution over this period of time; innovative processes and products.

We recently developed modules of an information science masters covering the most innovative scientific and technological domains of recent years. By proving these via links on the Patstec web site, we were able to offer students a digital product adapted to today's interactive learning, and encourage them to build similar products themselves through a compulsory technical-scientific scheme of work.

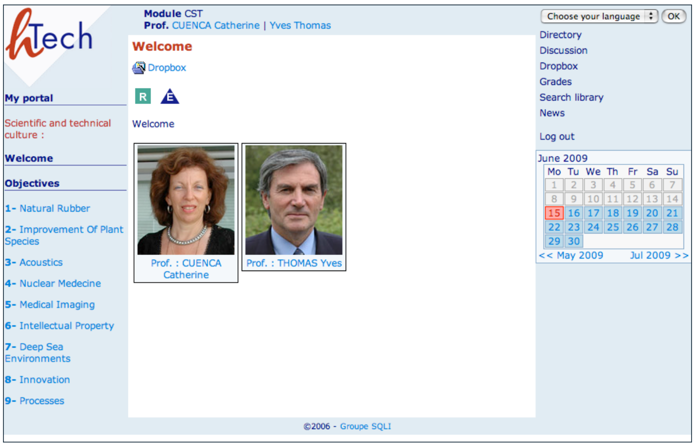

Fig. 5 - A digitized masters course in scientific and technical culture.

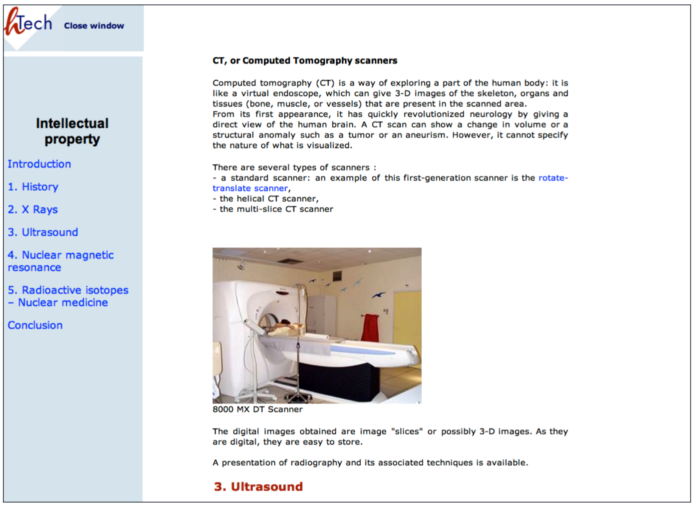

Fig. 6 - An example of the medical imaging chapter. All the documents involve many links to the Patstec web site.

In all these cases, the digital or virtual helps bring a human dimension to these objects, these artificial components that are naturally inanimate, austere and often obscure. Virtual elements are an indispensable addition to real objects and exhibitions.

Conclusion

In general, what we call heritage is looked upon as a testimony to the past, be it precious, magnificent or imposing. But in the case of the technological innovations of the last sixty years, the material artifacts are often unattractive, hard to interpret, or encapsulated within a 'black box'. This is why the immaterial side of this story, which can be used as a complement to the actual objects, is so important, as it represents the human dimension of these innovations in terms of imagination, creativity, strategy and interdisciplinary co-operation.

Certainly we are aware that bringing value and exhibitions to the preserved items and collections should be done with a minimum of fixed boundaries, to encourage diversity, aesthetics and efficiency.

Such projects require rigorous rules and standards and coordination. With this in mind, we have worked tirelessly for the last 10 years on numerous preservation experiments, as part of an international effort to preserve this valuable heritage.

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Contact

Yves Thomas
Professor at IHT-Polytech, University of Nantes
Address: rue Christian Pauc, BP 50609, 44306 Nantes Cedex 3, France
E-mail: yves.thomas(at)univ-nantes.fr

Catherine Cuenca
Chief Curator at IHT-Polytech, University of Nantes
Address: rue Christian Pauc, BP 50609, 44306 Nantes Cedex 3, France
Musée des arts et metiers – Cnam
Address: 292, rue Saint-Martin, 75003 Paris, France
E-mail: catherine.cuenca(at)cnam.fr; catherine.cuenca(at)univ-nantes.fr
www.patstec.fr