

**Millennial Time Capsules as a Promising Means for Preserving Records for Future Generations-16542**

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**ABSTRACT**

When we deal with preservation of Records, Knowledge and Memory (RK&M) for any long-term, non-inspected facility such a deep geological repository, there is no single technical or cultural provision that can be relied upon to do alone the preservation job 100%. Rather we should increase our chances by implementing a combination of approaches based on different components that provide redundancy and/or pointers to one another. Time capsules are no exception. However, they seem well suited to support national archives and other preservation elements, in order to preserve RK&M as long as possible or interesting. Time capsules are a ready to go, workable concept, with many examples of implementation of large-size, millennial time capsules at small depths based on science and lessons to be learned. A proposal is also made for considering and developing small-size time capsules placed strategically deep underground at repository level.

**INTRODUCTION**

Time capsules are used rather commonly by schools, companies, councils and even families to record and preserve today's artefacts for future generations, documenting how we live today. The practice is rather widespread and it suffices to search "time capsule" on the Internet. Numerous examples exist in the USA, Japan and Europe of millennial time capsules at small depths based on a scientific approach and with many lessons learned. Yet this technology is only scarcely studied, only one general book exists on the subject [1]. Until now, it is not part of the literature on memory keeping for radioactive waste repositories. In this paper we review some of these time capsules, we identify the Osaka dual time capsule as an example worth emulating for radioactive waste disposal, we highlights cultural aspects, potentialities, and management paths to carry a time capsule project forward. We also propose considering and developing small size time capsules to be placed underground at repository depth. These time capsules would be made of the same or more durable materials than current waste containers.

**WHAT IS A TIME CAPSULE?**

A time capsule is a purpose-built, sealed enclosure containing a historic cache of records to be used as a means to inform future generations at a specified time or upon inadvertent discovery. The above definition of "time capsule" is specifically tailored to records, memory and knowledge (RK&M) preservation. The Pompeii archaeological site, the pharaohs' burial chambers or the Altamura Caves, say, are not time capsules in that they were not purpose-built. At their

best, modern time capsules are meant to reach out to future archaeologists, anthropologists, historians, political leaders or society at large. Time capsules are also typically used to transmit family information and heritage. A boom in family-type time capsules occurred at the change of the millennium, as described in a New York Times article [2] of 22 April 1999. In this article it was noted that prestigious institutions such as the Smithsonian Institution were involved.

### **EXAMPLES OF MODERN, MILLENNIAL TIME CAPSULES**

Millennial time capsules can be categorized into two main groups with the *intention* of:

- Delivery of contents at a defined time in the future
- Delivery of contents at an unknown time

Time capsules may be placed so as to be clearly visible in their entirety or sign-posted in a place that is typically accessible by people (visibly in Table 1), or it can be less visibly located with no easy access by the public (“not visibly” in Table 1).

**Table. 1 Examples of millennial time capsules in different categories**

Time capsule or equivalent	Placed visibly (Y) or not visibly (N)	Designed for opening at a specific time (Y) or at an indefinite time (N)
Crypt of Civilization [3]	Y	Y
Osaka Castle [4]	Y	Y
Memory of Mankind [5]	N	N
Westinghouse [6]	Y	Y
Clock of the Long Now Foundation [7]	N	N
Pioneer, Viking and Voyager Space Probes [8]	N	N
Helium Centennial Time Columns Monument [9]	Y	Y

Several spacecraft were conceived as also serving as very basic time capsules for humans and/or aliens in the far future. For instance, Pioneer 10 and Pioneer 11 both contain plaques that give pictorial information about their time and place of origin; each of the two Voyager space craft contains a golden record with pictures and sounds of Earth, along with symbolic instructions for playing the record and data detailing the location of Earth [8].

## **DESCRIPTION OF MILLENNIAL TIME CAPSULES**

The **Crypt of Civilization**, located in the basement of Hearst Hall of Oglethorpe University (Atlanta, Georgia), right next to the university bookstore, is a large, airtight, sealed chamber conceived to include thousands of items from our civilization at the end of the 1930's [3]. Its design took inspiration from the Tutankhamen tomb. The contents of the Crypt include, for instance, over 640,000 pages of microfilmed material as well as machinery and instructions on how to use it, a set of Lincoln logs, a Donald Duck doll, and a device to teach the English language to the Crypt's finders. The US National Bureau of Standards gave professional and technical advice for storing artefacts and construction of the crypt. Many artefacts are stored in stainless steel receptacles lined with glass and filled with an inert gas to prevent aging, a concept later carried over to the Westinghouse Time Capsules and also by the other time capsules such as the BBC Time Capsule (argon gas), the Helium Centennial Monument (helium gas), and the Osaka Castle Time capsule (argon gas). A plaque clearly signifies the purpose of the Crypt to be opened in 8113 AD.

The **Westinghouse Corporation time capsules** were created in 1938 and 1965, respectively, on the occasion of the World Trade Fairs in Brooklyn [6]. They are embedded in the ground and a marker upon the burial ground reminds of where they are. The Westinghouse time capsules internal volume is 40 litres. They contain objects and documents from their epoch preserved in an inert atmosphere. Time Capsule I is made of Cupaloy, an alloy of copper, chromium and silver. It was chosen for its corrosion-resistant properties. Time Capsule II is made of Kromarc, a kind of stainless steel, also corrosion resistant. In 1965, Westinghouse chemists also studied the soil of the Flushing Meadow burial site and determined that it was lacking in chloride ions, which cause corrosion. They expressed confidence that the time capsules would stand the test of time. The Westinghouse capsules are buried within a petroleum pitch, chlorinated diphenyl and mineral oil mixture to act as packing to resist moisture and soil acids. In addition, for both Time Capsules a Book of Records was created to help preserve knowledge of the existence of the time capsules for 5,000 years. The more than 3,000 copies of the Book of Record were distributed to museums, monasteries, and libraries worldwide.

The **Helium Centennial Time Columns Monument** was built in 1968 to commemorate the 100th anniversary of the discovery of helium [9]. The Time Columns Monument is a six-story high, stainless steel structure containing four time capsules, three of which form the legs of the monument and one that stands erect. The capsules are intended for opening in 25, 50, 100, and 1,000 years from the date it was erected (1968). The first capsule was intended to demonstrate our dependence on natural resources. The subsequent capsules represent industry, science and history respectively, as they relate to our use of natural resources. Funding for the Time Columns Monument and site was obtained through contributions from individuals as well as from private and public organizations, especially those in the local helium industry. The monument also serves as a sundial. In 1982 a US Army Chinook helicopter airlifted the 8.5 ton Helium Monument from its original site on I-40 to its current site at the Don Harrington Discovery Center. In May of 1993, the first time

capsule in one leg of the monument was opened during a two-day celebration organized by the Silver Celebrations Committee.

The **Osaka Castle Dual Time Capsules** built originally by Matsushita (now Panasonic) Corporation [4]. Two time capsules of 500 litres volume each are buried at depths of 10 and 15 meters, respectively, in the grounds of the Osaka Castle in 1970. The Osaka Castle time capsules (intended for 5,000 years) are kettle-shaped and made of nickel-chrome alloy and themselves embedded into an external over-pack made of concrete. They conserve objects, documents and materials responding to suggestions from the natural and social sciences as well as from the arts. One of the time capsules serves as a “pilot” and is supposed to be inspected according to a secular schedule. It was indeed inspected in the year 2000. Of the 2,098 items in the unearthed time capsule, 173 items were inspected. Though some of the bacteria samples had perished, the rice cooker and television set worked normally. In addition, the experimental plant seeds had sprouted and most of the other items had been kept in the same state and working condition as when they were first placed in the capsule. After the inspection was completed, the capsule was buried again in November.

The **BBC Time Capsule**. On 17 November 1982, the BBC Chairman buried a Time Capsule in the grounds of Castle Howard in Yorkshire [10]. The occasion was part of the celebrations of the 60th anniversary of the founding of BBC; the purpose of the time capsule is to provide future generations, 2000 years hence, with a unique record of aspects of life in 20th century Britain. Among the contents of the capsule are the top three essays of a Maxwell Prize competition made expressly for the time capsule.

## **WAY FORWARD WITH TIME CAPSULES**

Millennial time capsules were/are conceived through a process that requires important resources, new scientific thinking, and involves society. The Osaka Castle Dual Time Capsule is the most elaborate and scientific endeavour in the field of time capsules to date, and it deserves being studied for further inspiration in the field of radioactive waste management. Indeed, the Osaka Castle Dual Time Capsule has many qualities that may allow it to surmount successfully the challenge of time:

- It is a cultural object placed in a culturally protected ground
- It has been designed to withstand natural phenomena
- It is unobtrusive; the only sign is a ceremonial plaque.
- Its very weight provides protection from easy removal
- It is under national jurisdiction. Literally it is in the portfolio of the Ministry of Education and of the Japanese nuclear regulatory commission (due to a Pu-clock in it) and of the city of Osaka
- It has replicas that help propagate memory
- It has a Pilot for inspection every so often.
  - The opening of the control capsule at regular intervals provides the basis for a recurring ceremony (ritual) as well as the opportunity to apply the most recent preservation techniques for improving on possible degradations.

Taking the Osaka Dual Time Capsule example, interesting management elements to create the time capsule were:

- Creation of a *preliminary executive committee* giving the general indications of the project: why the time capsule, for which time scales, and the kind of stakeholders to be involved
- Creation of *two main committees*: a technical committee made up of scientists and academics, and a selection committee made up of experts, e.g., in the natural sciences, social studies and the arts. Creation of sub-committees to deal with factors beyond the scope of the main committees. Creation of an executive committee that coordinates the activities of all these committees.
- The promulgation of *selection policy* (namely, what to look for and why) and procedures for selection. In Japan, in order to simplify the selection procedure, the selection committee was sub-divided into three divisions: Natural Science, Social Science and the Arts. These divisional committees became responsible for selecting records and objects in their own field of interest, in line with the overall selection policy. At the same time, they worked closely with the technical committee on the practicality and preservation potential of every item under consideration.
- A *budget* for acquiring specimens and for laboratory research. For instance, in the field of sound, for the Osaka Capsule, it was decided to store phonograph records. The records of the time were made, however, of vinyl chloride whose filler and plasticizer have a tendency to separate over a long period of time, creating an unacceptable amount of disturbance in reproduction quality. This meant a complete change of material to nickel-silver electro-plated with gold. These "gold" phonograph records are impervious to corrosion yet capable of normal stereophonic reproduction.
- Definition of the *technical criteria* for producing the time capsule and research into it. As an example, for the Osaka time capsule it was decided to use alloy NTK-22AT. This material was suitable for forming into rods and plates. In the case of the capsule, the metal would need to be formed into a large, hollow sphere. This decision presented many difficult technical problems in view of the size and shape of the container and the need to preserve the characteristics of the alloy. Ultimately, the technical committee and their advisers developed a special method of reverse casting which proved to be entirely successful.
- Finalizing the *decision on where to bury*. This decision took into account engineering and geological criteria, as well as social and administrative criteria. In the case of the Osaka time capsule the Senri hills, in the conurbation of Osaka, the site of Expo '70, was the first serious candidate. In Japan, foundations are driven deep into the earth as a precaution against earthquake damage. It would not be appropriate for the capsules to become enmeshed in the subterranean structures of a high-rise development. Osaka Castle Park was the next site to be considered. Geologically, this area is somewhat newer than the Senri hills area but for the past several thousand years at least there is no record of it having been a sea or river bed. The area in which the park stands is one of the most stable in the Osaka Plain. Moreover, the land is Government property administered by the City of

Osaka and, from 1970, it would be designated a protected site of historical importance by the Cultural Affairs Agency. Formal application was made to the Cultural Affairs Agency and final agreement was received on March 24th, 1969.

- *Cultural Heritage aspects.* Clearly, the Osaka Time Capsule is a cultural heritage object and site, and it is managed as such by the Japanese Government. In addition to that, 2 replicas of the time capsules were built at the same time as the other 2 that would be buried. The capsule that had been on display in the Matsushita (now Panasonic) Pavilion at Expo '70 was presented to the Osaka City Museum in Osaka Castle Park in November, 1971. The other capsule was (and is) housed in the Matsushita House of History at the Head Office of Matsushita<sup>1</sup> Electric Industrial Company in Kadoma, Osaka. The capsule in the Osaka City Museum is displayed in a room specially set aside for the purpose. From the windows of the room, the resting place of the buried capsules can be seen clearly.

## **SPECIFICITIES OF MILLENNIAL TIME CAPSULES**

From the point of view of preserving repository information interesting characteristics of millennial time capsules are that they:

- Are an easily understood means of preserving information
- Contain plenty of written records (and objects); digital records are optional
- Are not easily moved or damaged
- Can be erected at a repository location or elsewhere
- Can be conceived also in the form of monuments.
- Can offer the opportunity for regular opening ceremonies over centuries, giving, at the same time opportunity for re-inspection and updating.
- They can combine transmission with and without intermediaries
- There exist examples of scientific approaches to construct millennial time capsules with the involvement of society. The know-how for developing a millennial time capsule is fairly accessible.
- Can be linked to local lore and traditions
- There exist plenty of historical sites, such as ancient necropolises, at relatively low depth, and pre-historical caves whose contents have survived, at least partially, for millennia. Modern technology should be able to perform at least as well.

As for catering to local lore and traditions “the sky is the limit”. For instance:

- A municipality decides to place pictures of its people and places of the year X, plus a letter of the present mayor explains today's choices. The replica time capsule is opened every 33 years.
- Two municipalities will hold similar time capsules and will revisit replicas at different times creating a stronger link amongst

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<sup>1</sup> Matsushita later changed its name to “Panasonic”, which still owns the replica capsule.

municipalities and to the waste repository. They could also decide to have two different types of time capsules.

- Replicas can be placed in several places, e.g., besides its regular collection, a National Archive may also house a time capsule in one of its gardens.
- Etc.

Because they can be long lasting repositories of records, time capsules can serve a useful complementary role to that of archives; plus they would be able to fulfil their role with and without the presence of intermediaries. Dual time capsules are especially interesting in that they combine periods where intermediaries play a role of memory “re-launching” and periods where intermediaries are absent, providing a unique memory preservation mechanism.

## **CONCLUSIONS AND RECOMMENDATIONS**

Time capsules seem well suited to support national archives, which they may outlast, and other preservation elements, in order to preserve RK&M as long and as interestingly as possible. Time capsules are a ready to go, workable concept, with many examples of implementation of large-size, millennial time capsules at small depths based on science and with many documented lessons to be learned. Large-size, millennial dual time capsules are especially interesting in that they combine periods where intermediaries play a role of memory “re-launching” and periods where intermediaries are absent, providing a unique memory preservation mechanism. In particular, previous millennial time capsules were/are conceived through a process that requires important resources, new scientific thinking, and involve society. This also provides a mechanism for national projects that are truly widely owned, which also fosters memory preservation. Besides, time capsules such as the Osaka Dual Time Capsule epitomize the act of disposal: they make it more real and closer to us as a concept. They help the general public understand the disposal concept better; people may be reassured by the fact that some materials like copper, bentonite and inert gases were chosen by others before and will be used again, etc. It is recommended that all interested parties study this memory preservation technology and mechanism: industry as well as national/local stakeholders. Small-size time capsules placed strategically deep underground at repository level are a new concept worth considering. If they are made of materials as or more durable than current waste containers they can provide, in just a few litres volume, actual records to potential intruders far in the future. This technology should be explored as a component of a strategic approach to RK&M preservation.

*.... unlike ancient man; whose life was brief and dictated by forces beyond his knowledge or control, modern man lives long and he is aware of the world around him. He is also aware that by his personal effort he can create a better life for himself and for his children. He is inspired to pass on this knowledge, and time capsules are part of this inspiration.[11]*

*Time capsules . . . are significant attempts to transfer cultural information across millennia. . . . They are also potentially significant formal records of our world's civilization to distant futures. [1]*

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