A cybernetic model of computerization of the cultural heritage

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Abstract

An e-Europe for all should include the facilitation of European citizens to the cultural heritage of Europe and Mediterranean area. This paper proposes a vision for a transition to complex systems combining IT organizations and cultural institutions. It describes the impact and limits and proposes a preliminary cybernetic model to study the relationship between the organizations implied.

Keywords: business processes, computer networks, cultural heritage, discrete time systems, information technology, library, museum, social impact, simulation.

1   Introduction

The Information Society (InS) is characterized by an important cultural dimension. This desirable feature makes the main distinction between the information society and the industrial society, and is meant to serve the citizen (by spiritually enriching him) and the enterprize (by enabling it simultaneously to enter in the competition and to cooperate within a globalize economy), as well as human communities in various countries and regions (of which interdependence at various levels gets stronger). Recently, the European Commission (1999, 2000) has emphasized the high potential of Europe's cultural heritage and defined specific actions.

In April 1995, only two months after G7 Ministerial Conference on Information Society agreed the pilot projects Electronic Library

and Electronic Museums and Art Galleries (G7, 1995) the first virtual journey to several Romanian cultural institutions could be made by using the server developed by ICI-Bucharest people[1]. Since then many experiments to digitize the content of Romanian museums, art galleries and cultural sites have been made by various organizations in an unprecedented enthusiastic movement [Filip, 1996]. However a long term, integrated and systemic view of the local processes of the multimedia digitization of collections with the view to make then logically accessible to the national and international public is still to be defined and agreed by various factors such as cultural institutions, IT organizations and service providers, network operators and marketers of the transformed cultural goods. In this respect the paper proposes a vision compatible with international approaches as defined in various references describing the state of the art in the field (Cappelini, 1996; Dertouzos, 1997; European Commission, 1999; 2000; Salzer, 1992; Smith, 1996).

The paper is organized as it follows. First an extended vision is presented for the general class of cultural institutions (including historical sites, museums and art galleries). The economic and social impact of the new business development (including a dynamic, time delay model of the process) is analyzed too.

2   A vision

2.1   A Transition

Figure 1 shows a systemic representation of a possible vision on IT use in cultural heritage institutions (CI), such as museums and galleries, libraries, etc. The cultural goods (CG) from CI are accessible directly to the direct visitors (DV), or indirectly (IA) to the extended public (EP), through traditional transformed cultural goods (TTCG: books, cassettes, slides), produced by the traditional CG transformers (TCGT: publishing houses, studios), and marketed by traditional CG distributors (TCGD: mainly bookshops and kiosks). The effect of TTCG is stimulating a part of the EP to become DV. In recent days, IT
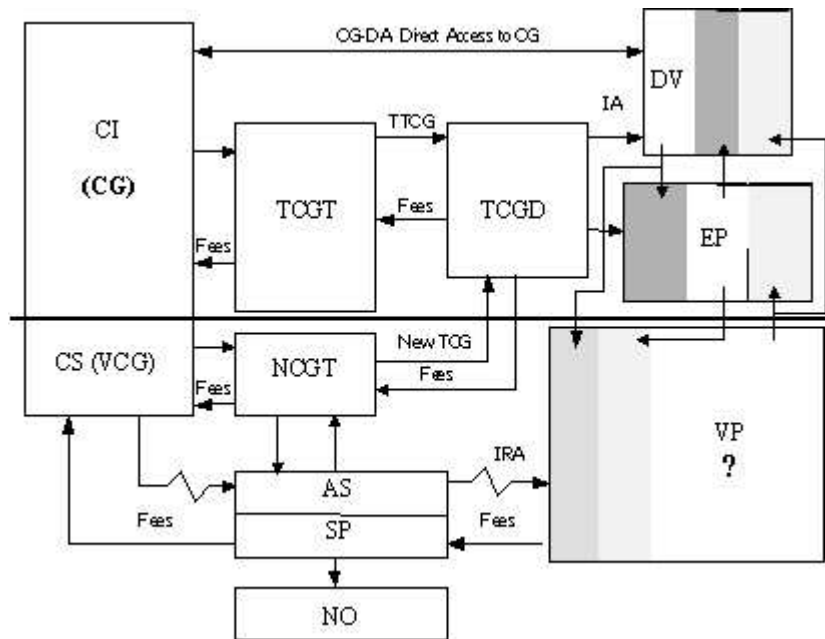
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[1] Address http://risc.ici.ro/docs/romania.html

Figure 1.A cybernetic view of IT application in culture

enables *new* CGT (NCGT) to use modern media, such as CDROM, to produce new TCG. Moreover, the computer and communication integration make possible that the CG became also virtual (VCG), through content servers (CS). They support the interactive remote access (IRA) of the virtual public (VP) through the application servers (AS) of the service providers (SP), which rely on network operators (NO).

We will concentrate on a preview of the future cultural consumption era, in trying to delimit from the pessimistic people that fear about the intrusion of technology and of business interests in the realm of the noble and generous activities of the cultural institutions. It is definitely benefiting to highly increase the EP by virtualisation, because the transformed cultural goods are not always available (have to be known, identified, bought or loaned from somewhere, and these cir-

Table 1.A comparison of media

TCG	Audience	Content	Capacity	Access cost
Printings	medium	static	low	Variable
Film	low	un-modifiable	medium	Medium
Microfilm	limited	un-modifiable	medium	Medium
Video	medium	un-modifiable	medium	Medium
CD(DA,ROM, I,Photo CD)	medium	un-modifiable	large	medium -
WWW	very large	dynamic up-datable	very large	low
VOD/ITV	large	static, quasi-interactive	large	low +

cumstances are usually not met with the one's time and availability). The virtualisation process highly extends the impact of the cultural information on the potential public, because of different reasons, partly transparent from above: access from different places, particularly from home, clubs, hotels, waiting rooms, during slices of the free time; easiness of identification; potential navigation through related information, for a more substantial thematic documentation; virtual integration of spread collections; attraction to young people fond of computers; easy updating, with a side effect of avoiding coexistence of different variants of the same information; access to issues unintently hidden to public because of the lack of exposing space; access to information preserved for security reasons; possibility to virtually rebuild ruined historical monuments, as any other destroyed artefact of the humanity. Some of these effects are possible also through TTCG, but a highly extended impact is reached through virtualisation.

Remote access is welldistinguished from the traditional and the new transformed cultural goods. Unlike these, which are *frozen* for a while, the modifications asking for new editions, the content servers of information are dynamic and likely to be updated and continuously enriched. In underlining this, one will not deny the importance of the traditional or new media, such as CDROM. They are physical objects themselves, making up collections and signifying that the collector was there where such objects and some events could be or happen. Various media are compared in Table 1.

2.2 Reasons

Cultural heritage is probably one of the most valuable products of the humanity. The cultural goods should be accessible to every people. This is not only an act of justice, but also a premise for continuously enriching and selfsustain of the culture itself. Against the theoretically equal rights to culture access, objectively or subjectively, today the access to culture is restricted by different reasons. Theoretically, anyone may reach a given museum, but actually very few can. Two such reasons are the most apparent, and affect every people: the distances and the lack of time. There is no place in the world to collect the whole treasures of the humanity, and practically every culture consumer is frustrated in his/her intention to access culture goods against all the space in the world. Many intended culture items are hidden to public, because of different reasons: security, protection, and lack of space in museums, private property. Many art objects lack integrity, their parts being spread in different places. Many human artefacts are partly or totally destroyed. A deep, systemic insight, even in a narrow cultural subject, is almost impossible because the sources are too spread, so too timely and costly to analyse, search and combine. To different extents, this situation affects everybody, elsewhere.

The only solution is a vector, which can make vanish the distances, and which can organise the information, potentially for any intended use. This vector exists in the computer network. The rest to do is a concerted, tremendous, but also feasible effort towards constituting the global culture collection of the humanity.

This ideal responds to all the problems listed before, and resists to any analysis. Other reasons plead for *edutainment*. Today the life is too capturing for the normal people. Shorter and shorter time is free, used mainly for leisure, to disconnect the body and the mind from the too aggressive business life. The edutainment is the combination of the two aims: pleasure and education. More and more the computer is used not only as a tool, but also to enjoy. But the computer is the above mentioned vector, which can bring virtually the culture at people's ease. The most visible, and equally the most favorable impact
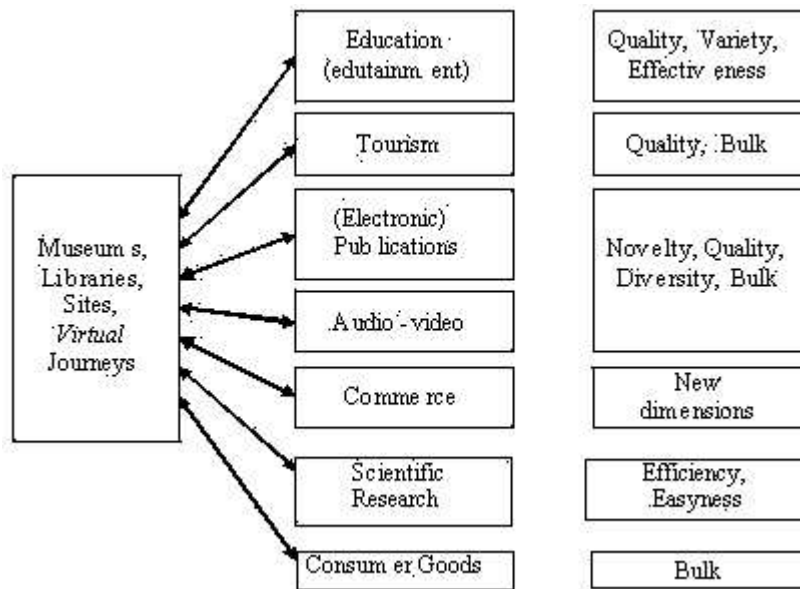
Figure 2.Interactions

of the computer is observable to the young people, in their very best age for building their personality.

2.3   What Virtual Attendance Cannot Offer

First, one cannot touch an object. Second, the object will not be seen in its natural environment (reading room or museum hall, natural landscape). External factors (ambience, other people, environment calling for esteem) are part of the emotional impact, active in the humanistic education. If the clouds position when above a monument or the light tinges in a museum hall, depending on the hour of the day and the season of the year, or even the street noise from under the library windows might be technically rendered, the old books' scent, the feeling of having an object under your own eyes (experimenting the sensations of its contemporary people), and of being not alone (being there with

other, directly touchable visitors) in admiring the same object, will for sure remain nontransferable or nonstirring by computers and networks. Neither the real space, nor the healthy movement accompanying the visit, can also be replaced. Incited and documented by virtual visits, these are supplementary appealing motivations for visitors to experiment real visits.

3   A mathematical model

The top part of Figure 1 (above the dashed line) suggests a synergy between the activities of cultural institutions (CI) and the commercial business of TTCG. Let consider a basic model of a pair composed of one CI and one TCGT For simplification the distributors of TCG are included in the TCGT, which is assumed to produce only one type of TCG. A very simplified discrete time, time delay, dynamic model can be set to represent the system dynamics. (See Esq. 1 through 6 below).

The state variables are: x_1 - the accumulated number of direct visitors (DV), at the end of the month, x_2 - the number of people who buy transformed cultural products (TCG), x_3 - the income of the CI, and x_4 - the profit of the TCGT. The control variables are: u_1 – the production cost of TCG editions and u_2 – the external contributions. The significance of various parameters is as it follows: a_{11} indicates the ratio of previous visitors repeating their visit, a_{12} the proportion of TCG buyers stimulated (inhibited) to visit the real CI, a_{13} shows how the CI income contributes to improving CI services (possibly by organising special events, improving displaying conditions, restoration or new acquisitions), a_{21} the proportion of visitors resolute in buying TCG as souvenirs, a_{31} represents the entrance fee, a_{42} is the price of the (single) TCG, b_{21} the influence of the new editions of the TCG, b_{31} is the proportion (currently very low) of CI rights paid by the TCGT, w_1, w_2 and w_3 show the influence of other factors, say season or external contributions.

$$
\begin{aligned}
x_1(k+1) \;=\; & x_1(k) + \sum_{\tau=1}^{\theta_{11}} a_{11}^\tau x_1(k-\tau) + \sum_{\tau=0}^{\theta_{12}} a_{12} x_2(k-\tau) + \\
& + \sum_{\tau=1}^{\theta_{13}} a_{13}^\tau x_3(k-\tau) + w_1(k)
\end{aligned} \tag{1}
$$

$$
x_2(k+1) = x_2(k) + \sum_{\tau=0}^{\theta_{21}} a_{21}^\tau x_1(k-\tau) + \sum_{\tau=1}^{\omega_{21}} b_{21} u_1(k-\tau) + w_2(k) \tag{2}
$$

$$
x_3(k+1) = x_3(k) + a_{31} x_1(k) + a_{23} x_2(k) + u_2(k) + w_3(k) \tag{3}
$$

$$
x_4(k+1) = x_4(k) + a_{42} x_2(k) - u_1(k) \tag{4}
$$

$$
\begin{aligned}
x_5(k+1) \;=\; & x_5(k) + \sum_{\tau=1}^{\theta_{51}} a_{51}^\tau x_1(k-\tau) + \sum_{\tau=0}^{\theta_{52}} a_{52}^\tau x_2(k-\tau) + \\
& + \sum_{\tau=1}^{\theta_{13}} a_{55}^\tau x_5(k-\tau) + \sum_{\tau=1}^{\omega_{53}} b_{53} u_3(k-\tau)
\end{aligned} \tag{5}
$$

$$
x_6(k+1) = x_6(k) + a_{65} x_5(k) - u_3(k) \tag{6}
$$

Of course this model is not the only possible representation and the process of parameter calculation requires reliable data, long time and serious efforts. However one can expect some relationships such as

$$
\begin{aligned}
& a_{12}^0 \gg a_{12}^\tau (\tau \geq 1) \\
& b_{21}^1 \gg b_{21}^2 > b_{21}^3 \ldots \\
& u_2(k) \gg a_{31} x_1(k)
\end{aligned} \tag{7}
$$

Such a model could serve to evaluate via simulation various decision alternatives such as: association between a CI and a TCGT, the opportunity to produce a new edition of the TCG, the fair value of CI rights,

the need for external contribution or the feasibility of new acquisitions or organisation of special cultural events. In the particular context of this paper it is worth studying two additional problems namely 1) the consideration of new media of TCG (for example CDROM) and 2) the effect of the revolutionary new ways of enabling access to cultural goods of an ever larger virtual audience via networks. In the first case, the scalar u_1 must be replaced by a vector and the models (1) through (4) must be modified accordingly. In the second case, two new state variables must be introduced, namely x_5 (the number of virtual visitors using the computer networks) and x_6 the profits of network operators and service providers (SP). A new decision variable, u_3 (investment in building and extending the content and application servers), is needed too. Two new equations are to be introduced in the model:

In addition, Equations (1) through (4) should be completed by new terms:

$$Eq(1) \leftarrow Eq(1) + \sum_{\tau=1}^{\theta_{15}} a_{15}^\tau x_5(k - \tau)$$

$$Eq(2) \leftarrow Eq(2) + \sum_{\tau=1}^{\theta_{25}} a_{25}^\tau x_5(k - \tau)$$

$$Eq(3) \leftarrow Eq(3) + a_{35}^\tau x_5(k)$$

$$Eq(4) \leftarrow Eq(4) + \sum_{\tau=1}^{\theta_{15}} a_{45}^\tau x_5(k - \tau)$$

Even if some coefficients may lack a precise estimation, one can expect better synergetic effect. We suppose the trend will be an increase in the evolution of x_1 and x_3 (due to the fact that a_{15} is expected to be nonnegative and $a_{35} > 0$) and a non decreasing evolution (possibly increasing) of future values of x_2 and x_4 . The modelling approach proposed here is in a very early stage. Efforts will be made to refine, validate and experiment such models with a view at supporting "What of ...?" analyses.

4   Conclusions

Tentative actions are running to computerise the patrimony of some museums Representative items of their collections are digitised in different museums to be accessed through Internet facilities, as part of the current Romania's WWW servers. A comprehensive site has been developed in ICI (http://lab223.ici.ro/museums).

One expects that the Information Society (based on knowledge and free data exchange) will be *more humane* than the capitalintensive society [Bavec, 1995]. In this respect, culture will be of more effect in the human progress, say by large and free access (irrespective of geographical place, time and available material resources) to cultural goods, at once with the preservation of cultural identity and diversity and with the protection of the cultural wealth of each country.

Many problems are facing the potential concepts and their implementation. More accessible prices for quality digitisation is compulsory, otherwise the undereducation of the artistic taste will result. New technological developments are consequently needed: more speed for communications, higher capacity disks and, better resolutions screens. New professions connected with the art of the multi media attractive presentation of the cultural information are to be skilled.

A particular focus should be put on the needed equal chances for the development of all cultures. From the point of view of the digitisation effort, support is needed to supplement with technology (HW and SW) the enthusiastic movement in the developing countries. Solutions for citizens' access, till a mass implementation of home personal computers, can be found in building library like centres open to public. In this respect, a project could be launched to digitise the traces of Hellenistic and Roman culture in the Mediterranean area.

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