BUILDING INTEGRATED MANAGEMENT SYSTEM-BIMS THE DEVELOPED RESEARCH AND APPLICATION OF "BIS MACHINE" METHOD

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Abstract. Process of an object digitalization is an expensive, long-term and complex work requiring high professionalism of contractors and especially quality technical and computer equipment. Problems of digitalization concept are similar to the dilemma while developing digital maps. The question is whether to develop small scale digital maps first followed by the system with more detail data or start immediately with very precise data. A new research on the field of "BIS Machine, method devoted to cultural heritage management and reconstruction have open various and valuable point of interdisciplinary aims.

Key words: digitalization, cultural heritage, reconstruction, "BIS Machine" method, GIS, photogrametry, CNC, computer, XYZ coordinates

INTRODUCTION

At first place is new management solution applied on cultural heritage units and object similar to GIS option in space management and analyses.

BIMS is offering system data integrated and based on completely new precision of graphic data not used in cultural heritage reconstruction before.

In GIS we have solution of graphical data in scales $1:300\ 000$, $1:100\ 000$, $1:25\ 000$, 1:5000, 1:1000 and in BIMS we can build system based on precision of graphic data between 1mm to 1/1000 of millimetre if it's necessary.

The advantage of new options begins in the phase of survey, photogrametric measurements giving us extremely precise graphic data-from points to cloud of points and surfaces.

In GIS our connection graphic and non graphic data is in for example one point defined with XYZ coordinates on one digital map or digital plan. In BIMS this connection can be in the 3D model defined smallest part of unit, architectural object or sculpture, on which whole object can be divided.

For one church smallest part can be one stone block of few thousands used to build whole church. On example of church st. Jacobs from Šibenik, Croatia, this research options will be presented in this paper. Also, definition of data base applied on reconstruction projects of sculptural units and experiments with positive/negative options in the sense of form is one of the research aim.

Further, validation of 3D model and produced replicas is experimental task which can be helpful in "BIS Machine" application research and developing processes.

WHY MANAGEMENT OF CULTURAL HERITAGE?

Most of stationary culture monuments are usually thought to be "eternal", "indestructible", "made of solid material" etc. Thus, eternity sign is placed in front of each stationary culture monument. However, the history tells us opposite.

First of all it should be pointed out that there is neither physical nor technical protection of most objects in so called western civilization. Only some objects have complete or partial protection from unwanted tempters, hooligans or destructors. Even in these cases protection has no category of absolute prevention. It means that most of them are exposed to possible vandal excesses, ill instinct of individuals and unbridled groups or any kind of terrorist attacks.

All peacetime modalities of possible aggression and devastations of objects being monumental heritage are only a part of danger that can occur for culture monuments. Natural disasters, ecological incidents, errors in building, adaptation or some other construction interventions as well as conflicts and wars (more than 100 in the last century) are direct causes of disappearance and permanent destruction of the world culture and civilisation pearls.

Based upon the above mentioned, we have to be actively involved in protection against some predictable devastation of which aging (tooth of time) is especially constant and active.

Opus of stationary culture monuments is, from the aspect of permanency, extraordinary wide. Apart from the traditional materials such as stone, metal, timber and the like, creations in not ordinary materials are also important. An example is sculptures from the Polish town of Wieliczka, a complex of salt mine being under the highest UNESCO protection. It is characterized by numerous sculptures, of both sacral and secular character, made of salt and thus destined to relatively fast decay.

It was the problem of preservation of the fast disappearing artefacts which motivated Polish and Croatian researchers to find a method by which sculptures and their replicas would be secured from decay. Salt, as the sculpture creation material is rarely used as well as some other short – duration materials (paper, foils and the like). However, durability and resistance against negative effects is a very complex notion which should take into consideration broadness of negative incidences starting from the sea-salt borne by wind to numerous Dalmatian

sacral objects to chemical pollution influence recorded on objects in Krakow region due to chemical and heavy industry (Nowa Huta, Skawina etc).

This is the most permanent process the numerous, almost all, stationary culture monuments are exposed to.

However, organized monitoring and prevention is possible today in consent with object requirements and categorization.

It is especially important that most culture monuments are a renewable resource owing to technology development and series of practical patents used for quality forming of certain objects category data bases. Also 3D virtual models and replicas, copies or the like are possible to develop.

Each form can be recognized in details, saved and directed as a digital datum with precision exceeding ratio 1000:1.

It should be pointed out that an object such as Šibenik cathedral, due to technological development, is defined by enormous number of points. All former generalizations made by the principle "four points circumscribe surface" are irrelevant and useless.

While studying Apoxiomenos sculpture, its head was done in scale similar to the size 1:1. It was defined with approximately 2.000.000 points XYZ.

It should be said that the recent photogrametric images of a cathedral-sized – objects have been defined by several thousand points.

The possibility of detailed object digitalizing allows conducting various analyses which in turn enables monitoring of existing status. Also negative processes affecting objects are noticed. Thus, quality object documentation allows making decisions on interventions, phase plans of reconstruction, improvement etc.

First of all every government policy managing monuments heritage should provide objects categorization by values, world and national importance. In accordance with the aforesaid objects digitalization process should be conducted as the first initial phase being the prerequisite of all further processes and plans.

Process of an object digitalization is an expensive, long-term and complex work requiring planned preparation, high professionalism of contractors and especially quality technical and computer equipment.

Digitalization conception problems are similar to the dilemma while developing digital maps. The question is whether to develop small scale digital maps first followed by the system with more detail data or start immediately with very precise data.

In the case of the Šibenik cathedral digitalization the starting point was to do stereo-photogrametric images of architectonic frameworks and elements followed by interpolations of images of relief, sculptures and other demanding elements. Namely, the required precision level offered varies e.g. 1mm is the limit satisfied for architecture whereas precision more than 1mm is required for sculptures, relief and ornaments.

In this way a part of 3D cathedral model could be immediately used for statistical and other analyses based upon less demanding data from those that would be used for complex ornamental cathedral parts.

It is this segment that GIS analogy is present in micro-field. Namely, similar problems are solved in the similar way as it is the case in GIS i.e. BIS.

Real works ratio in terms of financing is in practice very important factor directing and providing developing instantly available studies and analyses.

Thus, it is a meticulous, innovative and pioneer project that has not yet been realized for any stationary culture monument.

XYZ OPTIONS

There is a technical problem related to developing system conceptions of stationary culture monument management.

Namely, GIS attribute data are linked to some spatial points whereas digital map is defined by XY coordinates i.e. z values being not practical (although technically feasible) in the culture monuments management system.



Fig. 1. Basic division of object I – vertical drawing Ryc. 1. Podstawowy podział obiektu I – elewacja



Fig. 2. Basic division of object II – lay out Ryc. 2. Podstawowy podział obiektu II – rzut poziomy

Data base design should be, by the expert's opinion, based upon graphic data not as coordinates or terms but as the tiniest elements a certain building "can" be decomposed to.

In fact, the author's thesis being developed and investigated from 1994 to 2008 provides micro-geo-informatics as a real computer and technical analytical area.

Thus, in the case of the Šibenik cathedral the whole volume was divided into larger parts such as aisle, apse, campanile etc. Each of them was, in turn, divided into blocks or portals, ornaments, sculptures, heads and the like.

It means that each analytical approach, requiring detail specialist data on an object or parts of it, will graphically start from the selection of segment i.e. an object part – fig. 1-3.

However, inquiries and browsing will also be possible by the standardized inquiries such as "search for list of all outside covering stone blocks damaged more than 25 cm^2 in volume higher than 100 cm^{3} " – fig. 4.

Outside surfaces						
Code	Photo	Drawing	3D model			
S1	Yes	No	Yes			
S2	-	-	-			
S3	-	-	-			
S4	-	-	-			
S5	-	-	-			
S6	-	-	-			
S7	-	-	-			
S8	-	-	-			
S9	-	-	-			
S10	-	-	-			



Fig. 3. Coding system – example Ryc. 3. System kodowania – przykład

Code	Description	Material	Status	Demages in cm ²	emages Demages in cm ² in cm ³		Supervision	
S1-3	Stone block	Stone	Demages	792	1113	13 200,00	P.S.	
S1-4	Stone block	Stone	Demages	223	631	7 800,00	P.S.	



Fig. 4. Evaluation of damages – example Ryc. 4. Rozwój zniszczeń – przykłady

							12	1		
Heads from Apsida						124	1		1	
Code	Photo	Drawing	3D model	Replica			123	22		
I5-70	No	No	No	No			121	120		
I5-69	Yes	Yes	Yes	Yes	7	1		120		F
I5-68	No	No	No	No		Ĺ	19	11	17	11-
					F	1116	114	5	113	TO DO D
	15-68	15-6	9	15-70		12 _]8 4	111 	110 _16	19 151	n
						-	13	12	11	

Fig. 5. Graphic data base – example Ryc. 5. Graficzna baza danych – przykład



Fig. 6. Head I 5–69, 3D model Ryc. 6. Głowa I 5–69, model trójwymiarowy

Fig. 7. Head I 5–69, photo Ryc. 7. Głowa I 5–69, zdjęcie

The whole data series, especially relevant for management, starts from precious images of all object elements and integrated textual data for all parts the data will be recorded for. They will be structured into groups by technical or other kinship and linked with graphical data i.e. volumes. The design itself is characterized by unsolved problems and dilemmas, but the main GIS philosophy based upon stationary culture monuments is completely real.

The total valorisation of the "precious" object (the Šibenik cathedral – a unique object in the Renaissance and Dalmatia) will enable an adequate attitude to such value – fig. 5 and 6.



Fig. 8. Šibenik cathedral – prospectus Ryc. 8. Katedra w Szibeniku – widok ogólny

The object management system is polyvalent and useful for various consumer categories. Study of architecture and construction of buildings will be quite different compared to the present one. Diverse solution comparisons of these and other Renaissance objects will offer new knowledge and information.

Series of studies and elaborates that revealed building art enigmas, for the first time since Renaissance, was developed.

PRELIMINARY CATEGORIZED DATA OF ŠIBENIK CATHEDRAL

Main and historical data

Construction periods: 1431–1441, 1441–1473, 1475–1536.

Restoration activities: 1843, 1848.

Description of the activities: replacement of some apse heads and arcades of ships and domes in the period 1991–1995:

- Restoration of the missiles -- stroked dome in the patriotic war.

- Description of the activities: decomposition of the dome and replacement of the stone plate as well as other parts of the dome structure.

In 2000 year the object was registered on the list of the UNESCO protected culture monuments.

Data sources: Croatian Renaissance, the exhibition catalogue, Zagreb, 2004. g. Šibenska katedrala, M. Zenić, 2003

Object building material: stone

Origin of the material: island of Brač

Note: all data are provided as graphic data with attributes

Existing object equipment

Infrastructure: Power Lines network Lighting Draining Insurance Others

Object monitoring

Construction status of the object by its parts:

- A. Eastern part
- B. Central part
- C. Western part

Reconstruction and recovery plans

- 1. Very urgent activities
- 2. Urgent activities
- 3. Recovery programs
- 4. Repairs

Economic indices

- 1. Costs of investment maintenance
- 2. Costs of current maintenance
- 3. Projects of the object designing and equipping
- 4. Costs of the object digitalization
- 5. Object informatization

- 6. WEB
- 7. Video control
- 8. Virtual museum
- 9. Souvenir shop

Others

Object incomes

1. Incomes from copyrights for manufacturing souvenirs, replicas, videorecordings, films recording and the like

- 2. Web-site incomes
- 3. Incomes from entrance tickets and visits
- 4. Other incomes

Incomes from grants, donations, EU accession funds, world community, UNESCO and others

1. in the course of realization Purpose Amounts

Running projects

- 1. Project of digitalization and developing 3D models for
 - a. Complete object
 - b. Some parts of the object
- 2. Project of interior and exterior illumination
- 3. Project of power supply recovery
- 4. Project of the object and video control physical protection
- 5. Project of fire alert and protection
- 6. Project of virtual museum construction
- 7. Project of research of Croatian and foreign universities
- 8. Project of the object value assessment
- 9. Project of the object and its parts insurance

10. Project of developing replicas for ornaments and profiled parts of the object

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ZINTEGROWANY SYSTEM ZARZĄDZANIA BUDYNKIEM "BIMS". ROZWÓJ BADAŃ I ZASTOSOWANIE METODY "BIS MACHINE"

Streszczenie. Proces dygitalizacji budynku jest drogi i czasochłonny, a kompleksowe prace wymagają wysokiego profesjonalizmu wykonawców i szczególnego wyposażenia i sprzętu komputerowego. Problemy, jakie napotyka się podczas obróbki komputerowej obiektów architektonicznych, są podobne do tych, jakie występują przy budowie map cyfrowych. Pytaniem jest czy rozwijać mapy cyfrowe w małej skali, stopniowo uszczegóławiając je, czy od razu tworzyć bardzo precyzyjną bazę. Nowe badania BIS Machine na polu zarządzania i ochrony dziedzictwa kulturowego są wielodyscyplinarne.

Słowa kluczowe: digitalizacja, dziedzictwo kulturowe, rekonstrukcja, metoda "BIS Machine", GIS, fotogrametria, CNC, komputer, układ współrzędnych