CULTURAL HERITAGE
A CHALLENGE FOR EUROPE

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Changes in Cultural Heritage Activities: New Goals and Benefits for Economy and Society

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CHANGES is a European Project supported by the JPI Heritage Plus program.

Considering the diversity of European cultural heritage, the skills required in built heritage activities and the spread of environmentally sustainable approaches, the research aims at

producing new local models directed to support
Planned Preventive Conservation, Maintenance and Monitoring.

The **main topics** are:

- conservation and valorisation as preventive measures;
- effectiveness of maintenance, involving relevant craftsmanship and expertise;
- economic mechanisms underlying built heritage conservation in the context of regional economy and the wider construction sector;
- impact of knowledge gain and its dissemination on smart economy for built heritage conservation, heritage management and construction sector.

The **expected outcomes**, to be transferred to stakeholders and society, in order to increase social and human capital at a local level are:

- a better understanding of cultural heritage;
- an empowerment of local communities;
- a progress of protection quality of built heritage;
- environmental enhancement;
- an improved cost-effectiveness for private owners and managers of historic properties;
- a proposal for a funding scheme supporting a sustainable conservation process.

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Changes in Cultural Heritage Activities: New Goals and Benefits for Economy and Society

Partners:

- **Politecnico di Milano**, ABC Department
- **Katholieke Universiteit Leuven**, MAT Division
- **Uppsala University**
- **Delft Universtity of Technology**, Heritage & Architecture Section
- **Foppoli Moretta e Associati**

Associate Partners:

- Monumentenwacht Noord-Brabant
- Monumentenwacht Flanders
- Consorzio Villa Reale e Parco di Monza
- Navarra Gestioni
- Assimpredil ANCE, Association of Building and Related Companies of Milano, Lodi, Monza e Brianza provinces

Work Packages:

1. Project Management.
2. Conceptualization of previous experiences: **MonumentenWacht** in Belgium and in the Netherlands, **Halland Model** in Sweden, **Distretti Culturali** in Italy.
3. Implementation of maintenance systems: investigation on efficacy of maintenance practices in Belgium.
4. Implementation of maintenance systems: investigation on efficacy of maintenance practices in The Netherlands.
5. Implementation of maintenance systems: investigation on efficacy of maintenance practices in Italy.
6. Economic analysis of costs and benefits of preventive conservation practices (monitoring and maintenance systems).
7. Analysis of economic and societal impacts and externalities of valorisation strategies including conservation activities.
8. Dissemination and transfer.

WP6
ECONOMIC ANALYSIS OF COSTS AND BENEFITS OF PREVENTIVE CONSERVATION PRACTICES (MONITORING AND MAINTENANCE SYSTEMS)

Responsible
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- **Principal Investigator 4**: Prof. Christer Gustafsson, Uppsala University.
- **Principal Investigator 5**: Engineer Dario Foppoli, Foppoli Moretta e Associati consulting engineers.

Methodology adopted
Desk analysis.

Timing
June 2017 – April 2018

Abstract
Data gathered in previous WPs provided the basis for a model of analysis of costs and benefits, mainly related to the single property and its management. The outcome of the research derived from the data produced by the comparison of different advanced management activities. The aim was to go beyond the popular sentence that maintenance is better than cure and less expensive.
The examination of the new Maintenance Cost Analysis service implemented by the Associate Partners Monumentenwacht Flanders and Noord-Brabant, which offers tailor-made maintenance plans to calculate the recommendations of the architectural inspections, was compared with the formats and tools for maintenance plans practiced in Italy.
The target is going beyond qualitative models, introducing evaluation methods closer to reality, but also clearly related to boundary conditions.

Link to other WPs
Data gathered in previous WPs provided the basis for a model to analyse costs and benefits.

TABLE OF CONTENTS

THE PROBLEM ..... p. 6

OWNERS' ATTITUDE AND LITERATURE ON COST/BENEFIT ANALYSIS (SDT, NL, LS) ..... p. 7

MAINTENANCE PLANNING AND COST ANALYSIS ..... p. 10
- **The approach in Lombardy guidelines and the concept of preventive efficacy (SDT, LS)** ..... p. 10
- **Maintenance Cost Analysis service offered by Monumentenwacht Vlaanderen (AV)** ..... p. 11
- **Gap analysis Lombardy – MOP** ..... p. 14

CHANGES FINDINGS IN THE NETHERLANDS, FLANDERS AND ITALY (SDT, NL) ..... p. 15
- **Data from Italy** ..... p. 15
- **Data from Belgium** ..... p. 19
- **Data from The Netherlands** ..... p. 19

THE COSTS OF ICT TOOLS TO SUPPORT LONG-TERM ACTIVITIES AND THE MAKING OF INTEROPERABLE TOOLS (SDT, NL) ..... p. 20

PROVISIONAL CONCLUSIONS. BEHAVIOURAL ECONOMY AND OTHER DECISION MAKING FACTORS ..... p. 21

REFERENCES ..... p. 22

THE PROBLEM

Data gathered in previous WPs provided the basis for an analysis of costs and benefits of planned maintenance, mainly related to the single historic property and its management. The aim is to go beyond the popular sentence that maintenance is better than cure and less expensive, to understand which are the factors which affect decision making.

OWNERS' ATTITUDE AND LITERATURE ON COST/BENEFIT ANALYSIS (SDT, NL, LS)

The cost/benefit analysis of scheduled maintenance has been a deeply explored issue. Optimal strategies have been studied for machineries and systems, comparing the continuous repair option with planned substitution. Although learning from such studies, it is necessary to remind that planned substitution is not acceptable in the domain of cultural heritage. The only strategy can be based on prevention and careful repair, being quality, performances and image not given once forever, but evaluated through time with the tools, ethics and competences of the discipline of restoration, taking into account the authenticity issues.
Basic studies on maintenance produced popular statements on the comparison of cost and benefits of continuous (preventive) maintenance vs. reactive repair. Nevertheless the statements on cost effectiveness of maintenance as applied on built cultural heritage use to be definitely qualitative, as in very few cases it has been possible to gather reliable data on maintenance costs for historic buildings, and on the other hand published data are often treated with a bit of advocacy. These qualitative concepts are often summarized in diagrams, in which cost-time functions are compared. The synthesis provided by Forster & Kayan, as elaborated by Aziliz Vandesande (Vandesande, 2017), is a clear starting point.

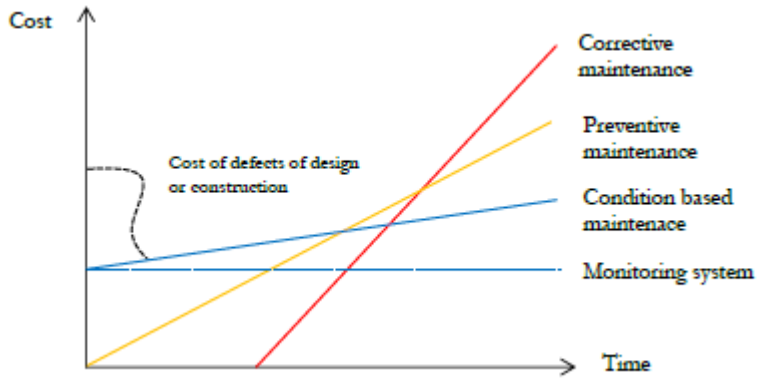

Figure 1 – Cost relationship between corrective, scheduled and condition-based maintenance with a monitoring system (Vandesande, 2017 based on Forster and Kayan, 2009).

According to some studies, maintenance proved to be cost-effective already after few years in some buildings taken as sample for the analyses (Kutasi and Vidovszky, 2010 from Hungary). On the other hand several experiences report that data are hardly available (Krstić and Marenjak, 2012 for Croatia), or even induced to describe owners' attitude to maintenance as negative (Dann, 2004).
Some authors argued that this attitude by the owners of historic properties is related to the long payback periods of continuous maintenance: calculating the Net Present Value, investments in maintenance would pay back less than waiting for complete conservation works after a long period (Della Torre, 2003). In literature several papers can be found, which implement NVP analysis to compare alternative strategies for historic properties, e.g. for energy retrofitting (e.g. Aste et al., 2012) or for reconstruction after earthquake (e.g. Baylon and Garciano, 2013). But NPV criteria are not so widely used in cultural sector management, and even in the financial arena they seem not to be strictly implemented in the majority of the cases, especially by small firms (Magni, 2009). Undoubtedly the benefits of maintenance can often be seen only beyond the term of decision makers' responsibility, therefore becoming less attractive, even without an NPV calculation to further justify the lack of interest.
Few studies tried to go deeper into the analysis of factors affecting facility management of historic properties. A doctoral thesis at Politecnico di Milano tried to find the parameters to estimate the costs for inspections and ordinary maintenance (Totaro, 2015).

It is worthy pointing out the one, carried out in the frame of the UK National Trust organization, which highlighted the cost induced by the impact of the growing number of visitors, showing that the increase of housekeeping costs could suggest not to allow the number of visitors grow beyond some threshold (Lloyd et al., 2007). The study implements on maintenance an attitude, which includes housekeeping and repairs as parts of the same management problem.
In the reality, property management will seldom implement a purely preventive, corrective or condition based maintenance strategy, and the cost of the monitoring and/or knowledge management system will be included in annual budgets as well. Looking at budgets, a simpler comparison among only two strategies has been proposed by Della Torre (2010).

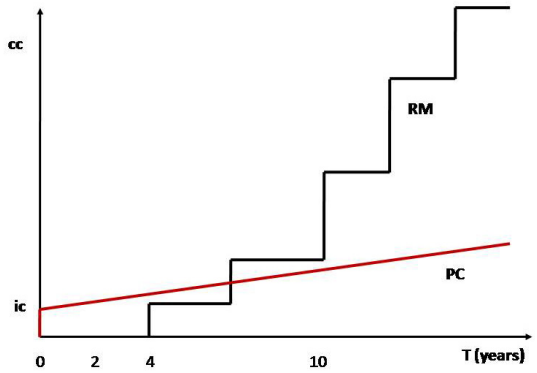

Fig. 2 – Comparison between costs cumulated by purely reactive maintenance and planned maintenance based on an information system (Della Torre, 2010).

In this case, the alternative is between a simple repair strategy, which entail to spend some money in case and to ignore the problem for years, and a strategy of continuous spending in preventive activities supported by a monitoring system that entails an initial set-up cost. The proposed diagram was definitely qualitative.
A similar alternative among two policies, but referred to a real case with realistic evaluation of expenditure has been provided by Ferreira (2014). Dealing with the conservation issues of medieval churches in Portugal, an economic perspective was developed, working with a typical church of 250 sqm, in order to compare the money spent with and without regular maintenance over a period of 30 years. This study has revealed that the money spent on a monument with regular maintenance corresponds to approximately 1/3 of the money spent on the same monument in the form of a heavy intervention after 30 years without maintenance (Fig. 3). This model doesn't include the monitoring system, as it refers only to repair and maintenance works.

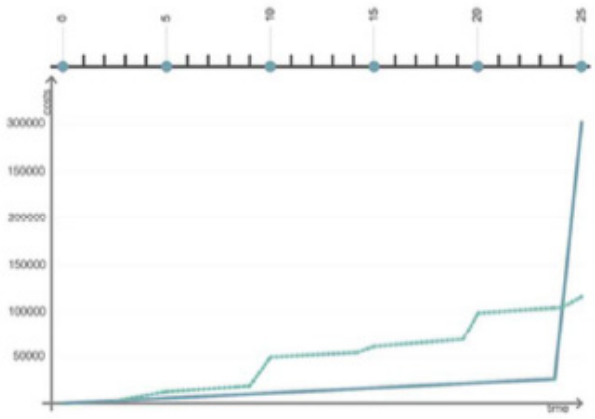

Fig. 3 – Comparison between the costs of continuous maintenance vs. the costs of an intervention delayed for 30 years (Ferreira 2014).

The literature review confirmed that:

1. The maintenance system is expensive and yields benefits only after a quite long time. Therefore the sceptical attitude by owners is diffused, even without taking NPV into account.
2. The detected approach tends to focus on a strict understanding of maintenance. This entails the risk of misunderstanding factors, which could allow a more effective planning and/or influence the decision making.
3. The relevant factors can be described as:
   - The durability of the building (materials, compatibility, technology...) and the quality of the works.
   - The preventive efficacy of preventive measures and repairs.
   - External hazards, prevention strategies.
   - The cost of the inspecting and knowledge management system.

MAINTENANCE PLANNING AND COST ANALYSIS

Some studies tried to define methods for predicting maintenance costs. As stated before, long-term conservation of historic buildings is affected by several factors, so that these predictions can be reliable only under some restrictions, basically related to local typologies. Prediction models developed in other contexts (e.g. Sodangi et al., 2011 for Malaysia) cannot therefore be easily transferred.
Models developed by CHANGES partners and associate partners build less on wide statistics than on the knowledge related to the single building.

The approach in Lombardy guidelines and the concept of preventive efficacy (SDT, LS)

The research carried out on behalf of Lombardy Region in the years 2000-2003 produced a model for the "Conservation plan", complying with the Italian law requirements for a maintenance plan in the frame of public works, including four documents, one of which being the Sheet of financial costs (*Prospetto degli oneri economici*).
The aim of that research was to show that in case of the general conservation and reuse of a building (*restauro* in Italian terms) the follow up with planned conservation is mandatory but also convenient, and even when an intervention is not foreseen it is useful and proficient to set up a preventive and planned strategy.
The convenience of maintenance is usually evaluated through the expression
VR + R > CI + CM + CG
Where all the costs should be treated as present costs, and: VR is the current value of a building, R is the rent due to use value or other exploitation forms (tickets, image rights…), CI is the initial cost, that is the construction cost (or the cost of acquisition, or the cost of the previous general conservation works, or the sum of them), CM is the cost for maintenance, CG is the running cost. All the costs should be treated as present costs.
As the initial cost CI cannot be changed, as well as its influence on the value of the building, the variables that the decision maker can move are just the running and maintenance costs; according to the management choices, however, also the current value of the property VR and its rent R will vary. Therefore the current value of the property can be described as the sum of a constant K, given by the initial cost, plus a term, which will be a function of the care given, reflected into the running and maintenance costs:
VR = K + f(CM + CG)
and
R = F(K) + f(CM + CG)
But the thesis went forward, pointing out in the "preventive conservation" the most convenient strategy, as it could produce a higher current value VR and a lower maintenance cost CM.
The research of the conditions, which make prevention convenient, is definitely necessary, as preventive activities require investments (costs), whose benefits emerge only after some time, as said above.
To give understandable arguments, the reasoning was carried out in terms of global costs CG:
CG = CI + CM + CG + CF
but the final costs CF could kept out of the perspective related to heritage buildings, as the demolition is not foreseen.
In this analysis the Time factor should be carefully considered (Moioli, 2015b), as the openness of the (never ending) lifecycle characterizes the field of protected heritage, which is maintained just to survive beyond any service life deadline, in comparison with ordinary built stock, whose service life is intended to come to an end, often foreseen from the beginning.
The basis of the thesis developed in that research was the assumption that thanks to preventive activities it is possible to avoid a good percentage of the failures, which don't belong to natural ageing of materials and elements, but happen just because of the lack of preventive treatments. Therefore the decision was made

not to link the evaluation of costs to the prevision of physiologic durability of materials and systems, but to reason empirically on the costs due to “unforeseen” events. In fact most of the repair costs, in heritage buildings built with traditional techniques, are related just to failures not timely repaired. It is not exactly the matter of enhancing the convenience of regular maintenance, but to point out the value of avoiding repairs, as in the context of cultural heritage no repair will ever be perfect; on the contrary it will always harm the significance of the cultural property.

The requirement to keep material authenticity entails also that the economic effects due to the diffusion of damages get higher than it was used to be deemed in ordinary buildings. Damages in the field of cultural heritage require expensive technologies and skilled operators (no matter if skilled in rare traditional crafts or in new techniques), and sometimes the damage is simply impossible to repair and leaves a lacuna, or a fake patch.

Under these hypotheses it was proposed a method to foresee the costs of the maintenance activities, selected according to their preventive efficacy, evaluated looking at the ratio between the cost of repair works, and the (minor) costs that the same repair would have if timely preventive activities would be able, e.g., to limit the diffusion of the damage, or to impair a reaction due to hidden incompatibility.

In this approach, the costs to take into account in a conservation plan encompass the needs for primary, secondary and tertiary prevention (Pracchi et al., 2010; Van Balen, 2014). But the scope of the tool went beyond, as the matter is not only to make prevention possible, but also to prepare the funds necessary for repairing those damages, which nevertheless and in spite of any care could happen. Therefore the costs foreseen in these sheets tend to overestimate the real costs: it is a suggestion for budgets, trying to avoid the customary tendency to delay the repairs, thus letting the condition get worse, and the costs get higher, and the loss a definitive one.

The costs related to conservation planned activities may then be identified in:

1. Costs due to planned prevention activities, inspection and monitoring, diagnostic tests.
2. Repair budget.
3. Costs due to activities carried out directly by the end user.
4. Costs for updating the plan.

Furthermore, the cost of preparing the plan itself should be considered. Although this item is not included in the budget, as it should been paid previously and it is not avoidable during the budget period, nevertheless the owner could see it as a cost to be considered together with the running management expenses.

Maintenance Cost Analysis service offered by Monumentenwacht Vlaanderen (AV)

Analysis of the new Maintenance Cost Analysis service implemented by the Associate Partner Monumentenwacht Flanders, which offers tailor-made maintenance plans to calculate the costs of recommendations of the architectural inspections over a period of 6 years for building owners and managers.

When Monumentenwacht Vlaanderen (MOWAv) was initially set up, it was assumed that this market would be self-regulating, ‘since, through the status reports, the attention of the owner or administrator is drawn to the needs of the building, Monument Watch actually generates work’ (Binst, 1997: p. 17). In theory, the condition report that owners and managers of historic constructions receive is a sound basis to set up a maintenance plan and implement interventions. However, when returning on subsequent inspections, the monumentenwachters often find the condition of the buildings unchanged or changed for the worse. From a 2011 member survey based on random sampling, it was observed that next to expected budgetary reasons the main reasons for not implementing therapy was the lack of specific work instructions and cost estimates (Monumentenwacht Vlaanderen, 2011).

In response to this market failure, MOWAv is setting up mechanisms to tackle very specific problems. From a 2011 member survey based on random sampling, it was observed that next to expected budgetary reasons the main reasons for not implementing therapy was the lack of specific work instructions and cost estimates

(Monumentenwacht Vlaanderen, 2011). In response MOWAv developed a new service in 2011, Meerjarenonderhoudsplanning met kostenraming (MOP) or Maintenance Cost Analysis, which offers a tailor-made report which stipulates the maintenance recommendations and provides cost-estimates over a period of 6 years for building owner-managers.

The MOP maintenance plan is drawn-up per individual property and includes the following information:

- Reference to the MOWAv condition report.
- A description of the recommended interventions grouped by type of work (i.e. painting, roofing and works on roof structures).
- The quantity and frequency of the required interventions.
- An indication of the cost for each intervention based on material cost and man-hours.
- An indication of the cost per year.
- An indication of the cost scheduled over a period of 6 years.

Meerjarenonderhoudsplanning met kostenraming

Datum

code rapport	locatie gebouw	omschrijving	meetcode	eenheid	hoeveelheid	frequentie	prijs / eenheid	totaal / jaar	2013	2014	2015	2016	2017	2018	2019
		Dakwerken													
4.1	dak (10) West	Reinigen en 2-maal coaten met bitumineus product van de zone rond de afvoeropening van de koperen goot	vh	m²	3	eenmalig	75,00	225,00				225,00			
6.2.1	vleugel (6), vleugel (9) West	Plaatsen van koperen kraal in de waterlijsten van plinten, voldoende ver uitstekend uit dagvlak van de gevels	vh	m	20	eenmalig	110,00	2.200,00				2.200,00			
1, 2, 4	alg	Regelmatig nazicht en onderhoud van de dakbedekkingen en aansluitingen, alsook de dakdoorbrekingen - herstellen van eventuele gebreken	sog		1	half-jaarlijks	1.000,00	1.000,00					2.000,00	2.000,00	2.000,00
2.6 11.1.1	toren (1) toren (2)	Plaatsen van klimhaken overeenstemmend met EN 517 voor bereikbaarheid van dakbedekking en topbekroning. De bevestiging moet zichtbaar zijn en de ondergrond voldoende stevig	vh	st	30	eenmalig	120,00	3.600,00			3.600,00				
2.6 11.1.1	toren (1) Zuid	Plaatsen van bijkomende klimhaken conform EN 517 op zuidelijk dakvlak toren (1) om de bereikbaarheid van toren (2) te verbeteren	vh	st	10	eenmalig	120,00	1.200,00			1.200,00				
9.1	alg	Plaatsen van monnikskappen in de dakbedekkingen voor het permanent verluchten van de zolders	vh	st	30	eenmalig	200,00	6.000,00					6.000,00		

Fig. 4 – Meerjarenonderhoudsplanning met kostenraming (MOP) or Multi-annual Maintenance Cost Analysis © MOWAv.

The MOP analysis for an individual property is based on regular building inspection data, obtained from the Monumentenwacht General Quality System for building inspections (MAKSbo). Each periodic inspection results in an inspection report and an advisory report. In the first every building component is allocated a 'state of preservation'-category, while the latter proposes interventions to guarantee proper maintenance. A MOP starts from an inspection report that is maximum 2 years old. First, the proposed recommendations are translated into descriptions of interventions, including interpretations on construction method and material selection. The defined interventions are grouped by type of work and location within the building envelope, such as facilitation for construction site or facade and gable works. Each of the intervention groups is then divided into subgroups, for example the invention group works on roof structures includes a.o. grouting of the joints between rinsed capstones with a calcareous mortar, replacing bituminous waterproofing of flat roofs and repairing angle rafter lead. Next, MOP attributes a realistic, estimated unit price to each of the defined subgroup interventions, based on a library of cost indicators and collected

reference prices. The unit prices are based on standardized Building Cost Data reference works (ASPEN INDEX from Belgium and Casa data from The Netherlands), restoration files of the Flemish Government and informal contacts with a network of contractors and restoration architects. However, in practice the actual prices are influenced by the contractor and the building owner who selects materials and techniques. To deal with this reality, the cost estimations are subdivided in 3 categories: estimated amount, lump sum and total sum. Finally, the quantity and frequency is defined for each of the defined subgroup interventions, according to the recommendations of the initial building inspection report. This allows defining the annual maintenance cost of an individual property over a period of 6 years (Vandesande, 2017). Several pilot cases demonstrate that MOP can serve as a trigger for private owners and managers to invest in maintenance works or at least most urgent repair works according to their available budget (Vandesande et al., 2016). The long-term implementation effects impact on the condition of historic structures and continuation after a 6 years period can at this time not be assessed. Nevertheless, it is observed that MOP is becoming an increasingly requested service among owners and managers of historic structures.

In view of coping with the MOP waiting list and providing a similar but simplified service to all owners and managers, the new condition reporting system was elaborated with the possibility of generating a maintenance calendar. The calendar is based on the summarising maintenance recommendations, unit, priority and cycle of indicted in the building component fiches. In effect, it provides the owner or manager with an overview of works that should be planned in the coming 12 years, what the magnitude of these works are and what type of craftsmen are required to make a quotation of and implement the works.

OVERZICHT VAN DE ADVIEZEN

code	verkort advies	eenheid	indicatieve hoeveelheid	frequentie	uit te voeren door	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
	Onderhoud																	
A2016/01	Daken, goten, afvoeren en controleputjes jaarlijks en na een hevige storm controleren, proper maken en lekken herstellen.	n.t.b.	-	j.	Beheerder Onderhoudsploeg	x	x	x	x	x	x	x	x	x	x	x	x	x
A2016/04	Tijdig opruimen en ontstoffen van de zolderkappen, gewelven, borstweringen en vloeren van minder frequent gebruikte ruimten.	n.t.b.	-	5j.	Beheerder Eigenaar	x					x					x		
A2016/05	De afwerklagen van het houtwerk aan de buitenzijde tijdig bijwerken en/of vernieuwen.	n.t.b.	-	5j.	Schilder Schilder	x					x					x		
A2016/02	De gietijzeren onderstellen tijdig ontroesten en voorzien van de nodige afwerklagen.	st	12	5j.	Beheerder Onderhoudsploeg	x					x					x		
A2016/03	Diefijzers en muurankers tijdig ontroesten en voorzien van de nodige afwerklagen.	n.t.b.	-	5j.	Beheerder Eigenaar			x					x					x
A2016/06	De beplanting rond het gebouw geregeld snoeien.	n.t.b.	-	perm.	Beheerder Eigenaar	x	x	x	x	x	x	x	x	x	x	x	x	x
	Gehele gebouw																	
A2016/15	Duiven weren aan het glas-in-loodraam boven de toegangspoort.	n.t.b.	-	1x	Monumentenwacht Specialist	x												
	Dak																	
A2016/14	De betonnen deksteen op de schoorsteen vernieuwen.	m²	1	1x	Dakwerker Metser	x												
A2016/07	De opening onderaan de pijnappel dichten om te beletten dat hierin vogels nesten.	m²	0	1x	Dakwerker Monumentenwacht	x												
A2016/11	De verkeerd geplaatste ladderhaken aanpassen.	n.t.b.	-	1x	Dakwerker	x												
	Dakwaterafvoer																	
A2016/17	De gescheurde soldeernaden in de goot van de zuidelijke zijbeuk degelijk herstellen.	st	2	1x	Dakwerker	x												
	Kapconstructie en zolder																	
A2016/12	De aantastingen door de spinthoutkever in de nokbalk behandelen.	m²	1	1x	Beheerder Onderhoudsploeg	x												
	Draagstructuur en overspanning																	
A2016/10	De loszittende rollagen herstellen.	m²	5	1x	Metser	x												
A2016/13	De gebarsten raamdorpel bijwerken met een geschikte reparatiemortel.	m	1	1x	Beheerder Onderhoudsploeg	x												

Fig. 5 – 12 years maintenance plan based on MOWAv inspection reports © MOWAv.

Gap analysis Lombardy – MOP

The comparison among the tools practiced in Lombardy and in the Flanders offers several opportunities to better understand the issue. Both models include three types of costs:

- Costs for operations, which have to be regularly made because of their preventive efficacy.
- Costs related to operational safety (scaffolding, platforms…), which may trigger further works for opportunity sake.
- Costs related to repairs for more or less expected damages, which should be repaired as soon as possible to avoid further decays (tertiary prevention, see Van Balen, 2014).

The prevision of the costs try to be accurate by means of a deep knowledge of the building and of several similar cases, as well as an analysis of the hazards that the building is exposed to: but obviously they cannot be perfectly accurate.

Therefore these plans have multiple contents: on the one hand they reflect the schedule of suggested activities, on the other hand they suggest a financial plan to cover some expenses that is reasonable to foresee.

Both the models avoid to go deeper in the financial evaluation, calculating the NPV of the plan. This is reasonable too, as they cover a short period (6 to 10 years), and their aim is not the comparison of different strategies or alternatives, but just the suggestion of the provisional sum that is likely to be required for maintenance in a given period. The calculation of NPV would improve the significance of the plan, but this would lead to pretend an accuracy, which has an intimate weakness as the prevision of the required operation is so rough.

In Lombardy several conservation plans have been drafted since 2005, including such a cost-estimation sheet. An example shall be seen in paragraph 4.1. of the present report (Sheet of the yearly costs foreseen for the conservation of Ca' dei Bossi in Bassono).

In few cases it has been possible to gather data about the implementation costs, leading to conclude that the average annual costs for continuous care could be estimated between 1,5 % to 2,5 % of the restoration costs, while at the beginning it was assumed that the annual budget could be 5% and even 10% in some cases. In the reality, analyzed cases are difficult to compare, as it should be clarified if technical systems maintenance is included, or not, and in the real cases costs are affected by several factors such as scale economies and safety requirements. Furthermore, only few activities have to be repeated every year, and the concentration of several activities every third or fourth year could be wise, in order to optimize the use of required devices and resources.

The following table summarizes the carried out comparison.

	Lombardy Guidelines	**MOP**
Starting point	In the framework of a restoration project, to be fine-tuned after the works carried out	Inspection and condition report
Interventions	Preventive actions and repairs as partial remake of works done	Foreseen on the basis of reported condition
Prices	Based on actual prices in carried out works	Based on a mix of price lists
Time span	10 years	6 years
Calculation of NPV	No	No
Mandatory	After works funded by public money	No
Practiced	Not always, only when forced	Increasingly requested by MW members

CHANGES FINDINGS IN THE NETHERLANDS, FLANDERS AND ITALY (SDT, NL)

Data from Italy

The activities carried out in the frame of CHANGES WP5 provided data and inspiring suggestions coming from the on field activities and the observation of their actual costs.

Case studies are included from Monza and Brianza district (Villa Reale in Monza, Ca' dei Bossi in Biassono, the Vimercate 12 churches conservation plans, Usmate Velate Municipality policies) and from Valtellina district, thanks to the activity carried out by FMeA. The Distretti Culturali frame (Barbetta et al., 2013) supplied a very useful background, as the existing relationships were effective in supporting the investigation activities. As reported in WP5 final report, the activities developed in the WP5 analyzed some of the pilot projects started in the following Cultural Districts:

- **Monza and Brianza Cultural District**: It was conceived as a model for a local development driven by culture and built cultural heritage. The main strategic vision was focused on culture as a unifying factor and the creation of synergies between tangible and intangible heritage (Della Torre and Moioli, 2012). Regarding these issues, specific actions were developed: conservation works on built cultural heritage (Ca' dei Bossi in Biassono, Da Corte Castle in Bellusco, the Stables of Borromeo Arese Palace in Cesano Maderno and the Spinning Mill in Sulbiate), the creation of a front office for the PPC (Moioli, 2013), the organization of training courses and the development of cultural and creative activities. The District was composed by 12 partners and stakeholders from several sectors were involved. In fact one the aims was the creation of a stable network between the cultural and economic systems. Thus, the strategic areas of work were: culture, identity, training and innovation.
- **Valtellina Cultural District**: It was about a multi-year programme for the enhancement of the Valtellina territory based on a closer relationship among landscape, traditional production and cultural identity, through an integrated process of cultural heritage valorisation. The main initiatives in the program concerned the valorisation, networking and protection of the tangible cultural heritage (the Road of the Terraces, intervention in S. Antonio in Morbegno, intervention at Castel Masegra in Sondrio, realization of a circuit of palaces and castles in the Tiranese, construction of a water park/museum in Alta Valle) and intangible cultural assets (promotion of typical products through new technologies, research in archaeological and cultural heritage, training at various levels) of the Valtellina territory, in terms of innovation and social/economic development.

The two above mentioned projects showed different ways to develop the idea of PPC during the intervention planning phase. Starting from an analysis of needs, the search for sustainability on the long run ended in interesting experiments, which had a common feature: people involvement and capacity building were taken as decisive factors for innovation through heritage sector (Della Torre, 2015).

The development of the two Cultural Districts was implemented with a continuous collaboration with the academic environment, where the Italian way to PPC was born. Therefore, a learning community was created, strengthened by exchanges at different levels. Also for this research this was a resource, as through the community it was possible to come across other case studies, developed also across the Italia-Swiss border, which provided further insights.

The case of **Villa Reale in Monza** has been extremely rich for the research aims (see CHANGES WP5 Report), but is it difficult to deal with cost evaluation in this case, because of the particular management system produced by the implemented concession tool. The control of the management costs and of conservation quality is the object of detailed agreements in the signed concession contract, but on one hand these topics are quite new for officers, on the other hand most of the conservation practices are carried out by the concessionaire as in house activities, so that most of the costs are treated as sunk costs, and are protected by privacy. Following the activities from inside, it has been possible to evaluate that the sum of a) the direct costs for reactive maintenance, due to local failures or to the follow up of the wear-and-tear produced by the

high number of visitors in some periods, b) the costs of the Information system (required by the concession contract); c) the salaries of specialists hired to carry out planned conservation and controls should equal a sum per year which is near the 0,5% of the total costs of the restoration executed by the concessionaire in the noble wing of the palace (€ 24.000.000).
In spite of a long lasting partnership, the Villa Reale and Parco di Monza Consortium still did not find the (financial and human) resources to set up a planned management of the huge and extremely complex property. Only reactive maintenance is carried out in the public buildings, most of them still waiting some use in the frame of a masterplan still to be developed. The available human resources are fully engaged in the maintenance of the huge park. Therefore this part of the property could not supply contents for this part of the research.

A project formally not included in the Cultural District frame, but developed in the Brianza area by the same key-persons, is the **12 churches project in Vimercate**. The project was interesting also as an example of community involvement (Moioli, 2015a; CHCfE, 2015: pp. 170-171), but the relevant activity for this research perspective was the coordinated inspection of the twelve churches, carried out by a contractor following the instructions given by the conservation plan. The inspections were carried out with the help of platforms (churches were not equipped for working safety) and included several preventive works and repairs on roofs, gutters, sewage systems, surface and statues cleaning. The total expenditure was equal to € 70.000, that is € 3.000 to € 9.000 for each church, according to their dimensions and conditions. It is worthy to remark that all these works had been overlooked for years, and the conditions of the churches were not fair and in some case almost bad.

Villa Scaccabarozzi and Villa Borgia were chosen as case studies for the CHANGES project on the proposal of the public owner, the Municipality of **Usmate Velate**, thanks to the relations strengthened with its employees during some previous training activities on Preventive and Planned Conservation in the frame of Monza and Brianza Cultural District.
The two public properties offered the possibility to work on case studies characterized by different conservation and management conditions, since the properties are currently used and are basically not in bad conditions, and represented the way to experiment the addition of the costs of the Preventive and Planned Conservation in the municipal budget.
The conservation plans, following Lombardy Region guidelines, of Villa Scaccabarozzi and Villa Borgia were implemented by a practitioner designated by the Municipality in close cooperation with the Politecnico di Milano and the Monza and Brianza Cultural District. CHANGES Project gave the possibility to have periodical meetings with the public works office directed at updating the conservation plans across the years and elaborating some first ex-post considerations.
During the following phase, the first inspections were executed through both visual observations and tests, as indicated in the conservation plans. The information were reported in the plants, obtaining a map with the “problems”. In this way the construction companies could accurately identify the elements that required maintenance, preventing the waste of resources.
The inspections are usually executed every six months, in parallel with the control of the fire protection systems. Conservation activities of various types were performed: verifications and repairs of electrical and hydraulic systems, limited building works, blacksmith’s works, etc (See Annex 15 to CHANGES WP5 Report).
Following this procedure, the Municipality realized that it could achieve savings on the public spending dedicated to maintenance. This is an important aspect considering that the financial resources for conservation activities are becoming more and more limited.
Another phase of the project was represented by the elaboration of some qualitative and quantitative data related to the maintenance works executed upon the two villas during the period 2010-2015. The activities

implemented during the years 2013-2014 and 2014-2015 were influenced by the introduction of the pilot projects in the Cultural Districts program.
A first consideration is related to the percentage of the expenditure dedicated to building works: in the first three annualities it is less than or equal to 10%, during the Cultural Districts project it is more that 30% of the total expenditure.

	2010-2011	2011-2012	2012-2013	2013-2014*	2014-2015*
Costs for building works	1,350	728	678	3,638	14,726.44
Total expenditure	13,848	14,917	10,988	11,320	45,171
Incidence	10%	4,8%	6%	32%	32%

* During the Cultural Districts project.

A second consideration can result from the comparison between the incidence of the costs of planned activities and the total expenditure (considered the ones executed due to damages or for the maintenance of the systems).

	2010-2011	2011-2012	2012-2013	2013-2014*	2014-2015*
Costs for planned works	3,064	4,440	737	4,925	41,557.32
Total expenditure	13,848	14,917	10,988	11,320	45,171
Incidence	22%	30%	7%	44%	92%

* During the Cultural Districts project.

The comparison between the two tables allows to deduce that the increase of building works in the last two years was exclusively related to activities of Planned and Preventive Conservation, which were necessary, but had been overlooked because of budget scarcity. The availability of funds granted by Cultural Districts project allowed to carry out preventive activities, which on the long run would avoid major expenditures for damages, above all on the systems.

The case of **Ca' dei Bossi in Biassono** is an example of implementation of the Maintenance Cost Analysis tool suggested by Lombardy Region guidelines.
In order to define the economic budget of the conservation activities (See Annex 16 to CHANGES WP5 Report) the following activities were carried out:

- Collection of the worksite documentation.
- Site inspection and risk assessment.
- Definition of the Program of conservation activities.

The costs were calculated on the basis of the activities, the operators, the equipment, and the hours of work needed. The table below summarises the annual and total costs of the conservation plan and the part of costs borne by the concessionaire, that are estimated on the basis of the percentage of the spaces occupied by each party.

	Spaces		Percentage
Concessionaire	rooms 21, 23, 28, 29	203.2 mq	35%
Municipality of Biassono	rooms 05, 06, 07, 11, 12	215.6 mq	37%
Association Gral	rooms 01, 02, 03, 15, 16	147.7 mq	28%
Common spaces	rooms 08, 09, 10, 19, 20, 22, 24, 27 (except elevators/stairs 04, 25, entrance space 14 and courtyard)	150.4 mq	
Total		**716.9 mq**	

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Annual costs of the conservation activities	11,816	6,816	6,816	6,816	8,307	13,597	13,597	13,597	13,597	15,088
Total costs	110,046 (annual average: 11,005)									
Total costs / concessionaire	38,516 (annual average: 3,852)									

The share of the costs among the Municipality and the Concessionaire is beyond the scope of this analysis, while it is interesting to observe that the total cost of the intervention granted by the Distretto Culturale program was equal to € 2.500.000,00, so that the estimated annual cost 11.005,00 is **0,44%** of the total cost. This datum, whose meaning can be clarified referring to the contents of such budgets, comes out of a real process, and it can be pinpointed for the conclusions.

The activities carried out in the frame of **Valtellina Cultural District** produced several experiences for inspections, diagnostics, survey and conservation activities. They provided insights into the costs of elementary conservation activities, whose interest is given also by he fact that costs have been reported from the perspective of the contractor, as FMeA performed as an engineering society, being an observant-player in the processes.
But the case to be analysed here, as it can be better compared with the other findings is the one of Zillis church (Switzerland), known beyond the literature (Bläuer Böhm et al., 1997; Bläuer Bohm et al., 2001) thanks to the relationships built already in Interreg project CPRE. The church is famous for the Romanesque painted ceiling, whose conservation required a follow-up included a continuous control and monitoring of microclimate, regular gutter cleaning, with an approach extended to structural concerns (leaning bell tower). It is worthy to observe that some problems were due to pests: “good results were achieved against a mono-specific infestation of Aspergillus glaucus inhabiting the painting and fixation layer of the 12th century wooden ceiling in Zillis (Switzerland). There, the individual wooden panels of the ceiling were successfully treated with the application of organotin (TBTO), a biocide that is efficient but which has been abandoned in Europe because of its high environmental toxicity. However, also in Zillis, the most important control factor was a system for climate control” (Sterflinger and Piñar, 2013).
The cost of the conservation carried out in 2002-2003 has been 4 million euros (1 for the investigation and project, 3 for the works, paid by the Foundation Stiftung Kirchendecke Zillis). A close and detailed inspection on mobile scaffolding has been then carried out every third year, filing collected data into an Information System. The cost per year is very high (€ 295.000 / three years), as very high are the required skills. In other words, the annual cost is **2,5%** of the restoration costs.
Costs are covered by fundraising (the Stiftung has a person who works for that). Fundraising has been possible (already for 12 years) because of the existence value and authenticity value acknowledged in this unique Romanesque painted ceiling In other words, the planned conservation of Zillis church is expensive but it should be meant as the conservation of a huge artwork more than an ordinary building. It should be compared with Leonardo’s Last Supper in Milan, or Giotto’s Cappella degli Scrovegni in Padua (Basile and Marabelli, 2007; Progetto Restauro n. 9, dicembre 1988).

As conclusions, referring to Italian case studies analysed in CHANGES, these statements can be proposed:
- Costs for planned conservation, all including, following interventions can be budgeted as a percentage of the costs of the total conservation performed.

- This percentage can vary in function of the conservation issues and the relevant values. The detected percentages of **0,5% and 2,5%** are consistent with previous empirical assumptions (giving confidence even on the basis of such a small sample) and can be assumed as the lower and upper limits.
- Elementary costs of inspection and maintenance works should be analysed in each single case, as too many variables can influence the final cost; optimization strategies should be implemented.

Data from Belgium

The Report from CHANGES WP3 stated that, according to owners, the main aim of maintenance is to safeguard the state of preservation of the building. The incentive for maintenance works is to keep the (financial) value of the ownership or to reduce financial spending later.

In Belgium the presence of Monumentenwacht organization is a key point for the research. In general, the case studies demonstrate the effectiveness and advantages of regular monitoring and maintenance activities in prevention and early detection of damages, despite other influencing factors. It was found that Monumentenwacht is an important stakeholder in the maintenance process, since they offer objective advice of a high quality. However, their services are insufficient for the full maintenance process. Owners need good and reliable professionals who can guide them in the execution of interventions. Furthermore, owners referred to a need for a local network of owners of historic properties, as a means to connect and learn from each other.

Then it was interesting to detect why, even though owners declare to appreciate the expertise and thoroughness of Monumentenwacht, only four private owners and two churches really have their properties regularly inspected and act upon the inspection reports. There are three main reasons why the owners of the other investigated cases did not rely on Monumentenwacht: (1) the property was in such a bad state that it first needed a restoration, maintenance was thus postponed (2) the owners perform their own regular inspections and only ask the advice of Monumentenwacht when they need specific expertise or advice, mostly as part of larger interventions, (3) they had no prior knowledge on the existence of Monumentenwacht.

The public owners tend to consistently use the inspection reports for prioritizing and planning interventions, based on their annual budgets. The private owners' approach was detected to be different in urban vs rural areas. The main reason why owners in the rural area did not act upon the reports of Monumentenwacht is a lack of necessary financial resources. In the urban environment, two reasons were given why some recommendations are not followed: (1) owners had difficulties translating the recommendations into actual interventions, (2) owners had difficulties in finding good contractors with expertise in historic buildings for small repair.

Therefore it seems that the action carried out by Monumentenwacht had an impact, although many barriers still exist, which impair a really effective and more diffused regular maintenance system. On the other hand, the properties regularly maintained seem to confirm the advantages of a preventive approach also on the financial side of the problem. No data were reported about the implementation of MOP in the analysed cases.

Data from The Netherlands

In The Netherlands the presence of Monumentenwacht organization has been the key point for the research, showing also in this case that problems arise in the follow-up of the recommendations, as skilled contractors are not always available, or the owner does not understand the need, or there is a lack of further competences in diagnosis and project. The need to plan and budget in advance seem not to be perceived; the attitude relies very much on the chain: regular inspection, condition assessment, timely repair.

The differences between the approaches and the systems proved to be so deep, that a comparison is almost impossible.

THE COSTS OF ICT TOOLS TO SUPPORT LONG-TERM ACTIVITIES AND THE MAKING OF INTEROPERABLE TOOLS (SDT, NL)

While the costs of the works and the salaries of specialists involved in planned conservation activities can be estimated by means of traditional price lists, the implementation of ICT tools introduces a variable, which is quite new and brings some uncertainties along. Regular maintenance can be carried out in a simple and direct way without the support of an Information System, but if the complexity of the system is growing, and high cultural values are involved, the storage of observed data is recommended, and information retrieval becomes more and more useful for wise technical decisions, as well as for costs analysis and budget prediction. This kind of cost represents a novelty, whose cost and cost/benefit effectiveness had to be investigated.

CHANGES partners offered a representative variety research backgrounds and on-field experiences. Monumentenwacht Flanders developed MAKSIN and MAKSBO in response to a growing need for knowledge management, while Italian research group has a long background on this issue.

A comparative analysis has been carried out among case studies, in which different tools had been implemented, in order to reduce the direct costs of the conservation plan (Della Torre et al., 2018). Villa Reale in Monza was among the case studies, as the research team had the opportunity to cooperate in the creation of the Maintenance Information System required by the concession agreement, making it very fit both for the purposes of facility management and historic conservation.

The conclusions can be summarized in few statements:

- **Information System/Relational Database** (and "Planet – Beni Architettonici" in particular: see Benatti et al., 2014) is the best solution to compile and manage the Conservation Plan, compared to the other tested tools, because it allows a dynamic-systemic management of process and associated data.
- **The hardware and software costs are negligible in comparison with the costs of specialists engaged to file the data in the system**: in the tests carried out not just in CHANGES frame, but in several other minor projects, the barrier to overcome has always been the initial cost of getting the Information System created and populated; in the Villa Reale case, the cost of the specialists, who worked in organizing and filing the available data coming out from a well done conservation work has been equal to (or maybe more than) the estimated cost of the maintenance for one year and a half.
- **The way to make planned conservation sustainable can be identified in the possibility of interaction and integration with modern interoperable BIM technologies**: the Database should become a Common Data Environment, interfacing with HBIM as well as with Facility and Property Management Information Systems, using proper ontologies for sharing information. By means of these tools, data produced for any conservation activity could be filed just one time and be available for the other processes and actors, dramatically reducing the human costs.

  Given the rapid evolution of techniques and tools in the direction of interoperability, it is legitimate to foresee that in a short time this barrier will no longer exist.

PROVISIONAL CONCLUSIONS. BEHAVIOURAL ECONOMY AND OTHER DECISION MAKING FACTORS

It will be necessary to take into account values and their understanding by different stakeholders, objectives of property management, different approaches to service life of properties and single elements.

The approach to existence value and authenticity is undoubtedly a central issue in these reflections on maintenance. The international comparison carried out thanks to CHANGES project confirmed that there are still differences in the practice of conservation, in the market systems, and even in the focus of the researches, reflecting the characteristics of each National heritage and the different kind of recognition. Thus the Italian system looks much more complex but controlled, while Monumentenwacht seems to give a strong push, but often impaired by the lack of control on contractors, or the lack of provisional budgets. The preventive analysis of maintenance costs appears therefore as a good step, and a recommendation, which could become general: the performed research proved these tools to be useful even if previsions are not perfectly accurate, but just because they help owners to provide a budget understanding that a small investment avoids major future expenses, and conservation will not happen for free.
The issue of provisional budgets introduces the understanding of prevention and maintenance as risk management. CHANGES partners agreed on the opportunity to face the topic implementing the logic typical of insurance activities.
On this research line, it seems useful to deal separately with minor and major risks.
In fact, historic building are affected by several small ordinary risks, mainly related to systems (electric, heating, water, sewages…). Systems are nowadays an obvious requirement to make a building usable, but they do not use to be foreseen in the historic building concept. They are responsible for most “unexpected” damages, which are often due to the lack of regular control and maintenance of the system themselves. Therefore this is a field, in which some work could be done linking the insurance premiums to the level of certified preventive maintenance, as already happens for some kind of risks. At a first glance the involved values are not very high, unless again in case of precious elements.
On the other hand, major risks due to natural hazards (and climate change) involve high values and even human lives. This entails the need to implement a macro perspective, as the problem goes beyond the decision level of single budgets. Financial protection against disasters has developed schemes, which could provide a general reference (Mahul et al., 2014). After 2016 earthquake in Central Italy, a large scale action has been taken in order to design prevention policies, ending up in the establishment of a governmental prevention department. From this experience many lessons can be learned about sharing information and responsibilities, but also about education to awareness and preparedness (Selby and Kagawa, 2012).

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changes

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