12th International Congress on the Deterioration and Conservation of Stone
Columbia University, New York, 2012

THE PRODOMEA PHASING AND COMPATIBILITY INDICATORS AS TOOLS FOR THE PLANNING AND DESIGN OF CONSERVATION INTERVENTIONS. ASSESSMENT AND VALIDATION IN THE SANTA CLARA-A-VELHA MONASTERY (COIMBRA, PORTUGAL)

Maria João Revez,[1] Marta Raposo[2] and José Delgado Rodrigues[1]

[1] *Laboratório Nacional de Engenharia Civil*
[2] *Conservator-restorer*

Abstract

The PRODOMEA 8-phase model is a Decision Support System (DSS) that aims at tackling with the diversity of conditions, materials, methods and disciplines involved in monument conservation interventions by accompanying planners through conceiving, designing and execution phases, suggesting recommended actions and key actors for each phase. For most recommended actions, different options available should be considered in light of their physical-chemical, operational, socio-cultural and environmental compatibility towards the monument, which may be assessed via quantitative and semi-quantitative indicators, resulting in an overall (in)compatibility index, thus guiding decision making.

The Monastery of Santa Clara-a-Velha (Coimbra, Portugal) today essentially corresponds to the early XIV century church and cloister, and to a rich collection of archaeological finds, that detail the nunnery life until it was abandoned to recurrent river flooding in the late XVII century; ultimately, all but the church top was submerged for most of the XX century. The Monastery recently suffered an extensive conservation intervention, integrated into a larger requalification project that included the construction of a containment barrier against flooding, the exhaustive archaeological survey of the site and the construction of an interpretative centre.

The PRODOMEA approach was applied as a post-intervention exercise with a double objective: to validate the use of this methodology as an assessment tool, and as an instrument to extract knowledge on best practices and on actions to be avoided or modified in future interventions. This paper reports the main outcome of this exercise.

The exercise indicated that this DSS is suited to serve as a planning tool for complex interventions and, for Santa Clara-a-Velha, its using would have made a qualitative difference, namely by anticipating some of the problems that arose during execution. Attention is drawn to three illustrative examples: the apse rooftop and the cloister paving bricks and lithic remains to be remounted.

Keywords: PRODOMEA DSS, Santa Clara-a-Velha Monastery, conservation intervention planning

1. Introduction

Planning conservation interventions for the built heritage is a complex task that entails addressing the most diverse issues and calls for a confluence of several distinct areas of knowledge. Tackling this extension of subjects would benefit from a systematized approach, but this same extension poses some difficulties at conceiving a sufficiently comprehensive methodology. On the other hand, the high specificity of

heritage objects does not help the definition of systematic methodologies to guide the planning process, since these may prove too rigid for the necessary adaptations to each specific case.

One of the possible ways one may seek to contribute at a better planning process is to analyse and learn from past experiences. This paper tries to apply a recently proposed systematic methodology to the planning of the Monastery of Santa Clara-a-Velha (MSCV) conservation intervention undertaken a few years ago, so as to assess the benefits and limitations of its application to a particularly complex case study.

1.1. The PRODOMEA DSS

The PRODOMEA DSS – available at www.prodomea.com – is a systematic approach to conservation interventions planning and assessment that proposes them to be regarded as processes divided into eight steps, each of which is further divided into sets of actions that should be handled by specific key actors. The model is particularly useful to take as a check list of issues to consider especially when planning a new intervention, but it may also be a useful instrument when performing an assessment of a past intervention.

The actions suggested by the PRODOMEA DSS may be combined with compatibility indicators that try to ascertain how (in)compatible were, or are foreseen to be, the choices made within the planning and execution of a conservation intervention, by analysing them in terms of their physical-chemical, operational, socio-cultural and environmental compatibility (Delgado Rodrigues et al. 2007).

1.2. The Monastery of Santa Clara-a-Velha: brief historical note

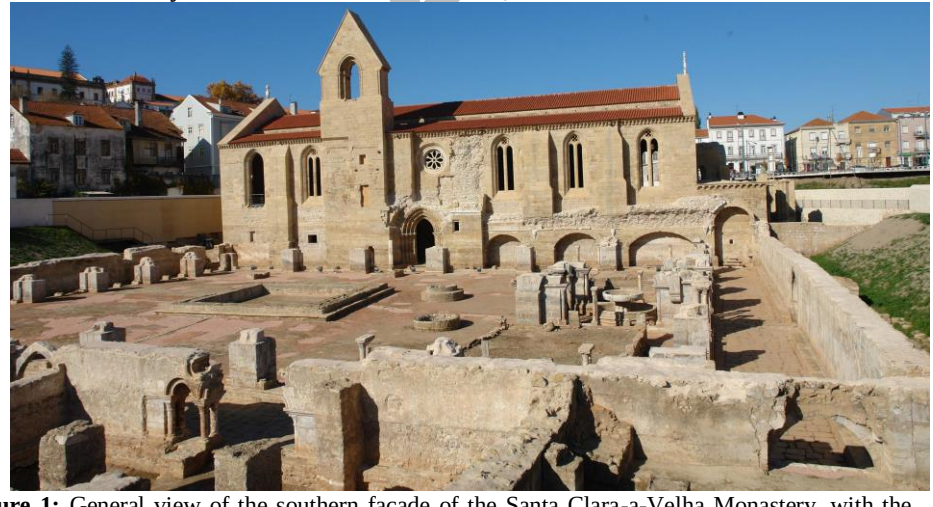

Figure 1: General view of the southern façade of the Santa Clara-a-Velha Monastery, with the cloister in the foreground. (Photo: © DRCC. José Augusto; retrieved June 15th 2012 from http://mnmachadodecastro.imc-ip.pt/pt-PT/minisitios/ContentDetail.aspx?id=557)

The MSCV was first founded at the end of the XIII century, but extinct less than three decades later. Shortly thereafter, though, and thanks to the patronage of Queen Elizabeth of Aragon, the monastery was re-founded, in the early XIV century. The monument that subsists today dates from this second foundation and features some

aspects that are distinctive of the work of the two architects responsible for the construction, such as the complete stone vaulting of the church and the trapeze-shaped cloister (Pereira 1995).

Throughout its entire history, the MSCV had to face the recurring floods of the nearby Mondego River, which caused it to suffer several adaptations that progressively raised the floor level of the complex and eventually led to the construction of an upper level in the church. These solutions did not prove sufficient and the monastery was altogether abandoned in the last quarter of the XVII century; in the upcoming centuries, only the church upper level would remain visible above the waters, the epitome of romanticism. The MSCV was listed as a National Monument in 1910.

An archaeological excavation in the late 1990s revealed some well-preserved ground-level cloister structures and a rich ensemble of findings that illustrated the nunnery life. After promoting a public debate on the preferred conservation solution for the monastic complex, IPPAR (Portuguese Institute for the Architectural Heritage; today DGPC (Portuguese General Directorate for Cultural Heritage)) decided that the MCSV would be kept dry, and an interpretative centre would be built for the safekeeping of the archaeological remains and to help visitors to better understand medieval monastic life. This decision entailed studying and preparing the construction of a groundwater containment barrier, while preparing an architectural project that contemplated the valorization of the ruin (Alves Costa 2005); the archaeological excavations went on throughout this period, as feasible.

Finally, in the beginning of 2004, the site management authority was ready to launch a request for tenders regarding the execution of the "Architectural MSCV valorization programme", which included the construction of the interpretative centre, the conservation of the ruin and the continuing of the archaeological survey of the monastery. In what concerns the conservation intervention, the site management authority was the sole responsible entity for all the preparation and planning.

2. Methodology

Case-study research was found to be an appropriate method for the testing of the PRODOMEA DSS because it allows research of a 'contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident' (Yin 2003: 13); and conservation interventions are inherently context dependent. The fact that a single case study is presented should not limit the analysis, since the 'goal will be to expand and generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization)' (Yin 2003: 10).

The recent Santa Clara-a-Velha Monastery conservation intervention constitutes the unit of analysis of this case study; it was chosen due to its complexity, which was expected to challenge, as much as possible, the robustness of the proposed planning methodology. The necessary data were collected from the documentation pertaining to the intervention, namely diagnosis reports and request-for-tender documents, including the intervention execution project, and the final intervention report. Analysis consisted in the juxtaposition of this documentation and the DSS steps 1 through 6; because this analysis regarded only the planning stages, steps 7 and 8, which deal with the execution proper, are not included here.

3. Results

Results of the request-for-tender and associated documents analysis are shown below, in tables 1 through 6.

Table 1: Step 1 – **Prediagnosis** | Key-actors – **Site manager (coordinator) and consultants**

Actions	Assessment	Grounds for the assessment
- production of photographs	×	some material identification and some conservation condition photos; sometimes poor image quality; no context photos.
- architectural survey	✓	deficient for cloister structures; some flaws in the church mapping.
- archive investigation	✓	a heavy archaeological and historical research was produced but not reworked for conservation planning. no reference to former interventions except for lithic remains.
- mapping of distinctive materials	×	only mapping of cloister ceramics
- mapping of degradation forms	✓	no survey of ceilings or rooftop; impossible to cross with mapping of materials; sometimes unclear terminology; does not match the lexicon directly.
- preparation of report on Prediagnostic Phase	?	information not available

[Key: (–): not performed; (×): unsatisfactory; (✓): satisfactory; and (✓✓): very complete]

Table 2: Step 2 – **Diagnosis** | Key-actors – **Site manager (coordinator)**

Actions	Assessment	Grounds for the assessment
- sampling planning	–	testing is referenced but no results are reported; tests to be performed during intervention have no sample planning.
- lithological and petrological characterization	×	stone designation only.
- characterisation of material properties (stone, plasters, etc)	–	testing is referenced but no results are reported.
- characterization of construction and artistic techniques	×	detailed for ceramic tiles and paving bricks; for stone structures, renders and plasters only references in the conservation condition survey.
- structural stability and natural hazards	–	insufficient structural planning for the remounting of cloister lithic remains;
- interpretation of damage processes (damage assessment)	✓	better than average association between damage processes and location.
- production of report on Diagnostic Phase	✓	three separate reports were produced: 1. stone and plasters/renders; 2. cloister ceramics; 3. lithic remains.

[Key: (–): not performed; (×): unsatisfactory; (✓): satisfactory; and (✓✓): very complete]

Table 3: Step 3 – **Conservation Concept** | Key-actors **– Site manager (coordinator)**

Actions	**Assessment**	**Grounds for the assessment**
- definition of the objectives to be achieved	×	a few objectives that are too broad and too generic; no connection between the concepts used and their material translation.
- consider ethical principles	✓	enumerated but somewhat generic; some cases of inadequate and/or contradictory application; (n.b.: adequacy difficult to judge without clearly defined objectives)
- definition of actions to be performed	✓	no connection to the objectives; seldom justified (no definition of specific criteria) and sometimes generic; ill-defined space/extension limits; somewhat poor correspondence between actions and materials/structures (e.g. no location mapping for lithic remains remounting or stone blocks replacements).
- consider local arts and methods and traditional background	–	not applicable
- identification of actions to be avoided	✓	no relevant omission was detected.
- involvement with the local community	✓✓	visits allowed up until possible; fostering of the strong local connection with the monument; strong concern with public fruition.
- involvement of the scientific community	✓	mostly Art History and Archaeology researchers; little contribution of natural sciences.
- taking into account local social & cultural issues	✓	strong linkage to prominent local historic figures; strong emphasis given to the relationship between the monastic symbols and the place and archaeological remains and the regional community.
- taking into account the natural and anthropogenic dynamic of the territory	×	Polis programme not integrated in conservation planning, with consequences in the actions planned for the apse rooftop water drainage; no reference to flooding risks during or post intervention.
- definition of the intervention phasing	–	left to the contractor's discretion.
- production of report on Conservation Concept	×	information is dispersed throughout tender documents and journal articles; however, no consistent conservation concept was found.

[Key: (–): not performed; (×): unsatisfactory; (✓): satisfactory; and (✓✓): very complete]

Table 4: Step 4 – **Intervention Action** | Key-actors – **Conservation scientist**

Actions	**Assessment**	**Grounds for the assessment**
- consideration of environmental stress	×	need for research mentioned only for cloister ceramics but not carried out.
- selection of materials to be used	×	some choices based on information for a similar monument sometimes used in an incongruent manner; somewhat unreasonable expectations on the protective capabilities of water-repellents. contradictions between different request-for-tender documents. testing for adequate consolidants for the ceramic paving eventually executed by the contractor.
- consider scientific principles: compatibility, effectiveness and harmfulness	×	only mentioned for the cloister ceramics, but not substantiated by exams nor in materials and techniques selection.
- consider the use of local (material) resources	–	not applicable.
- definition, execution and interpretation of trials experiments	×	definition for ceramics alone, but no execution; references to preliminary tests but no results reported.
- definition of technical solutions	✓	mostly covered although sometimes not very detailed; some solutions were uninformed (ceramic paving) or proved inadequate (apse water drainage system) or unnecessary (in-depth stone consolidation).
- definition of application procedures	✓	mostly covered though sometimes not very detailed.
- understanding hierarchy and sequence of actions	✓	minimal.
- understanding interaction between actions	–	qualifying factor for contractors.
- production of report on Intervention Actions	–	merged with intervention plan?

[Key: (–): not performed; (×): unsatisfactory; (✓): satisfactory; and (✓✓): very complete]

Table 5: Step 5 – **Intervention Plan** | Key-actors – **Site manager or consultants**

Actions	**Assessment**	**Grounds for the assessment**
- definition of the logistics requirements	✓	fair scaffolding specifications; sufficient for working spaces within the site.
- interference and identification with other site actions	–	no reference was found; apparently left to the discretion of the contractor.
- identification of needed skills	✓	given the nature of the works, it is not clear why the conservation technical manager is required to be a civil engineer; some disproportion between ceramics and stone conservation teams requirements; material scientist required with no clear attributions or purpose.
- planning the sequence & hierarchy of the actions	✓	minimal.
- consider the relevant tools, equipment and methodologies	✓	duly considered for the building stone, plasters and renders; some gaps in the remounting of lithic remains; basic for ceramics.
- consider the documentation issues	✓	all standard requirements plus monthly reports and concern with mapping updating.
- consider the durability and maintenance needs	×	mentioned but ultimately not considered.
- consider (further) research needs	×	only for ceramics (justified) and lithic remains (for unclear reasons).
- prepare a health and safety plan	✓✓	generic but nevertheless applicable.
- plan to inform the community about the intervention	✓	contemplated monthly updating of public information.
- consider the costs (consider alternatives)	?	target budget given with no further information.
- consider the request for tender format	✓	legal constraints were met; it was considered but not possible to make three separate requests for tenders: museum construction, archaeology and conservation.
- production of report on Intervention Plan/Project	×	discrepancies between different documents; no framework; no global analysis.
- prepare the request for tender documents	×	contradictions between different documents; no global content analysis; many technical specifications described in bill of quantities only; several omissions (e.g. contents listed here as not produced and stone diagnosis report)

[Key: (–): not performed; (×): unsatisfactory; (✓): satisfactory; and (✓✓): very complete]

Table 6: Step 6 – **Selection of Operators** | Key-actors – **Site manager**

Actions	Assessment	Grounds for the assessment
- consider the team composition/skills	✓	company experience in similar works is a compulsory requirement; experience and education of team leaders are compulsory; qualifications above minimum requirements not scored.
- consider the availability of operators	–	not applicable.
- consider the training of craftsmen	–	not applicable.
- consider documentation issues	×	not specifically mentioned.
- consider the execution time planning	✓✓	work scheduling is a tender qualifying factor; tender selection criteria included work articulation and distribution and coherence between work, equipment and human resources plans.
- consider the relevant tools, equipment and methodologies	✓	adequacy of tools, equipment and methodologies are tender qualifying factors but evaluation criteria are not clear.
- consider the costs	✓	cost plan and bill of quantities are compulsory; given the request for tender format, the cost plan depends on the working plan and on the bill of quantities.
- consider tender evaluation criteria	✓	technical quality has the highest weight; however, criteria for its evaluation are vague; cost is relatively more important than time.
- production of report on Selection of Operators	✓	quality assessment description could be more detailed.

[Key: (–): not performed; (×): unsatisfactory; (✓): satisfactory; and (✓✓): very complete]

4. Discussion

The main goal of this analysis was to evaluate the comprehensiveness and adaptability of the PRODOMEA DSS. Nevertheless, it was equally important to learn from a particularly rich planning experience and see where contributions towards a more efficient and/or compatible planning may be made.

4.1 The PRODOMEA DSS

As pointed out earlier, the principle behind the use of the PRODOMEA DSS is to adapt it to the characteristics and context of the planning at hand. For that, several actions are suggested and additional aspects may be considered stemming from the compatibility approach indicators (Delgado Rodrigues et al. 2007). The tables that guided the MSCV intervention planning process assessment were completed with some of these compatibility indicators. Hence, it was considered that this DSS shows the necessary adaptability to carry out a complex planning process, providing that it is combined with the compatibility indicators deemed necessary.

In terms of comprehensiveness, the PRODOMEA DSS seems to be able to encompass all the necessary steps and actions necessary to a successful intervention planning; there were generally no items in the documentation analysis that could not be fit into one of the required actions. A few exceptions were nevertheless found: the *characterization of construction and artistic techniques*, the *definition of technical solutions* and the items related to the request-for-tender preparation. These items were added to the tables and they are thought to constitute important contributions to this DSS, at least in the Portuguese context.

Some actions, such as the consideration of availability of local material or human resources, were deemed not applicable, but nevertheless they may be useful in different contexts and their consideration here was considered pertinent, even if just to be consciously dismissed.

4.2 The Santa Clara-a-Velha Intervention Planning Process

The DSS helped identifying some insufficiencies at planning level, which are briefly exposed below.

The absence of material mappings was found to constitute a relevant gap in the documentation files, not only because of the importance of keeping a detailed record of the monument, but also because it would facilitate present and future understanding of the diagnostic analysis performed for this intervention; additionally, planning the works would have been made easier. Given that this planning was mainly left to the contractor's discretion and used as a qualifying factor for tender evaluation; and that the diagnosis report was omitted from the procurement documents – leaving just the degradation mappings; there was a somewhat heavy weight put upon the contractor's judgment, technical knowledge and experience. This is of course an option, but it is one that is hardly complacent with the considering of cost as one of the qualifying factors for choosing the contractor.

Yet another document omission with an impact on the preparation of the intervention execution regarded the planning for the remounting of the lithic remains. In effect, the elements to remount were listed, but no location mapping accompanied this list; on the other hand, there was no scheme connecting the different pieces, namely the different columns and capitals; finally, no consistent remounting technical guidelines where found. This seems to have been trusted to the contractor's rules of good practice, which again advises against considering cost as a qualifying factor in tender appraisal.

On the other hand, the interpretation of degradation factors was not supported by analytical data and/or scientific literature. Preliminary testing would probably have made a difference, particularly for the cloister paving bricks, since knowledge on these materials is far from extensive and the special environmental conditions to which they were exposed throughout their history would require a more in-depth research to provide the best available solution for the exposure level now intended. The need for these preliminary studies was identified and reported by the site manager; however, it was not seen through. The search for technical solutions was ultimately left to the judgment of the contractor, who resorted to scientific consultancy during conservation works. This consultancy eventually decided against consolidation, since there were not enough data – nor time to obtain it (Revez et al. 2008) – to assess the durability and harmfulness of the treatment over time; and the intervention was kept to its essential minimum (Nova Conservação 2008).

After a complete diagnosis, the definition of clear objectives is fundamental for orienting the subsequent planning stages. In this case, the broadness of the defined objectives prevented, to a large extent, both their translation into the materiality of the ruin and the supporting of the actions to be performed. Significance analysis (see, for example, the Burra Charter) might have made a qualitative contribution at this level.

Although never clearly stated, public fruition seems to be a major concern for the guidance of the intervention planning. Paradoxically, the Polis city programme for the requalification of the area immediately adjacent to the east of the MCSV was not integrated in the planning. This led, for example, to the designing of a water drainage system for the apse rooftop that proved inadequate upon the realization of its visibility from the boardwalk implemented within the Polis programme. The solution eventually proposed by the contractor was partially accepted by the site manager. However, the finishing layer chosen by the latter, based on biocide and water repellent applications, will have a limited durability and require frequent maintenance (Nova Conservação 2008). Maintenance, however, was not considered within this intervention project; nor was there any planning found for the periodic inspection of the fragile cloister paving, of which the periodical monitoring would plausibly prove crucial for future decisions regarding these ceramics.

Finally, it is important to highlight that choosing the right key actors for each step is important. The site manager was the essential key actor, resorting to some internal consultancy. However, most reports are not signed, leaving no record of specific authors. Also, no conservator scientist seems to have been consulted.

6. Conclusions

The PRODOMEA DSS seems to be able to tackle complex conservation intervention planning processes; it is both comprehensive and adaptable enough to respond to the multiplicity of aspects that must be considered within the scope of a built heritage conservation intervention. Nevertheless, some actions are proposed to join the PRODOMEA DSS list, such as the *characterization of construction and artistic techniques*, the *definition of technical solutions* and the items related to the request-for-tender preparation.

Most probably, the application of this DSS to the planning of the MSCV intervention would have helped to prevent some inconsistencies and resolve beforehand some of the problems that were raised during conservation works.

Acknowledgments

The authors would like to thank the DGPC (Portuguese General Directorate for Cultural Heritage) and the DRCC (Cultural Office for the Centro Region), and in particular Artur Côrte-Real, coordinator of the Santa Clara-a-Velha Monastery, for their collaboration. The possibility of consulting the procurement documents and final report at the head office of *Nova Conservação, Lda*, with due permission from the DRCC, is also gratefully acknowledged to the company's director, Nuno Proença. The first author additionally acknowledges the Portuguese Foundation for Science and Technology PhD grant referenced SFRH/BD/37356/2007.

References

Alves Costa, A. 2005. 'O último projecto para Santa Clara-a-Velha', *Revista Património – Estudos* **8**: 55-61. Lisbon: IGESPAR.

Delgado Rodrigues, J. & Grossi, A. 2007. 'Indicators and Ratings for the Compatibility Assessment of Conservation Actions'. *Journal of Cultural Heritage*, **8**: 32-43.

DRCC and CCRV. 2004. Valorização do Mosteiro de Santa Clara-a-Velha: Proposta de concurso.

Nova Conservação. 2008. Relatório final da intervenção em Santa Clara-a-Velha.

Pereira, P. 1995. 'A Arquitectura 1250-1450'. In *História da Arte Portuguesa*, Pereira, P. (ed.) vol. I (1995). Lisbon: Temas & Debates.

Revez, M. J., Costa, D. & Delgado Rodrigues, J. 2008. 'Effects of TEOS-based Consolidants on Ancient Paving Bricks'. In *Stone Consolidation in Cultural Heritage – Research and Practice*. Delgado Rodrigues, J. & Mimoso, J. M. (eds.)369-378. Lisbon: LNEC.

Yin, R. 2003. *Case Study Research: Design and Methods*. 3rd edn. Thousand Oaks: Sage Publications.