Re-architecture : lifespan rehabilitation of built heritage - capitellum

RE-ARCHITECTURE *capitellum*

Lifespan rehabilitation of built heritage

PROEFONTWERP

ter verkrijging van de graad van doctor aan de
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para a minha mãe Elisabete que me encaminhou,

en voor mijn man Martin die met mij het pad bewandeld heeft

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colomna

Summary

We are the citizens of a brand-new XXI century, who inherited from earlier generations, not only their fortunes, but also their depths towards the world environment. We can either, close our eyes and continue with our lives, just as we have been living them, following the market waves; or we can dare to look out of Plato's cave, and aim to understand the problems of our world. Trying to overpass the cave entry, this research faced two different realities that can be quite alike. First, the planet is demanding for ecological concerns, regarding the use, transformation and waste of resources, especially the non-renewable; with neither restrictive control, nor consciousness of its impact on the future generations.

Second, the building stock is "breaking down in the seams", with too many unoccupied buildings, while still new construction rates increase consistently, as well as the rate of existing buildings being intervened or demolished, in order to reuse the profitable land property. Such interventions are often self-centred in short term achievements, supported by cultural values, which aim beyond the preservation of both built and natural heritage. This regards not only the promoters and property owners, but the designers themselves, when focusing on present achievements, neglecting the past and the future in their designs.

Within a building there are many forms, components and materials that could still be reused, reprocessed or even recycled, but designers simply waste such built resources, probably due to other priorities and aims. This unconsciousness does not signify a present, but a future consequence, because most of those resources could still be used. Also, the existing buildings can be culturally significant, but time does not allow us, now, to appreciate what next generations might consider as valuable. Nonetheless, instead of being aware and responsible, the choice to neglect both past and future is the most common solution, especially if the building is not listed at any safeguard institution.

Probably this way of apprehending the world's reality is mainly due to the fact that the cultural values regent in our society are mainly ruled by economic and political values. This brings consequences of over-considering the effective capacity of built heritage; especially because involved actors are often not fully aware of the consequences of their actions and choices.

However, the regent cultural values change continuously in our society, as well as the aims that conduct such interventions. Designers responsible for rehabilitation designs can subvert this reality and show to all other involved actors that, at least, within their limited range of actions and decisions, they are very well able and willing to proclaim such lifespan consciousness.

But, is it possible to develop lifespan conscious rehabilitations of built heritage? Is our generation of designers prepared for such a challenge? This research aimed to answer this question positively. And for that purpose, RE-ARCHITECTURE®, a design process support system was developed, tested and verified with architecture students and architects, involved in rehabilitation interventions. Therefore, all designers committed in developing rehabilitation designs, which effectively evidence the consciousness and attention for the building lifespan: past, present and future; can now easily find technical sustenance.

Samenvatting

zuil

Wij zijn de bevolking van de splinternieuwe 21ste eeuw, die niet alleen rijkdommen van eerdere generaties heeft geërfd, maar ook de dieptepunten wat betreft natuur en milieu. We kunnen onze ogen hiervoor sluiten, doorgaan met leven zoals wij daarvoor deden en de marktfluctuaties volgen, of we kunnen proberen een kijkje te nemen buiten Plato's grot en proberen de problemen van onze wereld te begrijpen. In de poging de grot uit te komen, heeft dit onderzoek twee verschillende realiteiten onder ogen gezien, die toch behoorlijk veel raakvlakken kunnen hebben. Allereerst vereist onze Planeet ecologische bezorgdheid wat betreft gebruik, transformatie en verbruik van natuurlijke bronnen, vooral de eindige, waarbij geen beperkende controle, of bewustzijn van de invloed op de toekomstige generatie aanwezig is.

Ten tweede barst de bestaande gebouwenvoorraad uit zijn voegen, met teveel ongebruikte gebouwen, terwijl het percentage nieuwbouw gestaag stijgt, evenals het aantal bestaande gebouwen dat wordt gerenoveerd of gesloopt, met als doel het winstgevende grondbezit te hergebruiken. Dergelijke ingrepen zijn meestal het middelpunt van huidige prestaties, gebaseerd op culturele waarden die een ander doel hebben dan behoud van het gebouwde en natuurlijke erfgoed. Het betreft niet alleen vastgoed vertegenwoordigers en eigenaren, maar ook de ontwerpers zelf, wanneer zij zich alleen richten op actuele resultaten, zonder het verleden en de toekomst in hun ontwerpen te beschouwen.

In een gebouw zijn vele vormen, componenten en materialen te vinden die nog hergebruikt, herbewerkt, of gerecycled zouden kunnen worden, maar de ontwerpers verspillen simpelweg dergelijke toegepaste materialen, waarschijnlijk vanwege andere prioriteiten. Dit onbewustzijn resulteert niet zozeer in directe gevolgen, maar wel in gevolgen voor de toekomst, omdat het merendeel nog gebruikt had kunnen worden. Ook kunnen de bestaande gebouwen cultureel zeer belangrijk zijn, maar de tijd staat ons niet toe, nu, te waarderen wat volgende generaties in de toekomst zullen gaan waarderen. Niettemin is de keuze om zowel het verleden als de toekomst te verwaarlozen de meest gangbare, in plaats van alert en verantwoordelijk te zijn. Vooral als het gaat om een gebouw dat niet bij een beschermende instantie geregistreerd staat. Waarschijnlijk wordt deze houding ten aanzien van op de wereldrealiteit veroorzaakt doordat de culturele waarden in onze maatschappij vooral worden beïnvloed door de economische en politieke waarden. Dit zorgt voor overwaardering van de capaciteit van het gebouwde erfgoed, vooral omdat de betrokken actoren zich vaak niet geheel bewust zijn van de consequenties van hun acties en keuzes. Echter, de regerende culturele waarden veranderen continu in onze maatschappij, evenals de doelen die zulke ingrepen sturen. Ontwerpers verantwoordelijk voor renovatieontwerpen kunnen deze realiteit verwerpen en aan de andere actoren laten zien, dat zij, in ieder geval binnen hun eigen beperkte reeks van acties en beslissingen, zeer goed in staat kunnen zijn en de wil kunnen tonen om een dergelijke levensduurbewustheid uit te dragen.

Maar, is het mogelijk om levensduurbewuste renovaties van gebouwd erfgoed te ontwikkelen? Is onze generatie van ontwerpers voorbereid op zo'n uitdaging? Dit onderzoek is gericht op een positief antwoord op deze vraag. Voor dit doel is RE-ARCHITECTURE®, een ontwerpproces ondersteunend systeem, ontwikkeld, getest en geverifieerd met architectuurstudenten en architecten, die betrokken waren bij renovatie-ingrepen. Daarom kunnen nu alle ontwerpers eenvoudig technische ondersteuning vinden, wanneer zij betrokken zijn bij de ontwikkeling van renovatieontwerpen, die het bewustzijn en aandacht voor de levensduur van het gebouw: verleden, heden en toekomst, weerspiegelen.

■ Sumário

coluna

Somos os cidadãos do novo século XXI, que herdaram das gerações anteriores; não só as suas fortunas, mas também as suas dívidas para com o ambiente mundial. Podemos fechar os nossos olhos e continuar com as nossas vidas, exactamente como as temos vivido, seguindo as oscilações do mercado; ou podemos ousar observar fora da caverna de Platão, aspirando compreender os problemas do nosso mundo. Tentando trespassar a entrada da caverna, esta investigação deparou-se com duas realidades diversas, que podem ser bastante idênticas. Primeiro, o planeta reclama por atenções ecológicas, no que diz respeito ao uso, transformação e desperdício de recursos; especialmente os não renováveis; sem controlo restritivo, nem consciência do seu impacto nas gerações futuras.

Segundo, o parque edificado está a "arrebentar pelas costuras", com demasiados edifícios desocupados; quando os valores da construção nova continuam a aumentar medianamente; assim como os valores de edifícios existentes, alvo de intervenções ou demolições, para que tão lucrativas propriedades possam ser reutilizadas. Frequentemente centradas em realizações a curto prazo, estas intervenções sustentam-se em valores culturais, com ambições que ultrapassam a preservação do património construído e natural. Isto diz respeito, não só aos promotores e proprietários, mas também aos próprios projectistas, quando concentrados somente em realizações presentes, negligenciando o passado e o futuro nos seus projectos.

Num edifício existem muitas formas, componentes e materiais, que poderiam perfeitamente ser reutilizados, reprocessados ou até reciclados, mas os projectistas simplesmente desperdiçam-nos, provavelmente devido a outras prioridades e ambições. Esta inconsciência não representa uma consequência para o presente, mas para o futuro; já que grande parte destes recursos poderia ainda ser usado. Também, o edifício pode ser relevante culturalmente, mas o tempo não nos permite, agora, apreciar o que futuras gerações poderão vir a valorizar no futuro. Mesmo assim, em vez de atentos e conscientes, a escolha para negligenciar o passado e futuro é a solução mais corrente, sobretudo quando o edifício não está classificado por qualquer instituição de salvaguarda. Provavelmente, esta forma de apreender a realidade do mundo deve-se ao facto de que os valores culturais regentes na nossa sociedade sejam maioritariamente dominados pelos valores económicos e políticos. Isto traz consequências, sobrestimando a efectiva capacidade do património construído; especialmente porque, frequentemente, os actores envolvidos não estão cientes das consequências das suas acções e escolhas.

Felizmente, os valores culturais regentes na nossa sociedade mudam constantemente, assim como as ambições que conduzem estas intervenções. Os projectistas responsáveis por projectos de reabilitação podem subverter esta realidade e mostrar a todos os outros actores envolvidos, de que, pelo menos, no seu limitado raio de acção e decisão, são muito bem capazes de promulgar tal consciência temporal. Mas, será possível desenvolver reabilitações conscientes da temporalidade do património construído? Estará a nossa geração de projectistas preparada para tamanho desafio? Esta investigação ambicionou responder positivamente a esta pergunta. RE-ARCHITECTURE®, um sistema de apoio à metodologia projectual foi desenvolvido, testado e verificado com estudantes de arquitectura e arquitectos, quando envolvidos em intervenções de reabilitação. Desta forma, todos os projectistas realmente empenhados em desenvolver projectos de reabilitação que, efectivamente evidenciem atenção e consciência pela temporalidade do edifício: passado, presente e futuro; podem agora facilmente encontrar sustentação técnica para tal.

■ Introduction

RE-ARCHITECTURE: Lifespan rehabilitation of built heritage is a doctoral research, funded by the Foundation for Science and Technology (FCT), Portugal; and hosted by the Eindhoven University of Technology (TU/e), Unit Architectural Design + Engineering (ADE), during the period January 2004 – December 2007.

Prof. Jouke Post, Chairman of the ADE Unit, is the First Promoter; together with the Co-promoter Dr. Peter Erkelens, Associate Professor and Research Coordinator in the same Unit. Prof. José Aguiar, Associate Professor at the Technical University of Lisbon, Faculty of Architecture, Portugal, is the Second Promoter.

Graduated in 2002, at the University Lusíada of Lisbon, Portugal; with the "Best Architecture Student" prize (2001/2002); the researcher has become officially an Architect, at the Order of Architects (OA), Portugal; just before starting this doctoral research.

The research proposal approved by both Fund and Host Institution was developed within the research program framework of the former Building Technology Group, BUILD – Towards New Technologies. It combined two research guidelines:[1]

1. Research into the composition of buildings and its environment in relation to planned lifespan, industrial production, flexible use and autarchic properties, and
2. Research into potential values and architectural and technical possibilities for rehabilitation and re-use of existing buildings and their environment.

This research had a challenging main question and the strong aim to achieve a positive answer, when reaching the final stage of this doctoral research. However, such question, obviously, can not be answered with a simple 'yes' or 'no'.

Therefore the main research question – Is it possible to develop lifespan conscious rehabilitations of built heritage? – was divided into three sub-questions, not less complex than the first one.

- **WHAT is built heritage?**
- **HOW should a lifespan conscious rehabilitation be done?**
- **WITH which design process, technologies or materials could a lifespan conscious rehabilitation be done?**

In order to find the answers to these three questions, a research method was developed, where in successive stages all these important issues could be approached, questioned, analysed and discussed. The research period was divided into three main phases: the design theory, the design product, and the design result (*vide* Figure 1).

The design theory includes LEVEL 1, where the background theory is presented and the problem field is explained, in order to introduce the phenomena of Heritage and Interventions; and LEVEL 2, where the theory directly connected to the problem is framed, and the definitions regarding Built heritage (WHAT) and Lifespan rehabilitation (HOW) start shaping the research taxonomy.

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[1] BTO (2003) *BUILD – Towards New Technologies*, Eindhoven: Technische Universiteit Eindhoven

The design product, including LEVEL 3, LEVEL 4 and LEVEL 5, deals with the third and last sub-question, theorizing a lifespan design process for rehabilitation interventions and producing a design process support system (DPSS) which could guide and/or accompany the designer in his design developments, whenever aiming for lifespan consciousness (WITH).

In LEVEL 3 the research focuses on the prototype development. This is, in fact, the period for creating the DPSS, inclusive the consolidation of its theoretical model and the identification of the adequate content (guidelines and tools), to support architects involved in rehabilitation designs.

Relevant literature survey, four case studies and two trimesters with architecture students (Portuguese and Dutch), have been the factual support for the prototype development. Two architectural offices; Victor Mestre | Sofia Aleixo, Portugal and XX Architecten, the Netherlands; have attentively accepted to expose their design processes regarding two rehabilitation designs of heritage buildings, from the turn of the last century (XIX – XX); one unlisted and other listed (Safeguard Institution classification).

During the development of LEVEL 3, among other small activities/workshops, two trimesters were organized and implemented with two groups of Portuguese and Dutch students, in order to identify faults and/or lacking stages in the theoretical model. Also, the researcher could retrieve the adequate information a designer normally requires during his rehabilitation design process. The prototype underwent several evolutions along all those experiences (*vide* Appendix 0), as it was meant to be a dynamic and creative process.

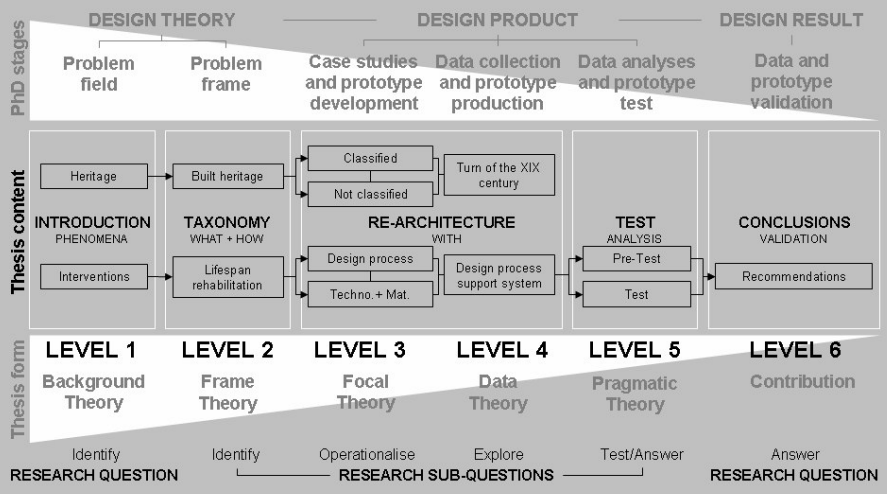

Figure 1 – The research method (adapted from Philips, 2000)[2]

[2] Philips, E.M. (2000) *How to get a PhD: A handbook for students and their advisors*, 3rd ed., Buckingham: Open University Press, p. 88

LEVEL 4 includes the data collection and the prototype production of the DPSS, named RE-ARCHITECTURE®[3]. The researcher first had to simulate its interface and inherent functions; develop its global structure, the databases and carefully select the content of both website and database. However, for its effective production, the researcher had the helpful assistance of two TU/e students and two reviewers (*vide* Acknowledgements on *scapus* - book II).

LEVEL 5 includes the pre-test and test, regarding the verification of the prototype as a useful DPSS. The two trimesters method was implemented again (*vide* LEVEL 3); but now, the students had free access to use RE-ARCHITECTURE® during their rehabilitation design developments (Pre-test). Also several architects, mostly practising in Portugal and the Netherlands, were invited to use RE-ARCHITECTURE® (Test).

The design result includes LEVEL 6, where all conclusions and recommendations are exposed. If the students in the pre-test period, as well as the architects in the test period showed interest and declared RE-ARCHITECTURE® as a useful DPSS, this research can prove its contribution to raise lifespan consciousness in rehabilitation design developments. Possible remarks or errors found during the entire research process will also be mentioned, so that other researchers will not repeat the same mistakes.

It is the belief of the researcher that, by providing such DPSS to a field where technical knowledge and expertise is lacking, as concluded in the problem field (*vide* book I – *basis*), wise designers will take advantage of it. They might choose to use it thoroughly, step-by-step, or only for specific consulting moments, e.g. building elements database, assessment tools, etc. They are free to use it in their own particular way.

Rehabilitation interventions might be developed by field experts, but also by designers, who usually develop design proposals for both new and existing building interventions. Therefore, field of expertise, even if a useful assistance; is not a mandatory requirement to use RE-ARCHITECTURE®. All designers can retrieve useful information and knowledge.

Field experts will see it as an instrument that aims, together with them, for the proliferation of lifespan consciousness and consequently, for the preservation of natural and built heritage. Other designers, however, will see it as an entrance door to the rehabilitation field of expertise. RE-ARCHITECTURE® does not aim to be a “House of Knowledge”, but just a useful door.

The most important concern, within this doctoral research, was to contribute methodologically to the rehabilitation design processes of the designers, as well as, to provide them a sample of such broad universe of expertise knowledge. ‘Rome was not built in one day’, hence, if designers and/or respective designs become more lifespan conscious than they were before getting acquainted with the DPSS and/or the theoretical model, this doctoral research can already be considered worthwhile.

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[3] Pereira Roders, A. (2006) *RE-ARCHITECTURE trial*, Eindhoven: Technische Universiteit Eindhoven, available at: http://www.bwk.tue.nl/re-architecture/ (accessed on 24-09-2006)

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■ Acknowledgements *capitellum*

Having now the three books almost fully revised, it is time to have a break and dedicate some time to the acknowledgements, where I can freely express my eternal gratitude to all those who have contributed to the success of this doctoral research, voluntarily or involuntarily. The acknowledgments have been arranged similar to the structure of this doctoral research – *basis*, *scapus* and *capitellum* – .

First, *basis* acknowledges all those who have been my true foundations; before and during this challenging last four years of my existence. Second, *scapus* acknowledges all colleagues and field experts that have inspired me with their informal talks, designs, writings, presentations, etc. Last, *capitellum* acknowledges all those who have been involved in the challenging development, construction and test of RE-ARCHITECTURE®.

Starting with the four case studies, I would like to thank *XX Architecten* (The Netherlands) and *Victor Mestre*⎪*Sofia Aleixo* (Portugal), who have attentively accepted to spend some of their precious time exposing their design processes.

The dedication Sonja van der Meer, who partially filled in the database of building components, concluded and revised by Martin Roders was priceless. Also, my gratitude to Daniel Muñoz Alonso who constructed the preliminary prototype of RE-ARCHITECTURE®, tutored by Prof. Dr. Michael Franssen; and to Peter van den Brand who constructed the final prototype. Dr. Eng. Ana Karla de Medeiros was tireless explaining me what necessary about Process Mining techniques and helping the conversion of the "pure" data into "workable" data.

My gratitude to the tutors Dr. Ad Vermeltfoort, André Walraven and Isabel Valverde who co-oriented and co-supervised the architecture students, from TU/e and ISMAT; during their rehabilitation design developments in both test periods of 2005/2006 and 2006/2007. They were always coherent and contributed to the level of accuracy achieved at the results of such test periods. The trainees involved in this doctoral research have also, at their own scale, contributed to its success and achievements. Those were respectively, Bruno Godinho, Chiara Bonsignori and Josué Eliziário. Except for Chiara, both Bruno and Josué assisted also on the education activities, planned for this research.

I would also like to take this opportunity to thank all students that contributed to this doctoral research both in 2005/2006 and 2006/2007. Especially from 2005/2006, I would like to highlight Matthijs Stoffels and Laura Mol; Cristovão Gonçalves and Josué Eliziário; who, even after the trimester finished maintained contact and gladly contributed to the organization of the Exhibitions RE-ARCHITECTURE 05/06. Sergio Nave also cooperated with the development of a work layout and João Candeias supported all internet communications, presentations and exchange of work.

From 2006/2007, I would like to highlight Hannah Frederiks, Monique Blacha, and Bram Bus, as well as Tânia Farias, AlexAndré Mendes and José Nabiça. As group representatives, they helped motivating the other students. Also, my true appreciation goes to Daniel Tulp and to Sanne van den Berg; for developing the work layout.

Thank you to both professional Associations (OA and BNA), to the magazines who published the Articles and News challenging the architects and two all those who have accepted the challenge to cooperate with this doctoral research, by registering, filling in the Pre-Survey and accessing the universe of knowledge and tools available at RE-ARCHITECTURE®. Even if only a minority actually used it and later returned to fill in the Post-Survey; their will to cooperate was evidently illustrative.

Thank you! Without you all, I would have never passed the boundaries of theory!

Summary

Due to the extensive literature review and the level of knowledge achieved within the prototype development phase (LEVEL 3), the decision was made to divide the production of this doctoral research into three books. The Latin term *columna* (column) was used as a metaphor to illustrate the entire production. Consequently, book I was named *basis* (base), book II *scapus* (shaft) and book III *capitellum* (capital).

Fundamentally, *basis* refers to the design theory phase, enclosing the problem field, scientific method and taxonomy (LEVEL 1 and 2). There, one can find the researcher's evolution process, when; surveying the problem field, identifying the main research question, developing a scientific method and defining the research taxonomy regarding the WHAT and HOW.

Scapus refers to the design product phase, enclosing the prototype development (LEVEL 3). The case studies considered in this level will be reported in capitellum. With a more didactic approach then basis and capitellum, *scapus* gives an overview of both building and design processes, so that the designer can better understand the background and assumptions of the design process theorised for lifespan rehabilitation interventions.

At last, *capitellum* refers to the design product and result phase (LEVEL 4 – 6); enclosing both stages of test (theory and product), respective results analysis, validation and recommendations. There, not only the validation of the theorized design process will be revealed; but also the research method used for its development; as well as, the transformation of the theorized design process into a design process support system (DPSS).

Capitellum is the disclosure of this doctoral research. Away from its theoretical content, *capitellum* reveals two other prominent dimensions of RE-ARCHITECTURE®: its framework and its interface. The framework regards the background structure, whilst the interface is the appearance of what accessible at RE-ARCHITECTURE®. On both dimensions there have been three distinctive phases: the conceptual, preliminary and final prototype.

Moreover, it presents all tests – methods, motivations & assumptions, and results – on both design theory and product. *Capitellum* is an 'open book" to the whole experimental procedure undertaken during this doctoral research. Its purpose was exactly to reveal all its stages; so that by the conclusions, all could be clearly correlated and the respective strengths, weaknesses, opportunities and threats (SWOT) analysed based on facts.

During both tests, this doctoral research had the privilege to step upwards and "stand on the shoulder of giants", while confronting the theorised taxonomies and design process. From the Netherlands and Portugal; challenging architects and architecture students at *Technische Universiteit Eindhoven* and *Instituto Superior Manuel Teixeira Gomes* truly enabled such worthy disclosure.

Capitellum shall reveal to interested field experts, designers and students, accurate conclusions on the factual contribution of this doctoral research and further recommendations to the raise of lifespan consciousness in rehabilitation interventions of built heritage. Even if the researcher is aware that this is just the beginning of a long and challenging journey, it is fundamental to go further with a clear perspective on how RE-ARCHITECTURE® exactly can pay a contribute to such crucial expertise field.

Built heritage shall not stop aging and natural heritage shall not get less affected, unless something is done. Every line designers draw or erase has a direct effect on both built and natural heritage. It is up to them that such effect is more positive than negative. And it is up to us, scientific community, to sustain them better and better with the fundamentals.

■ Samenvatting *kapiteel*

Vanwege het uitgebreide literatuuronderzoek en het niveau van vergaarde kennis in de ontwikkelingsfase van het prototype (NIVEAU 3), is er besloten om de output van dit promotieonderzoek onder te verdelen in drie boeken. De Latijnse term *columna* (zuil) is gebruikt als metafoor om de gehele productie te illustreren. Boek I is daarom *basis* (basement) genoemd, boek II *scapus* (schacht) en boek III *capitellum* (kapiteel).

In essentie verwijst *basis* naar de fase van de ontwerptheorie, welke het probleemgebied, de onderzoeksmethode en de taxonomie omvat (NIVEAU 1en 2). Hier kan het ontwikkelingsproces van de onderzoeker worden onderscheiden, waar het probleemgebied wordt onderzocht, de onderzoeksvraag wordt bepaald, de onderzoeksmethode wordt ontwikkeld en waar de onderzoekstaxonomie met betrekking tot het WAT en HOE wordt ontwikkeld.

Scapus verwijst naar de productontwikkelingsfase, welke de ontwikkeling van het prototype omvat (NIVEAU 3). De in deze fase beschouwde case studies zullen beschreven worden in *capitellum*. Met een meer didactische benadering dan *basis* en *capitellum*, geeft *scapus* een overzicht van zowel de bouw- als ontwerpprocessen, zodat de ontwerper de achtergrond en aannames van het ontwerpproces, zoals uitgelegd voor levensduurgeoriënteerde renovaties, beter kan begrijpen.

Als laatste verwijst *capitellum* naar de ontwerpproduct- en resultaatsfase (NIVEAU 4 t/m 6), welke beide testfases (van de theorie en het product), de bijbehorende resultaatsanalyses, bewijsvoering en aanbevelingen omvat. Hier wordt niet alleen de bewijsvoering van het getheoretiseerde ontwerpproces geleverd, maar ook de ontwerpmethode die gebruikt is voor de ontwikkeling ervan en de transformatie van het theoretische ontwerpproces in een ontwerpproces ondersteunend systeem (DPSS).

Capitellum is de bekroning van dit onderzoek. Naast de inhoud worden twee andere vooraanstaande dimensies van RE-ARCHITECTURE® onthuld: de achtergrondstructuur en de interface, die weergeeft wat toegankelijk is in RE-ARCHITECTURE®. Beide dimensies zijn drie afzonderlijke fases van het conceptuele, voorlopige en definitieve prototype gepasseerd.

Verder presenteert *Capitellum* alle testgegevens – methodes, motieven & aannames en resultaten – van zowel het ontwerp van de theorie als het ontwerp van het product.

Capitellum is een “open boek” met de volledige experimentele procedure die in dit onderzoek doorlopen is. Het doel was om alle stadia te laten zien, zodat in de conclusies alles helder gecorreleerd zou kunnen worden.

Gedurende beide tests heeft dit onderzoek het privilege gehad zich op te richten en “op de schouders van de reus te gaan staan”, tijdens het behandelen van de ontwikkelde taxonomieën en het ontwerpproces. Uitdagende architecten uit Nederland en Portugal en architectuurstudenten van de *Technische Universiteit Eindhoven* en het *Instituto Superior Manuel Teixeira Gomes* hebben deze waardige ontknoping mogelijk gemaakt.

Capitellum zal geïnteresseerde velddeskundigen, ontwerpers en studenten accurate conclusies bieden over de bijdrage van dit onderzoek en aanbevelingen geven voor de toename van levensduurbewustheid van herbestemmingsingrepen in gebouwd erfgoed. Het gebouwde erfgoed zal niet ophouden met verouderen en het natuurlijke erfgoed zal niet minder aangetast worden, tenzij er iets gedaan wordt. Iedere lijn die ontwerpers trekken of uitvegen heeft een directe invloed op zowel het gebouwde als het natuurlijke erfgoed. Het is aan hen om te zorgen dat dit effect meer positief dan negatief is. En het is aan ons, wetenschappelijke gemeenschap, om hen steeds beter te ondersteunen met de grondslagen.

Sumário *capitel*

Após uma extensa revisão de literatura e dado o nível de conhecimento atingido na fase de desenvolvimento do protótipo (NÍVEL 3), decidiu-se dividir o produto deste doutoramento em três livros. O termo em latim columna foi usado como metáfora, ilustrando a completa produção. Consequentemente, o livro I foi nomeado *basis* (base), o livro II *scapus* (fuste) e o livro III *capitellum* (capitel).

Basicamente, *basis* descreve a fase teórica do projecto de investigação, incluindo o seu âmbito, método científico e taxonomia (NÍVEL 1 e 2). Ali, pode descobrir-se o processo evolutivo da investigadora, quando examinou o âmbito da investigação, definiu o seu problema principal, desenvolveu o método científico, e definiu a taxonomia do QUÊ e COMO.

Scapus descreve a fase produtiva da investigação, incluindo o desenvolvimento do protótipo (NÍVEL 3). Os casos de estudo considerados neste nível serão relatados no *capitellum*. Com uma abordagem mais didáctica do que *basis* e *capitellum*, *scapus* oferece uma visão global de processos metodológicos de construção e projecto, de modo a que o projectista possa compreender melhor o enquadramento e princípios inerentes à metodologia projectual teorizada para reabilitações conscientes da temporalidade do edifício. Por último, *capitellum* descreve a fase produtiva e resultante do projecto de investigação (NÍVEL 4 – 6), incluindo ambas fases de teste (teoria e produto), respectiva análise dos resultados, validação e recomendações. Ali, não é apenas apresentada a validação da metodologia projectual teorizada, mas também o método científico adoptado para o seu desenvolvimento, assim como, a transformação da metodologia projectual teorizada num sistema de apoio à metodologia projectual (DPSS).

Capitellum é o desfecho do doutoramento. Longe do seu conteúdo teórico, *capitellum* revela outras duas dimensões proeminentes de RE-ARCHITECTURE®: sua estrutura e interface. A estrutura expõe a organização de fundo, enquanto o interface a aparência do que acessível em RE-ARCHITECTURE®. Em ambas dimensões houve três fases distintas: o protótipo conceptual, preliminar e final. Além disso, apresenta todos os testes – métodos, motivações & suposições, e resultados – no desenho da teoria e produto. *Capitellum* é um "livro aberto" ao procedimento empírico seguido no doutoramento. Sua finalidade era precisamente revelar todas as suas fases; de forma a tudo poder ser claramente correlacionado e as falhas e virtudes analisadas nas conclusões, fundamentadas em factos.

Durante os testes, esta tese de doutoramento teve o privilégio de subir e "permanecer nos ombros dos gigantes", ao confrontar as taxonomias e processo projectual. Dos Países Baixos e Portugal, desafiantes arquitectos e estudantes de Arquitectura da *Technische Universiteit Eindhoven* e *Instituto Manuel superior Teixeira Gomes* realmente permitiram esse digno desfecho. *Capitellum* irá revelar aos especialistas, aos projectistas e aos estudantes interessados, conclusões na contribuição factual deste doutoramento e futuras recomendações para o aumento da consciência da temporalidade em reabilitações no património construído. Mesmo se a investigadora sabe de que este é o começo de uma longa e desafiante viagem, é essencial avançar com uma clara perspectiva de como o RE-ARCHITECTURE® pode contribuir exactamente para tão crucial temática.

O património construído não parará de envelhecer e o património natural não deixará de estar menos lesado, a menos que algo seja feito. Qualquer linha desenhada ou apagada pelos projectistas tem efeito directo no património construído e natural. É da responsabilidade deles que tal efeito seja mais positivo que negativo. E é responsabilidade nossa, comunidade científica, sustentá-los cada vez melhor e melhor com o fundamental.

Chapter 5 Producing the prototype

5.1 Introduction

Chapter 5 illustrates the production process of the prototype, developed in this doctoral research. As earlier referenced, RE-ARCHITECTURE® is the prototype of a design process support system (DPSS) that aims to effectively support architects and architecture students, when developing or simulating rehabilitation interventions in built heritage.

RE-ARCHITECTURE® sustains the importance of lifespan consciousness – regarding the building's past, present and future – in rehabilitation design developments, through a more theory-based approach introduced in the design process and the respective design developments. Therefore, such approach requires a considerable range of knowledge available and a dynamic work environment which designers can easily access, while performing their own design processes.

As in many other sciences, such as Medicine, experts have learned to use computerised work environments, where they can easily access field-related knowledge e.g. symptoms, treatments, medicines, etc. Such work environments are time-saving and have proved to help experts to systematise processes, increasing the quality of their results.

Technical books, journals, magazines, etc. can equally sustain experts; however, they are much more time-consuming; especially when it is still necessary to search among the relevant literature for the right reference. Inversely, when its content is computerised, the knowledge of several experts can be inter-complemented and quickly accessed by all interested experts, whenever required.

RE-ARCHITECTURE® comprises a dynamic database with an online interface to store all relevant knowledge. Designers should be able to access the respective guidelines; but also, they should be able to create their own design process through the available tools and store all relevant data and information.

During the production period there have been three distinctive stages, named conceptual, preliminary and final prototype. Those stages are illustrated in the following chapters. Chapter 5.2 starts describing the background of RE-ARCHITECTURE®, **framework,** and its respective evolution along the three versions of the prototype: conceptual, preliminary and final.

Instead, Chapter 5.3 describes the foreground of RE-ARCHITECTURE®, **interface**, and its respective evolution through the three stages. The six distinctive areas that structure the interface are presented in the following chapters. Those are effectively the: header (*vide* Chapter 5.3.1), top black menu (*vide* Chapter 5.3.2), top blue menu (*vide* Chapter 5.3.3), left menu (*vide* Chapter 5.3.4), content (*vide* Chapter 5.3.5) and footer (*vide* Chapter **Error! Reference source not found.**).

Last, Chapter 5.4 explores the potential of such framework and interface, presenting some final remarks. Those shall be readdressed in the Conclusions and Discussion related to producing the prototype (*vide* Chapter 7.6), after having tested it and being scientifically entitled of verifying its degree of effectiveness and usefulness.

5.2 Framework

The framework of RE-ARCHITECTURE® has been developed with the aim to provide a clear and consistent structure that organizes the content for the website. In such design process support system the researcher not only developed a consistent framework that hosts what relevant to sustain the users theoretically. She also developed a dynamic database that supports users, when producing and storing their developments, along the different activities of their design process.

The framework and subsequent database are accessible through an internet website **– www.re-architecture.eu –** especially and exclusively created for this research. TU/e provided space on their servers to store the data that forms the background of the website.

Three versions of the prototype have been produced: conceptual, preliminary and final. As earlier referenced, the conceptual prototype was simulated during November-December 2005. Then, the preliminary prototype was produced during the first semester of 2006 and the final prototype was mainly produced during the last trimester of 2006 (*vide* book I – *basis*).

> Access is the Microsoft Office "database management program that gives you an improved user experience and an expanded ability to import, export, and work with XML data files." [4]

The **framework** of the conceptual prototype was first simulated by the researcher with the Microsoft Office program Access; so that the three supervisors; Prof. Post, Prof. Dr. Aguiar and Dr. Erkelens; as well as, Prof. Dr. Aerts, from the Faculty of Informatics (TU/e) could better understand the aims targeted for RE-ARCHITECTURE® (*vide* Figure 2).

Since the beginning of the prototype's production, there have been two types of tables planned to incorporate in this design process support system. The fixed (f) ones that would be filled previously by the researcher and respective assistants; and the dynamic (d) ones that would be filled by the user; directly, whenever creating and progressing within his own design process; or indirectly, by the system itself, which would log all workflow data.

In total, the framework of the conceptual prototype consisted of twenty-three tables. Accordingly, there was a main table that would store the registration information of all **users** (tb01 user). Each user could create an infinite number of **design processes** (tb02 design) and would be asked to fill in a **post-survey** (tb06 survey), enabling the researcher to control his judgment regarding the framework, interface, content, most/least useful utilities, and the degree of efficiency of RE-ARCHITECTURE® to support the implementation of lifespan ideologies into the design processes of rehabilitation design developments.

To support the registration of the users and the registration of the design processes, secondary tables were made, regarding the **birth year** (tb00 year) and the **country** where users would be working (tb00 country). For the registration of the design process, another secondary table was made, providing the **months** (tb02 months). For the assessment of the parameters raised from the Post-Survey, a secondary table was made, containing the scale of five **values** (tb00 value).

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[4] Microsoft Cooperation (2007) *Introducing Microsoft Office Access 2003,* Reading: Microsoft Cooperation, available at: http://office.microsoft.com/en-gb/access/HA010714971033.aspx (accessed in 04-06-2007)

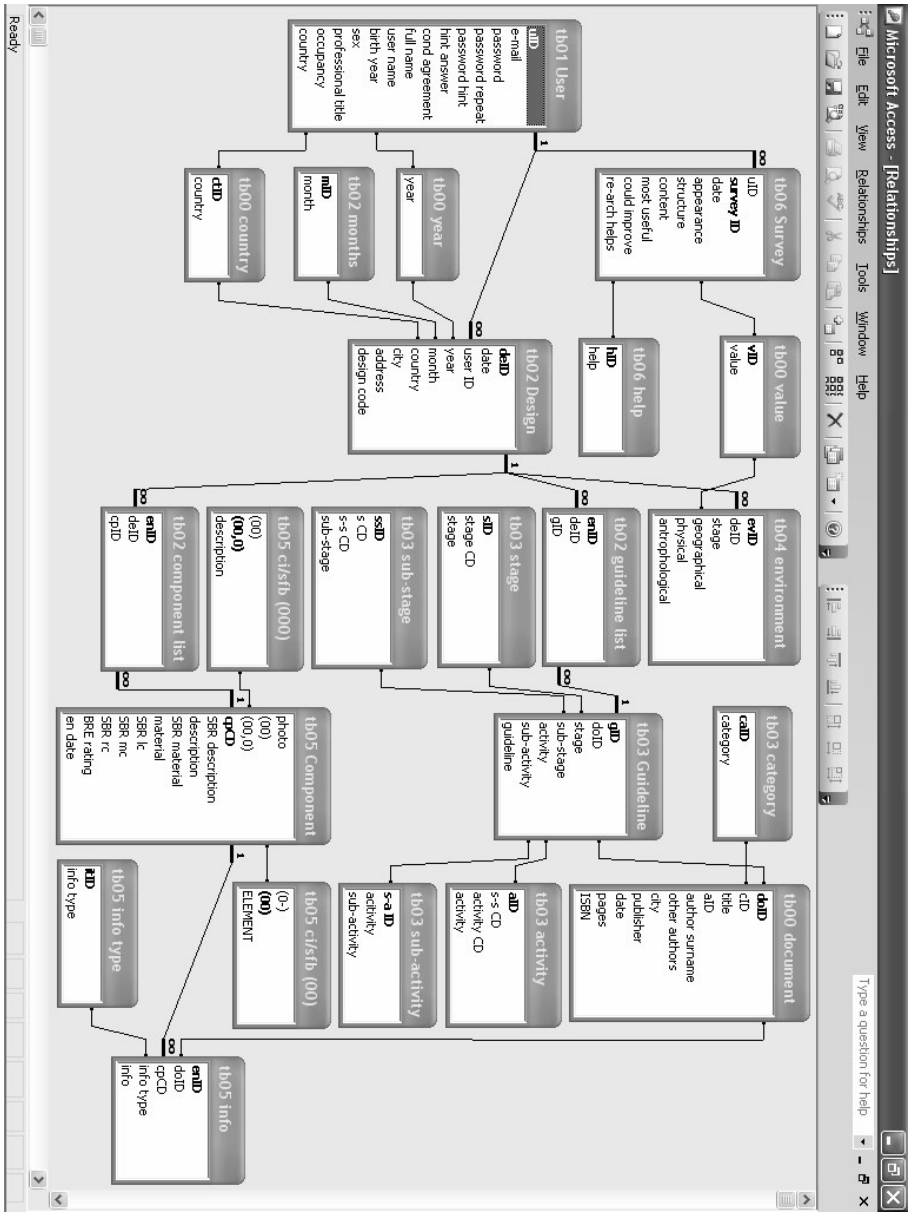

Figure 2 – The relationships between the tables (conceptual prototype)

This table would be also connected to evaluation activities and respective environment, significance and condition assessments. An example of this type of evaluation tables, referring particularly to the **environment** assessment, was created to illustrate the researcher's intention (tb04 environment). At this stage of the research, the environment had other parameters than the final naturals and unnaturals. They were respectively, the geographical, physical and anthropological.

Both previous and following tables were simulated directly related to each design process. They would allow the user to store, in each stage, sub-stage and activity of his design process, all related information and access it worldwide, through the internet. At this level, there were two main groups of tables: the tables that structured the database of **guidelines** and the tables that structured the database of **components**.

First, the database of guidelines was structured among eight tables: the one that would **list** the selections of the designer (tb02 guideline list), the table that would store all **guidelines** (tb03 guideline) indexed per **stage** (tb03 stage), **sub-stage** (tb03 sub-stage), **activity** (tb03 activity) and **sub-activity** (tb03 sub-activity). Last, but not least, each guideline would have named the **document** from which the reference was quoted (tb03 document) and the respective **category** of document (tb03 category).

Second, the database of components would be structured among five tables. The main table (tb05 component) would store all information related to the **component** life, maintenance and replacement cycle and respective complementary information provided by the *Stichting Bouwresearch* (SBR), as well as, the related rating recognized by the Building Research Environment (BRE).

All inventoried components would be similarly indexed, through two related tables ordered according to the CI/SfB indexing manual. The CI/SfB indexing structure would be divided in two related tables, regarding the **second** (tb05 (00)) and the **third** (tb05 (000)) CI/SfB level. Attached to this main table, a secondary table would list all **information** (tb05 info) filtered accordingly to its **type** of information (tb05 info type). Finally, each component could be added into a **list** (tb02 component list) by the user, according to his aims for the new existence of the building being rehabilitated.

No knowledge would be introduced, which had not been researched and published in acknowledged technical references; providing only trustful and credible technical knowledge. Especially, the SBR reference has been fully translated from Dutch into English, and also the respective CI/SfB codes were revised. SBR used the NL-SfB codes (CI/SfB adapted to the Netherlands) and in some occasions those codes differed from the original CI/SfB codes.

> "PHP, which stands for "PHP: Hypertext Preprocessor" is a widely-used Open Source general-purpose scripting language that is especially suited for Web development and can be embedded into HTML. Its syntax draws upon C, Java, and Perl, and is easy to learn. The main goal of the language is to allow web developers to write dynamically generated web pages quickly, but you can do much more with PHP."[5]

> "PhpMyAdmin is a tool written in PHP intended to handle the administration of MySQL over the Web. Currently it can create and drop databases, create / drop / alter tables, delete / edit / add fields, execute any SQL statement, manage keys on fields, manage privileges, export data into various formats and is available in 52 languages."[6]

As Access databases are often considered as inconsistent by the IT expertise, when simultaneously used by multiple users; the one created by the researcher was converted into a PHP dynamic database, accessed through another support program, PhpMyAdmin.

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[5] Olson, P. et al. (2007) *PhP Manual: Preface,* Country unknown: The PHP Group, available at: http://www.php.net/manual/en/preface.php (accessed in 04-06-2007)

[6] PhpMyAdmin Devel Team (2007) *PhpMyAdmin*, Boston: Free Software Foundation, available at: http://www.phpmyadmin.net/home_page/index.php (accessed in 04-06-2007)

The main differences between the frameworks of the conceptual and the preliminary prototype, are predominantly visible in the Pre-Survey and Post-Surveys; the info boxes, the database of components and the report. This evolution represents an increase of tables in the database to a total number of forty-one tables (*vide* Figure 3).

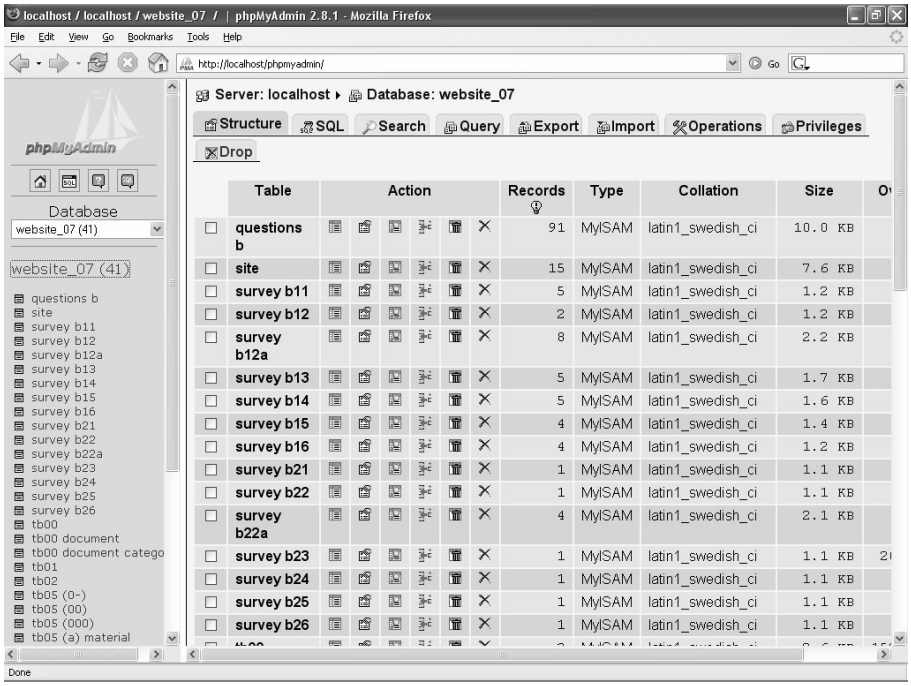


Table	Action	Records	Type	Collation	Size
questions b		91	MyISAM	latin1_swedish_ci	10.0 KB
site		15	MyISAM	latin1_swedish_ci	7.6 KB
survey b11		5	MyISAM	latin1_swedish_ci	1.2 KB
survey b12		2	MyISAM	latin1_swedish_ci	1.2 KB
survey b12a		8	MyISAM	latin1_swedish_ci	2.2 KB
survey b13		5	MyISAM	latin1_swedish_ci	1.7 KB
survey b14		5	MyISAM	latin1_swedish_ci	1.6 KB
survey b15		4	MyISAM	latin1_swedish_ci	1.4 KB
survey b16		4	MyISAM	latin1_swedish_ci	1.2 KB
survey b21		1	MyISAM	latin1_swedish_ci	1.1 KB
survey b22		1	MyISAM	latin1_swedish_ci	1.1 KB
survey b22a		4	MyISAM	latin1_swedish_ci	2.1 KB
survey b23		1	MyISAM	latin1_swedish_ci	1.1 KB
survey b24		1	MyISAM	latin1_swedish_ci	1.1 KB
survey b25		1	MyISAM	latin1_swedish_ci	1.1 KB
survey b26		1	MyISAM	latin1_swedish_ci	1.1 KB

Figure 3 – The interface of PhpMyAdmin at RE-ARCHITECTURE® database (preliminary prototype)

First, the post-survey included more questions that could provide evidences on the raise of lifespan consciousness, after getting acquainted with RE-ARCHITECTURE®. For this reason, one table was created to store all **questions** (questions b) and a group of fourteen tables was created to log all answers provided by the users when filling in the **Pre-Survey** (survey b11:b16) and the **Post-Survey** (survey b21:26).

Second, the information available on the **website** in the introductory info boxes, first simulated in PowerPoint, was also converted into a table (site). Third, the database of components was complemented with three other tables; one regarding the **first** (tb05 (0-)) CI/SfB level, and other two regarding respectively the CI/SfB index of **materials** (tb05 (a) material) and the CI/SfB index of **works** (tb05 (A) work), describing how the component was constituted. These tables provided more dynamics into the database, as components can be ordered and filtered according to these specific parameters.

Fourth, the report was an application simulated in the conceptual prototype and materialised during the preliminary prototype. It comprised two tables; one listing the different **tools available** (tools available) and the other logging the list of results achieved by the users, when making use of the available tools.

When the preliminary prototype was finished, there were too many inconsistencies; which would certainly compromise the results of this doctoral research (*vide* Appendix 2). Eng. van den Brand agreed to cooperate and fix most complex incongruencies, while the researcher would fix the least complex ones. Eng. Peter van den Brand has also re-produced all applications, which had been simplified to the capacity level of the IT trainee. The framework of the final prototype functions with a total of sixty-six tables (*vide* Figure 4).

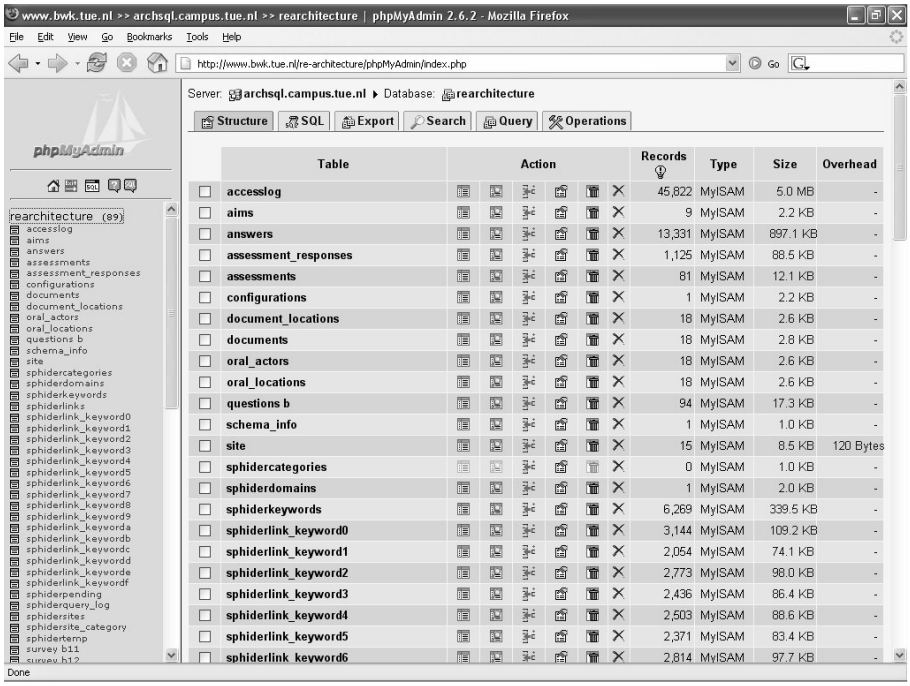


Figure 4 – The interface of PhpMyAdmin at RE-ARCHITECTURE® database (final prototype)

First improvement of the final prototype was the application to log all **workflow** data and store it in a table of the RE-ARCHITECTURE® database (accesslog). This application registered not only the workflow of the registered users; but, of everyone who would access the website. Second improvement was the introduction of a fourth type of tool, the "log book", to support the inventories and surveys undertaken during both pre-design and design stages.

Several tables were produced to implement the "log book" for twelve activities, within the theorised design process. Specifically, to support the activities within the analysis sub-stages (pre-design and design); documentary, oral and physical inventories; six tables were produced to list: the primary and secondary **documents** (documents); the primary and secondary **actors** (oral_actors); the primary and secondary **locations** (document_locations and oral_locations); and last, related to the physical inventory, the **categories** (survey_categories_pi) and **guidelines** (survey_guidelines_pi).

Similar tables were created to provide the **categories** and **guidelines** of the activities; within the synthesis sub-stages: environment, significance and condition surveys. Then, a last table would log all data inserted by the users, respectively identified per activity, categories and guidelines (surveys_responses).

The third increase of quality regards the application of the **forgotten password**. Not so technological, but very user friendly, this application would send an e-mail to the user (configurations) in case he/she had forgotten the password used to access RE-ARCHITECTURE®. Furthermore, the **search engine** has been also implemented, enabling the user to search for keywords of interest, within the content of all guidelines. The search engine required a total number of twenty four tables (*vide* Appendix 1).

Moreover, fourteen tables, produced during the preliminary prototype to log the **answers** of the users on the Pre-Survey and Post-survey, were converted into one single table (answers). Also the activities inherent in the Evaluation sub-stages were all joined in one single table (assessments), counting with one extra table to log all **assessment** results inserted by the users (assessment_responses).

In its final version, the framework of RE-ARCHITECTURE® became much more consistent and accurate. As aimed in the conceptual prototype, it surpassed the level of fixed database that simply supplies technical and useful data to its users. The framework of the final prototype not only supplies such expertise, but also requires the interest of the user to build his design process and register, step by step, all progresses achieved during his design developments.

5.3 Interface

The interface of RE-ARCHITECTURE® has been developed, with the aim to provide a "functionalistic", clear and consistent composition throughout the website; which users would be able to identify easily how to navigate through its menus and contents of interest.

Parallel to the process of evolution described in the production of the prototype's framework, its interface has also passed through three versions: the conceptual, the preliminary and the final prototype. The reference to the conceptual and preliminary versions will be made, together with the final version of the prototype; so that the evolution of the interface is clear. The structure of the interface was subdivided into six distinctive areas presented in the following chapters (*vide* Figure 5). Those are the:

1. Header (*vide* Chapter 5.3.1),
2. Top black menu (*vide* Chapter 5.3.2),
3. Top blue menu (*vide* Chapter 5.3.3),
4. Left menu (*vide* Chapter 5.3.4),
5. Content (*vide* Chapter 5.3.5) and
6. Footer (*vide* Chapter 5.3.6).

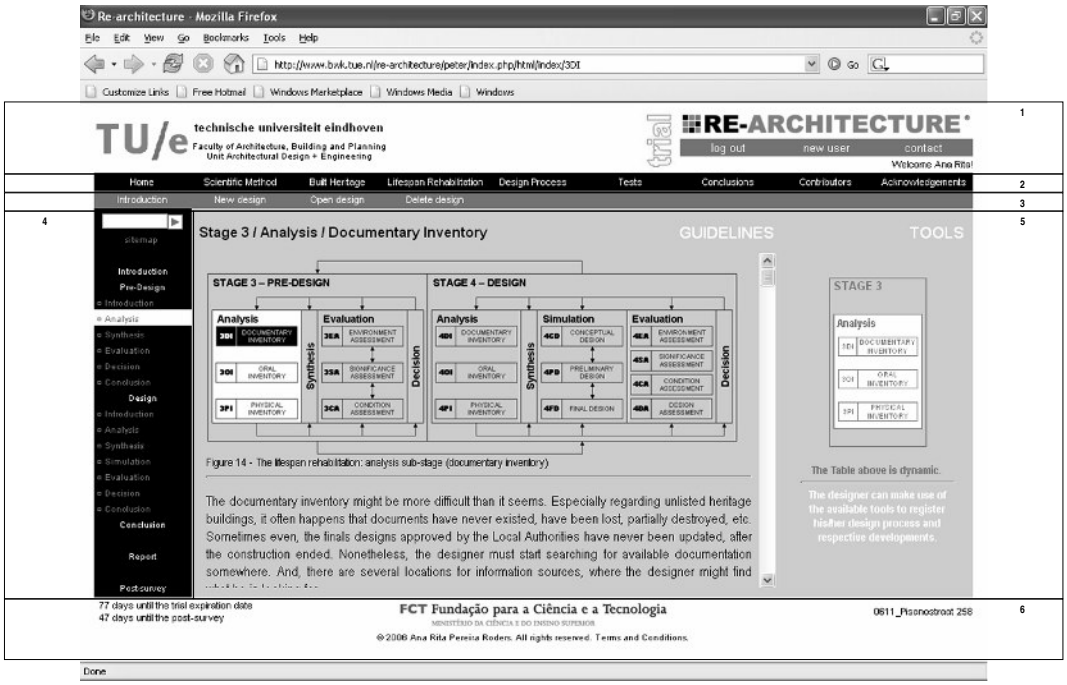


Figure 5 – RE-ARCHITECTURE®: The composition of the interface

5.3.1 HEADER

The **header** has two distinctive areas: the area aligned at the left and the area aligned at the right (*vide* Figure 6). The area aligned at the left contains the hyperlinked logo of the *Technische Universiteit Eindhoven* (www.tue.nl); the respective reference to the Faculty of Building and Planning and the Unit Architectural Design and Engineering, host institution of this doctoral research.

At the right, the user finds the hyperlinked logo of RE-ARCHITECTURE® (www.re-architecture.eu) and the top left blue menu, where the user finds two utilities: **login/logout**, **new user** and one text-based link **contact**. Whenever the user is logged in, a Welcome message, with the name of the user, appears below the top left blue menu. Except for the last one, the previous mentioned features are available on every page of the website.

In the conceptual stage the top left blue menu had more three utilities, than the preliminary and the final prototype. Those were: the report preview, report reset and sitemap. During the preliminary prototype the first two were already moved to the left menu and in the final prototype the sitemap was also moved to the left menu, below the search engine (*vide* Chapter 5.3.4).

5.3.1.1 NEW USER

THE BEGINNING OF A PROGRESSIVE JOURNEY

When aiming to use RE-ARCHITECTURE®, designers need to first register themselves as new users and fill in the required personal information, sub-divided in three stages. At the first stage (1/3), users are asked to fill in their e-mail, password, and repeat password (*vide* Figure 6). This information is quite important for future visits at the website, as users will have to fill it in, every time they want to login on RE-ARCHITECTURE®, so that the framework system recognises them and provides their respective information, submitted under their user code (*vide* Chapter 5.3.1.3).

They should also agree with the Terms and Conditions. Among other clauses, they should agree with the fact that their access to RE-ARCHITECTURE® shall be conceded for a temporary period of four months and that this doctoral research is authorized to use their personal information for characterizing the sample of users, as well as their work material to monitor their use of the developed prototype.[7]

Plus, they should also agree to fill in the Pre- and Post-Survey; which would allow the researcher to monitor their initial level of lifespan consciousness (Pre-Survey) and respective progress, after three months of use (Post-Survey). Their work flow, during the three months of use would also be objectively monitored, making use of process mining techniques (*vide* Appendix 8).

[7] Pereira Roders, A. et al. (2007) *RE-ARCHITECTURE: Reality or Utopia?*, Haupt, T. & Milford, R. (eds.) Proceedings of the CIB World Building Congress 2007: Construction for Development, Cape Town: CIB, p. 2619-2626

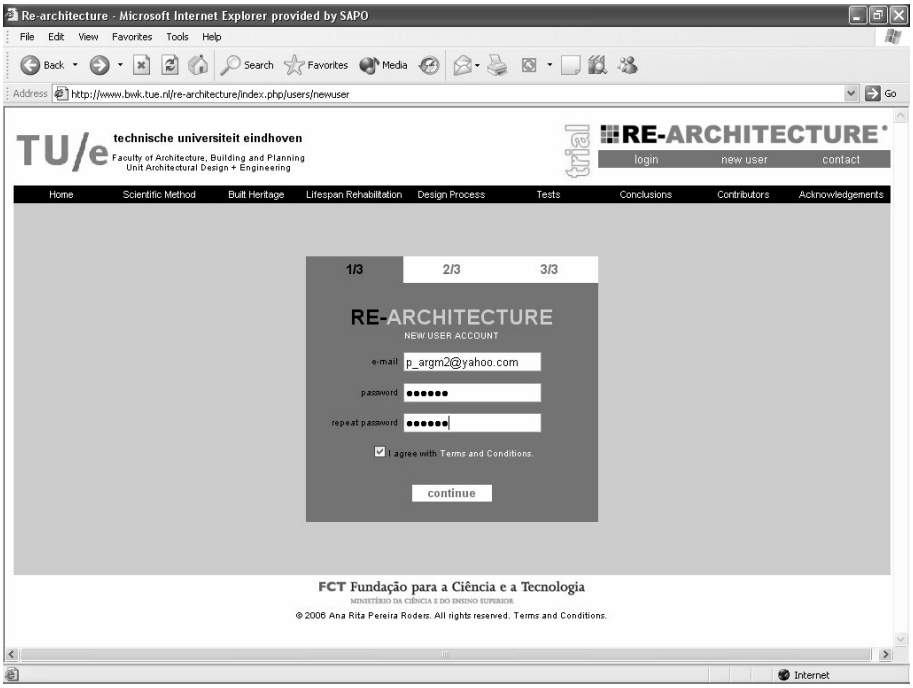


Figure 6 – RE-ARCHITECTURE®: New user 1/3

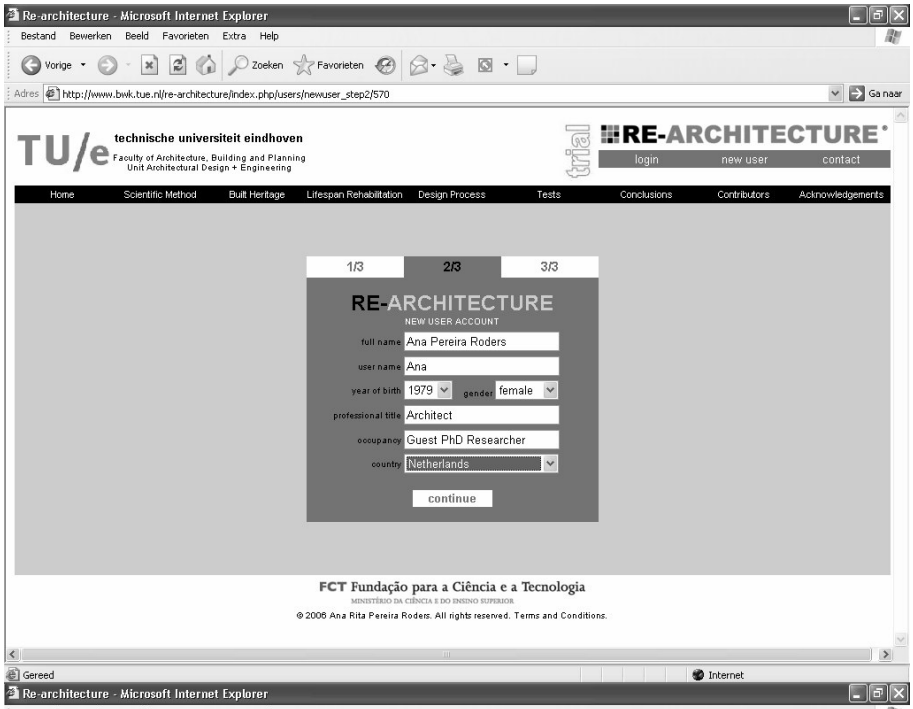
At the second stage (2/3), users should provide their full name, user name (the name to appear at the Welcome message), year of birth, gender, professional title (e.g. architect, engineer, building surveyor, etc.), occupation (e.g. designer, researcher, lecturer, etc.) and respective country (*vide* Figure 7). This information would help determining the different groups of users. The main difference in the final prototype is the third stage (3/3), where all users, are asked to fill in the Pre-Survey (*vide* Figure 8), "before exploring the RE-ARCHITECTURE® world".

5.3.1.2 PRE-SURVEY

THE METHOD TO TRACK THE USERS BEFORE THE STIMULUS

The Pre-Survey was created in the preliminary prototype to control the user's initial degree of lifespan consciousness. Therefore, the user would be asked to fill in the Pre-Survey before getting acquainted with RE-ARCHITECTURE®. When the results of the Pre-Survey would be compared with the results from the Post-Survey, undertaken after acquainted with RE-ARCHITECTURE®, approximately three months later; the differences between their arguments would support the researcher determining the effective contribution of RE-ARCHITECTURE® to the user's raise of lifespan consciousness.

Figure 9 illustrates the first step of the Pre-Survey, in the final prototype. First established in the preliminary prototype, its framework and consistency were considerably improved in the final prototype. Instead, its aesthetics and questions were mostly maintained.



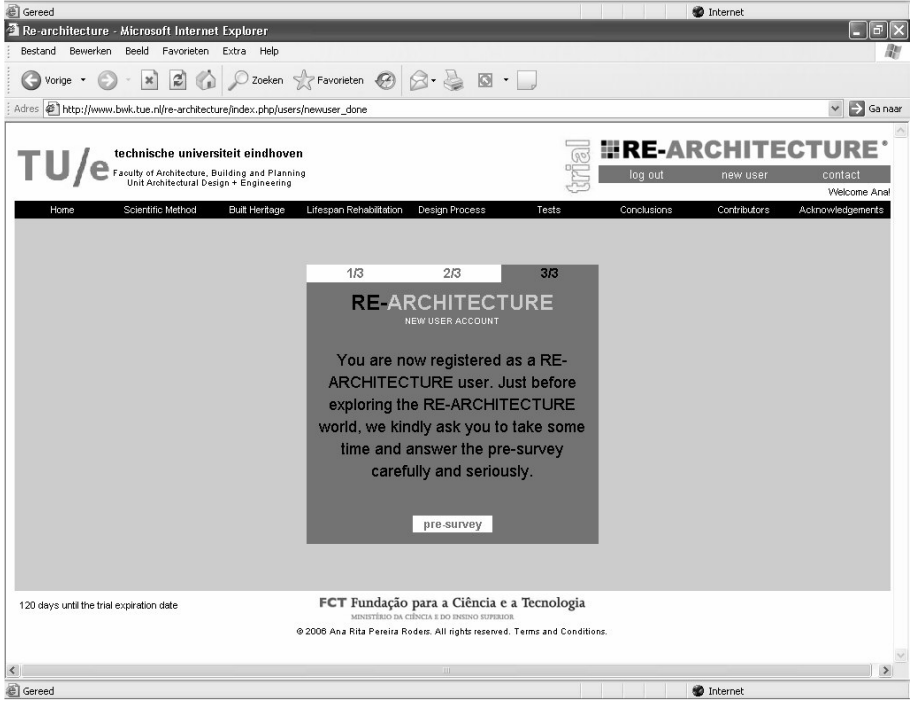


Figure 7 – RE-ARCHITECTURE®: New user 2/3

Figure 8 – RE-ARCHITECTURE®: New user 3/3

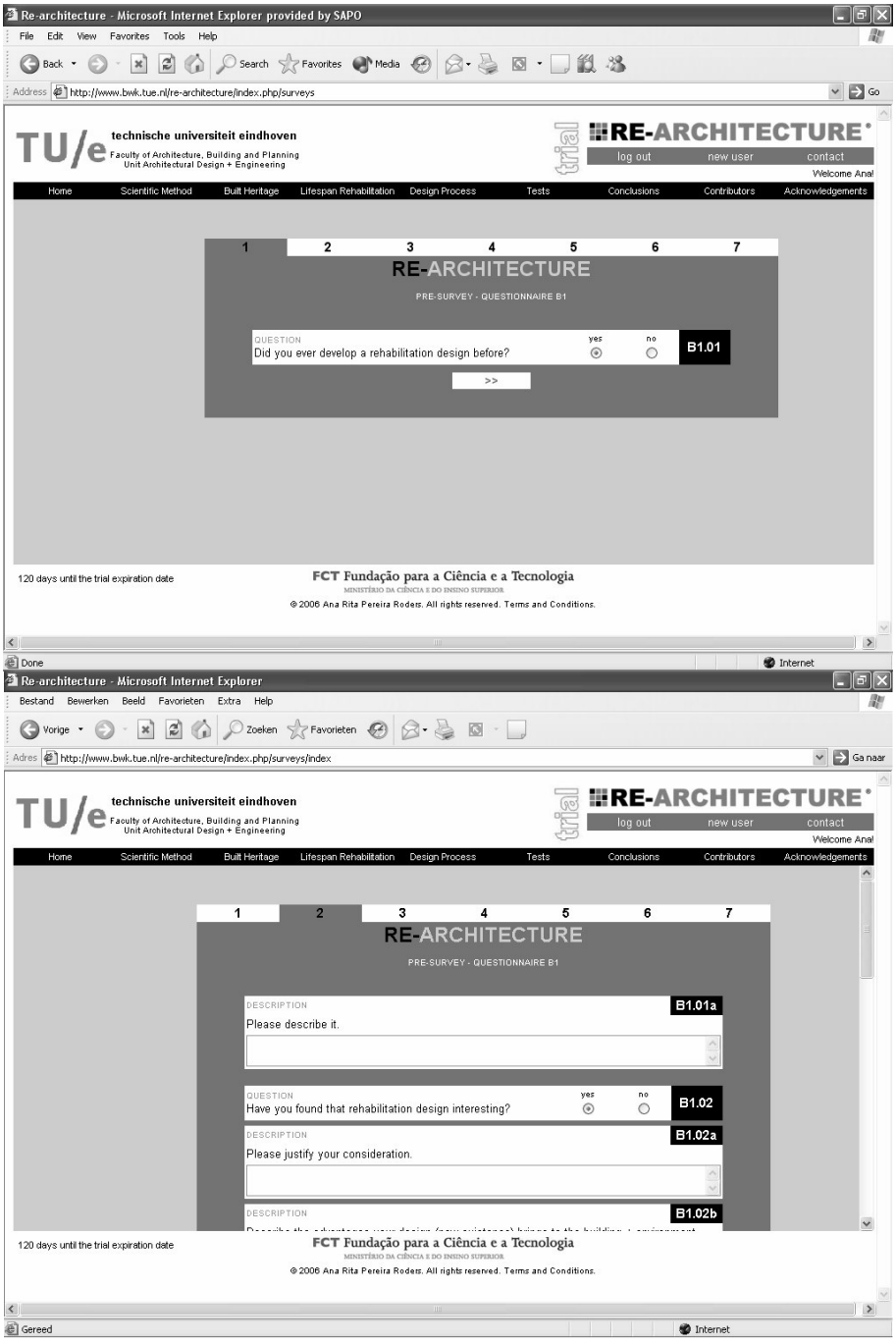


Figure 9 – RE-ARCHITECTURE®: Pre-Survey 1/7

Figure 10 – RE-ARCHITECTURE®: Pre-Survey 2/7

The first question of the Pre-Survey would ask the users about their earlier experience in rehabilitation designs. When answering positively, the users would be submitted to the second step of the questionnaire, subdivided in seven steps, and asked to describe one representative rehabilitation design (*vide* Figure 10). Inversely, when answering negatively, users would pass immediately to the seventh and last stage and only answer about their expectations towards RE-ARCHITECTURE® (*vide* Figure 11).

The style of the interface chosen for the Pre-Survey (questionnaire B1) was similar to the one chosen for the Post-Survey (questionnaire B2). The researcher tried to maintain the same style used previously in the paper-based questionnaires A1:A3.

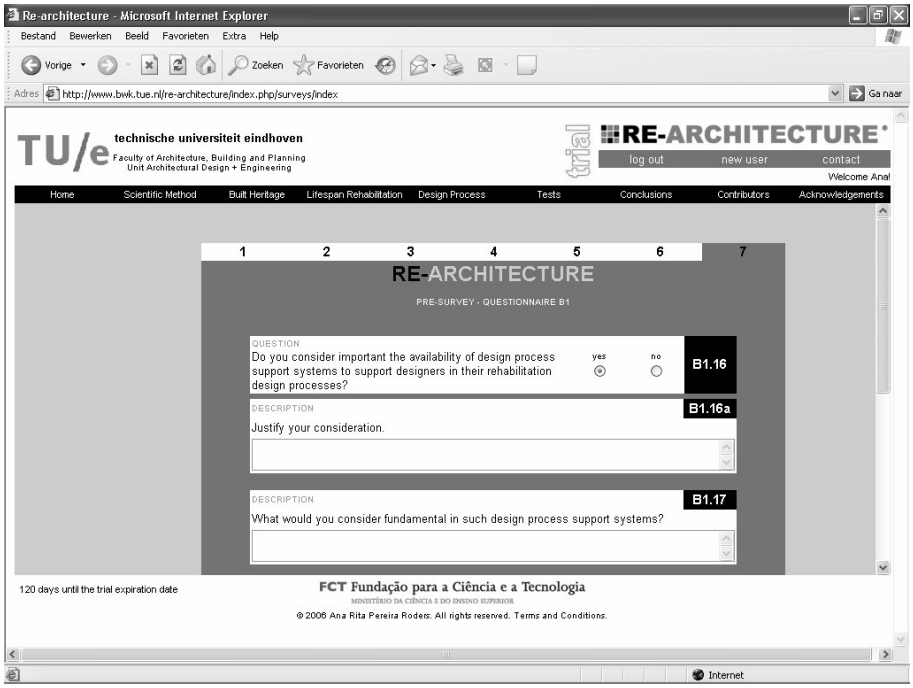


Figure 11 – RE-ARCHITECTURE®: Pre-Survey 7/7

5.3.1.3 LOGIN / LOGOUT

THE PROGRESSIVE JOURNEY

After filling in the Pre-Survey, users would be redirected to the content of RE-ARCHITECTURE® and their access would be automatically granted for four months. Therefore, the login / logout system allows the user to access it on a personal level.

Unless the user provides the information that allows him to access RE-ARCHITECTURE® – the e-mail address and password with which he first registered – to other users, sharing the same work environment is not possible. RE-ARCHITECTURE® aimed to provide a private environment where the user can store all design process-related information with security.

The login system has two more utilities: **remind me next visit**, the utility that allows the computer to remember the e-mail and the password of the user on a next visit, as long as he selects that option on the present visit and visits RE-ARCHITECTURE® on the same computer; and **I forgot my password**, the utility that sends an e-mail to the user with the registered password, in case he has forgotten his own password (*vide* Figure 12).

Below the utility **I forgot my password,** a new user can also find a shortcut to the **new user** utility.

5.3.2 TOP BLACK MENU

Similar to the structure that organised the production of this doctoral research, the top black menu consists of nine text-based links. They provide to the new user, before registering, access to some basic information regarding RE-ARCHITECTURE research: **Home**, **Scientific Method**, **Built Heritage**, **Lifespan Rehabilitation**, **Design Process**, **Tests**, **Conclusions**, **Contributors** and **Acknowledgements**.

This basic information is readable in an info box when clicking the respective button in the centre of the interface. It is accessible from every location within RE-ARCHITECTURE®. The idea of providing basic information, regarding the doctoral research to the new users, before registering, has been there since the conceptual prototype.

The only major change between the preliminary and the final prototype (*vide* Figure 13) was that the Home page became a secondary page and the logo gained a new place at the **Start** page, with the development of a RE-ARCHITECTURE® logo, to be officially registered as a European trademark.

Home provides a brief introduction to RE-ARCHITECTURE® as a design process support system that "aims to effectively assist architects and architecture students, interested in achieving higher levels of lifespan consciousness, when developing or simulating rehabilitation interventions in built heritage".

Scientific Method explains the specific research method followed during this doctoral research "with a first phase of design theory (problem field, taxonomy); then, a second phase of design product (development, production, tests); and finally, a third phase of design results (theory and product validation, assumptions, recommendations)."

Built Heritage and **Lifespan Rehabilitation** present the two main definitions that have guided the production of such design process support system. **Built heritage** as all buildings older than 25 years, "potential suppliers of manufactured resources, which should not be wasted without an accurate technical assessment"; and **Lifespan Rehabilitation** as the rehabilitation that, independent of classification, "respects the building's past, present and future"; reflected on the decisions involving what and why to subtract, remain and add.

Design Process provides a brief elucidation to those who might be interested in registering as a new user, describing the theorised design process as a "coordinated set of stages, which aims to improve the traditional experience-related approach; where design problems are solved, based on individual practice or idealism, to a more conscious and theory-based approach; based on technical knowledge and attentive to potential alternatives."

Tests explains the two different stages where architecture students, in both the Netherlands and Portugal; have been challenged to "pre-test the research theory and product model, in 2005/2006; and to test the research product, in 2006/2007"; this last stage, together with a limited number of architectural offices.

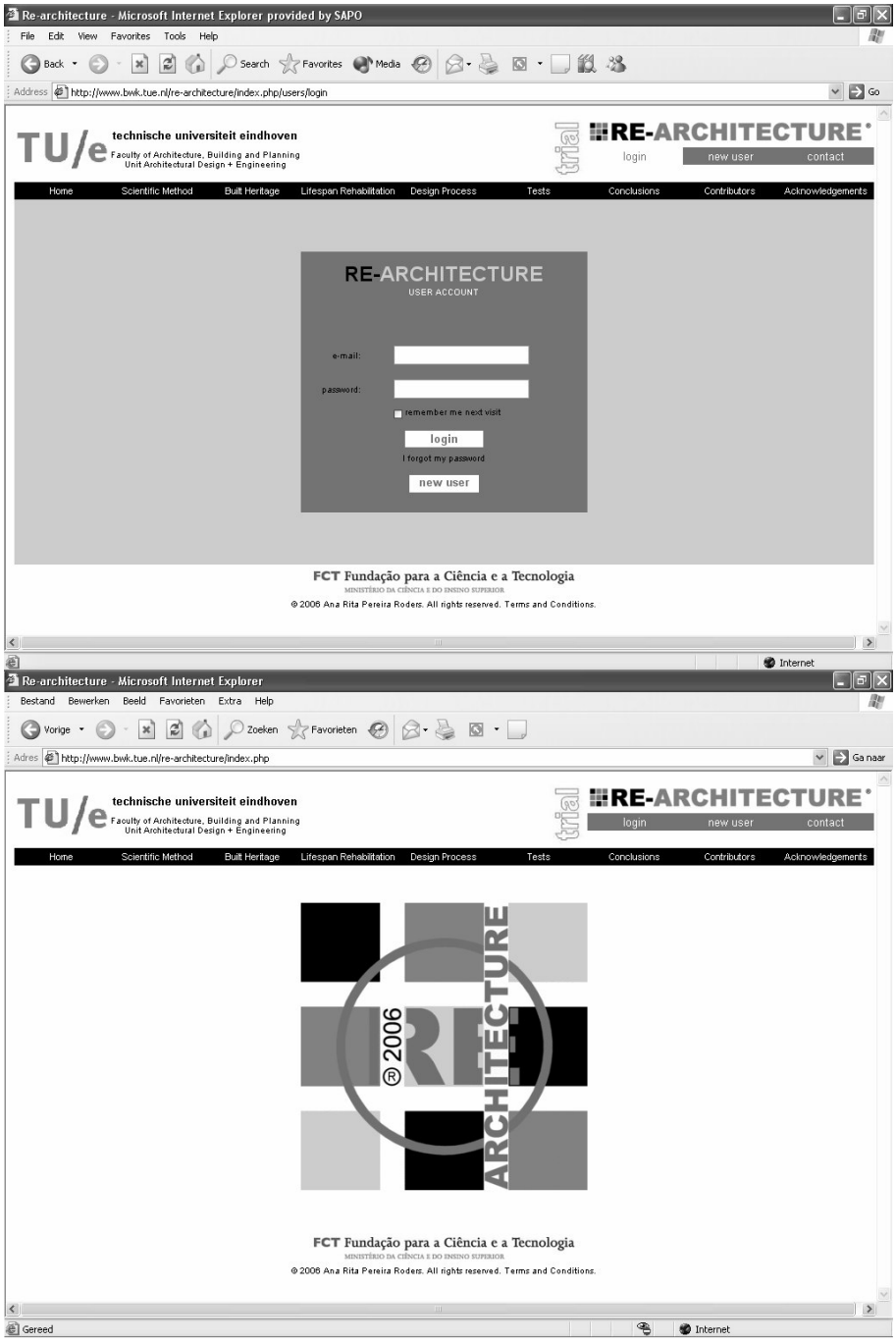


Figure 12 – RE-ARCHITECTURE®: Login

Figure 13 – RE-ARCHITECTURE®: Startpage

Conclusions emphasises on the aims of this doctoral research to "contribute, directly to the quality of rehabilitation designs, and indirectly to the preservation of both natural and built heritage". But, also reminds the responsibility of the designer to "effectively raise such lifespan consciousness".

Contributors list the group of experts involved in the production of RE-ARCHITECTURE®: first, the researcher; second, the supervisors, third, the IT experts, trainee, and tutor; and fourth, the student assistant and final reviser.

Acknowledgements lists the several Institutions involved in this doctoral research. The first nominated are the Foundation for Science and Technology and Eindhoven University of Technology (TU/e). Second, *TU/e Docu-center Bouwtechniek,* which provided data for the database of components; together with the publishers *Stichting Bouwresearch*, James and James Science Publishers, Blackwell Publishing Ltd. and Taylor & Francis Group. Moreover, there are also more acknowledged companies of building components (accessible in PDF), whose figures were selected to be integrated in the database.

5.3.3 TOP BLUE MENU

After filling in the Pre-Survey (at the first visit) or every time after logging in, the user faces the emergence of a secondary menu, below the top black menu, named top blue menu. This menu provides to the user one text-based link: **Introduction** and two utilities: **New design** and **Open design**.

Introduction invites the user to create his design processes; but recommends "the new user to first go through the universe of the guidelines, before starting to use the available tools. The frequent user however, will mostly make use of the available tools, to register his/her design process and respective developments."

At the first visit, when no new design has been created, and the user just finished his Pre-Survey, an acknowledgement message emerges; explaining that from that moment on, the user is entitled to create his "first design process (new design) and explore the RE-ARCHITECTURE world." It also reminds that on next visits, users can either "create new design processes or go further with the previously created design processes (open design)".

There are only few differences between the top blue menu from the conceptual, preliminary and final prototype (*vide* Figure 14). In the conceptual prototype, there were more utilities available. However, these utilities should only be available when a design is open (e.g. close design).

Furthermore, with the removal of the text-based link **User Survey** (conceptual prototype) and the removal of the text-based link **Contact us** (preliminary prototype) of the left menu moving to the header, there was no logical motive to have it there, available without any text-based links. The same rule goes for the search engine located in this menu; as without a design process opened, it should not be possible yet to search for keywords.

The utility **Close design**, from the conceptual prototype, is not to be found in the top blue menu, from the final prototype; even when the user has already accessed one of his design processes. It was considered irrelevant as the user would not need to use it, when moving to another design and to exit he could simply logout. The only utility that does emerge, whenever the user accesses one of his design processes, is the **Delete design**.

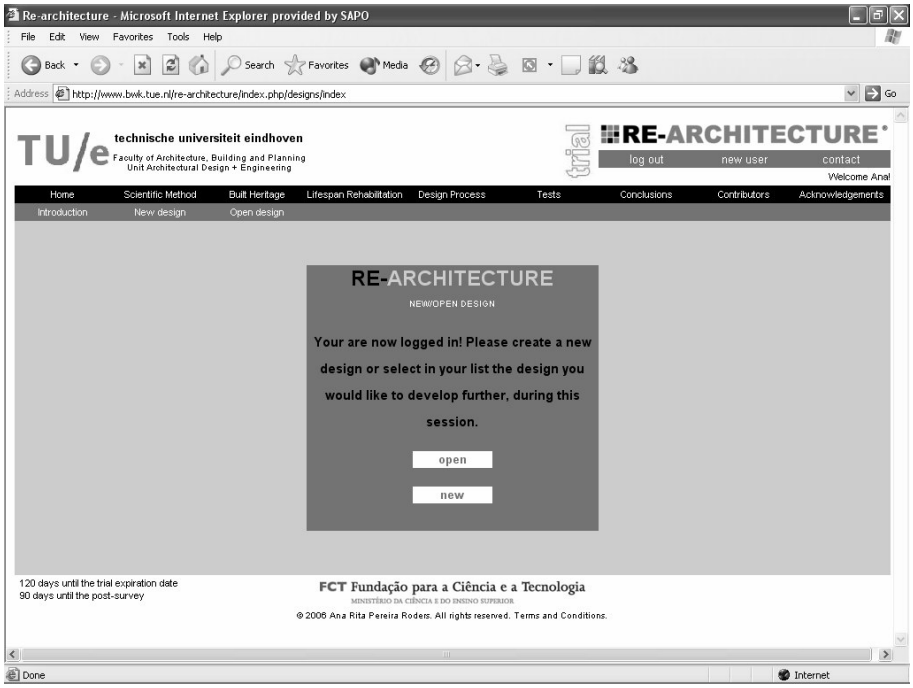


Figure 14 – RE-ARCHITECTURE®: New / Open design (final prototype)

5.3.3.1 NEW DESIGN

THE BEGINNING OF A UNIVERSE OF DESIGN PROCESSES

When aiming to create a new design, the user has to fill in some basic information; so the system can create a new entry in the database, connected to the user information. There is no limit for the number of design processes a designer can create. Moreover, no other user than the one that created the design process, may have access to his own work environment and respective design process results.

As indicated in the Terms and Conditions, it is the responsibility of each user to control exactly who has access to his design processes. Accordingly, "The user is not only responsible for maintaining the confidentiality of his/her password and account; but also, for any activity that might occur under his/her account."

The system will register each entry and will join three fields of information: year (2004), month (December) and address (Pisanostraat 258), to provide the user with a code for each design process (0412_Pisanostraat 258). This code shall always be visible at the right side of the footer; so that the designer does not get confused; whenever working in more than one design process in the same period.

Besides year, month and address, the user is also asked to fill in other fields of information, such as the country and the city where the building is located (*vide* Figure 15).

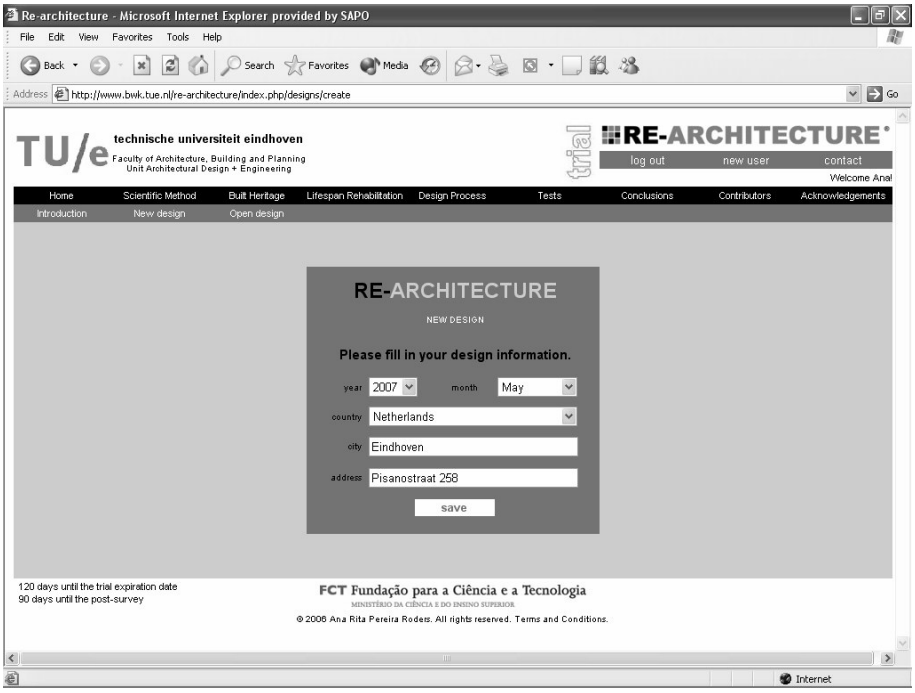


Figure 15 – RE-ARCHITECTURE®: New design (final prototype)

5.3.3.2 OPEN DESIGN

THE UNIVERSE OF DESIGN PROCESSES

Whenever the user is not willing to create new designs, but just to login and open a design which is being developed at the moment without further interruptions, he can just select the **Open Design** utility and choose the design of interest among the list of designs. Some users might have a long list of design processes in which they are working simultaneously; others may be only be working on one design process at a time. It all depends on the users and their work methods.

The **Open design** utility suffered no evolution since conceptual prototype. It has always been there in the way it is presented, providing a centralised info box, where the available design processes would be listed for the user.

Figure 16 illustrates the final prototype and the respective list of design processes available to be opened by this specific user.

When selecting the design process of interest, the user finally accesses the whole design process which consists of guidelines and tools (*vide* Figure 17). From this moment, also the Left menu emerges together with all its inherent utilities. But, these shall be further explained in the following Chapter 5.3.4.

By opening the design process; the user is in fact entering the RE-ARCHITECTURE® world. In earlier presented stages, most procedures were officious and not design process related. From this moment, the work environment is available, personal to each user.

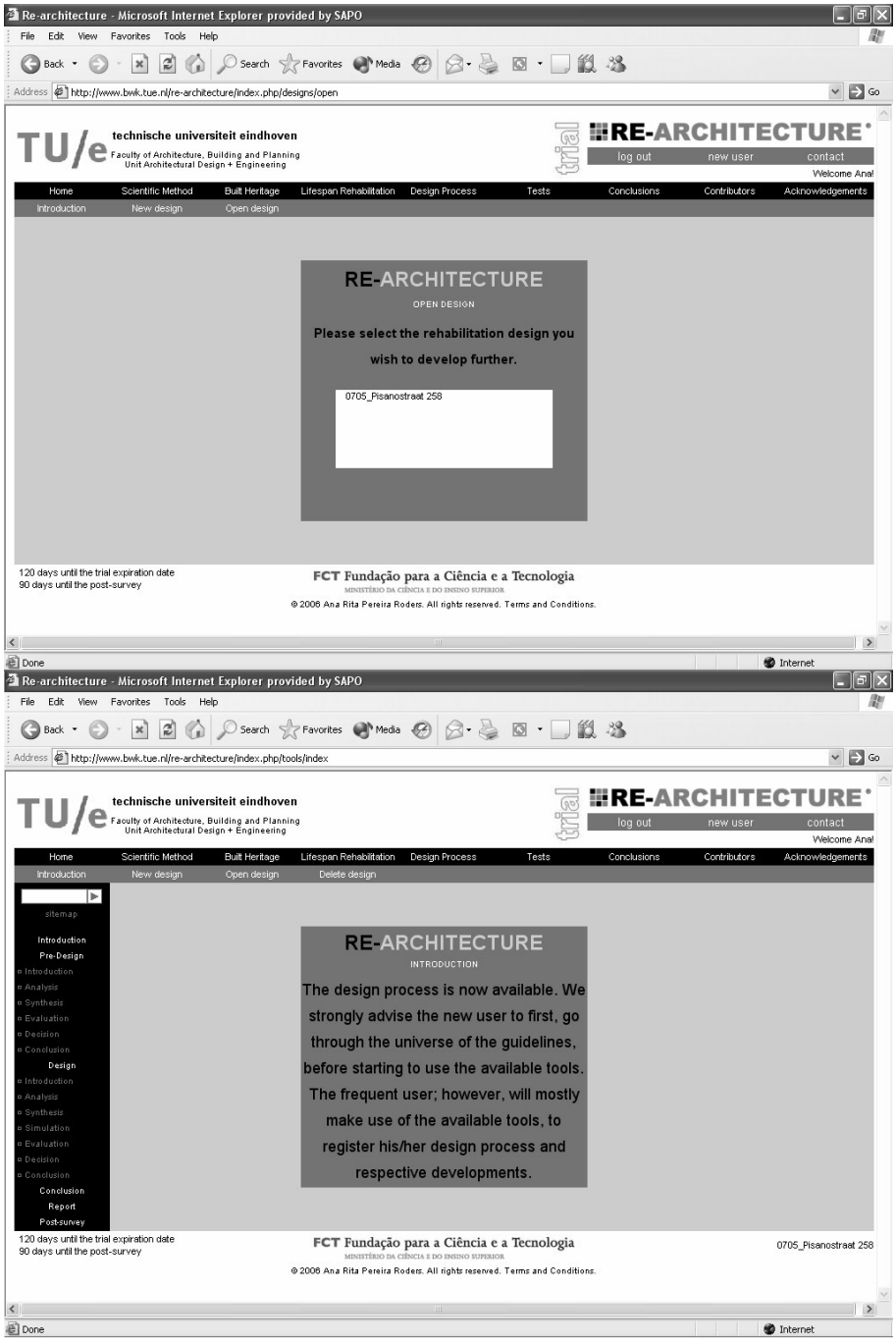


Figure 16 – RE-ARCHITECTURE®: Open Design

Figure 17 – RE-ARCHITECTURE®: Introduction

5.3.4 LEFT MENU

The left menu provides access to five fundamental utilities: the **search engine**, which promptly finds the keywords of interest throughout the guidelines, the **sitemap** providing the global structure of the guidelines, the **main navigation system** and respective links to each sub-stage and activity of the theorised design process, the shortcut for the **report system** and the link to the **Post-Survey**.

Except for the report system, further explained in Chapter 5.3.5.2, the interface of all other four utilities shall be illustrated in the following chapters. There, regarding one utility after another, the differences between the distinctive interfaces, along the three prototypes shall be particularly identified and illustrated.

5.3.4.1 SEARCH ENGINE

THE MECHANICAL DISCOVERY

The search engine is the first utility of the left menu; located right at the top of the menu. This utility was simulated in the conceptual prototype and implemented in the final prototype. As the guidelines would be opened as PDF document in the preliminary prototype, there would be no need for the production of a private search engine; since the program Adobe Acrobat Reader provides that function already among its list of utilities.

Figure 18 illustrates the search engine of the final prototype. The user writes the keyword(s) of interest (e.g. values) in the white box and clicks on the arrow on the right, to go further. Then, a new page opens in the content area with another white box and all the links listed, to the pages within the universe of guidelines which contain the relevant keyword(s) that the engine has found.

5.3.4.2 SITEMAP

THE MANUAL DISCOVERY

The sitemap is a manual version of the search engine. Like the table of contents of a book, the sitemap provides to the user the full structure of the html pages and respective links to re-direct the user straight to the one he is interested to visit and read its content; within the universe of guidelines. Similarly to the search engine, the sitemap has been part of the interface since its simulation in the conceptual prototype; but, was only implemented in the final prototype (*vide* Figure 19).

First, the text-based link to the sitemap was located at the header, next to the login / logout utilities (conceptual and preliminary prototype). However, the researcher has decided to relocate it below the search engine, because there was no need to have the sitemap always accessible, especially when the user has not been logged in yet and being enabled of free access to all guidelines and tools.

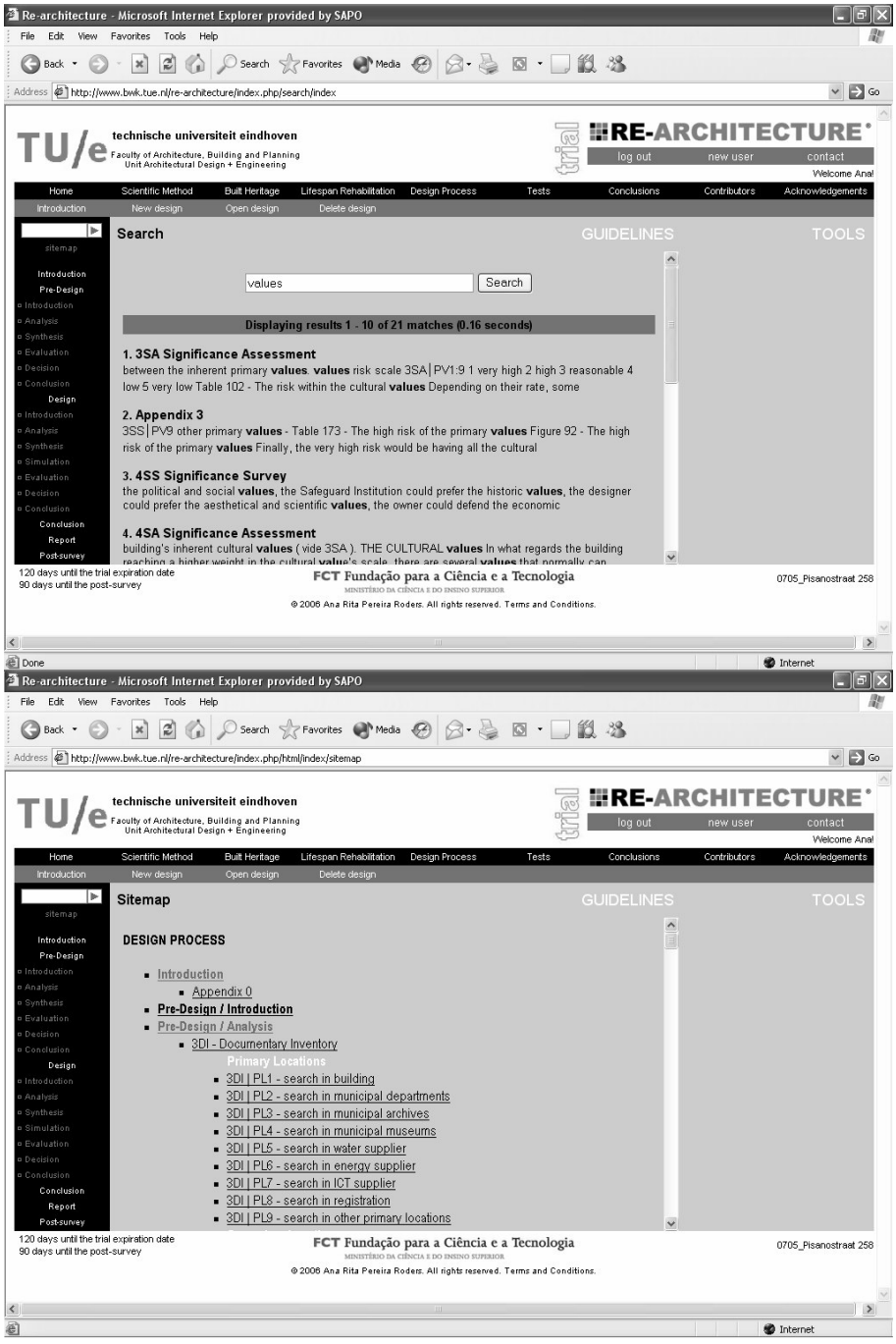


Figure 18 – RE-ARCHITECTURE®: Search engine

Figure 19 – RE-ARCHITECTURE®: Sitemap

5.3.4.3 MAIN NAVIGATION SYSTEM

THE THEORISED DESIGN PROCESS

The main navigation system comprises a set of text-based links which redirect the user to the pages of the various sub-stages and activities from the theorised design process.

In the conceptual prototype there were respectively eleven text-based links: the **Introduction**, the stage **Pre-Design** with its respective sub-stages of **Analysis**, **Synthesis**, **Evaluation**, and **Decision / Report**; the stage **Design** with its respective sub-stages of: **Analysis**, **Synthesis**, **Simulation**, **Evaluation**, and **Decision / Report.** Moreover, a kind of pull-out menu was simulated as a sub-navigation system that would open as a white window, when pointing on the respective item from the main navigation system.

This secondary navigation system, which had not been produced in the preliminary prototype, but only in the final prototype (*vide* Figure 20), would lead the user to the activities within each respective sub-stage. For example, in the Analysis sub-stage, the user would be able to find the text-based links to the Documentary Inventory, the Oral Inventory and the Physical Inventory. The main difference between the conceptual and the final prototype is, that more five text-based links were introduced to the **Introductio**n and **Conclusion**, of both Pre-design and Design stages, to the overall **Conclusion**; and a shortcut to the **Report** utility (*vide* Chapter 5.3.5.2).

5.3.4.4 POST-SURVEY

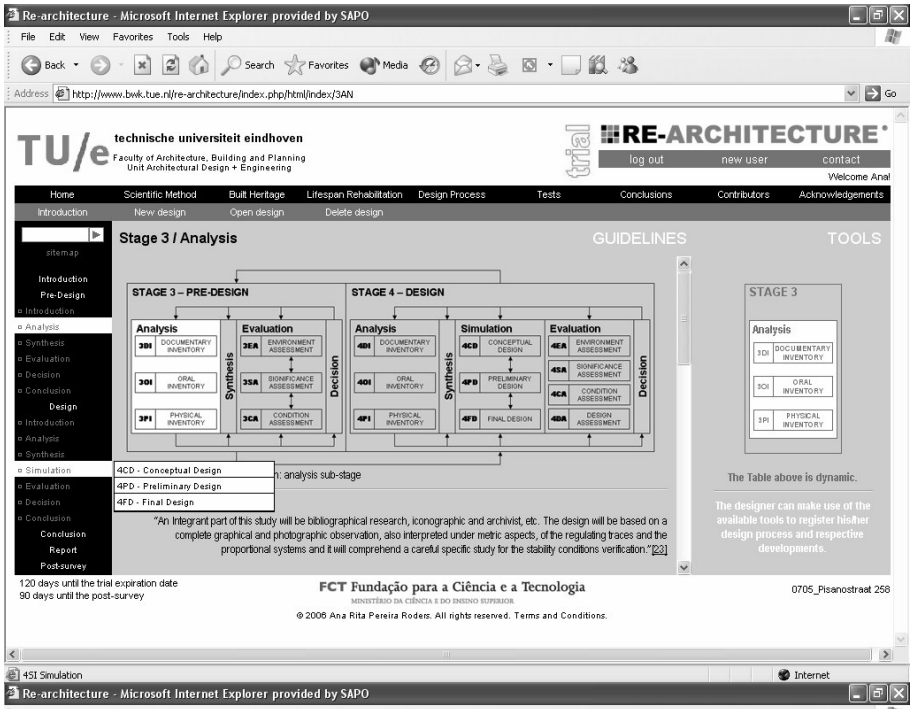
THE METHOD TO TRACK THE USERS AFTER THE STIMULUS

As earlier explained, when first simulated in the conceptual prototype, the Post-Survey exclusively aimed to assess RE-ARCHITECTURE®; its framework, interface, content, most/least useful utilities and the degree of efficiency of RE-ARCHITECTURE® supporting the implementation of lifespan ideologies; through the opinion of its users.

Similar to the first question of the Pre-Survey, the first question of the Post-Survey asked the users about their experience in rehabilitation designs, but now supported by RE-ARCHITECTURE®. When answering positively, the users would be submitted to the second step of the questionnaire, subdivided in nine steps, and asked to describe one representative rehabilitation design (*vide* Figure 22). Inversely, when answering negatively, users would pass immediately to the eighth stage and only answer about their consideration towards RE-ARCHITECTURE® (*vide* Figure 23).

Only later, during the production process of the preliminary prototype and few meetings with field experts, the Post-Survey became more complete, ending in the final prototype, with a total number of nine steps; comprising twenty-one main questions and twenty-eight sub-questions (*vide* Figure 21).

Different from the Pre-Survey, which would have to be answered as a pre-requisite to the access of the full content of RE-ARCHITECTURE®, the infill of the Post-Survey would have to be taken forward, voluntarily by the user, after using it for more than three months. Several strategies were developed and implemented to remind the user about the Post-Survey. Those were: the countdown of the post-survey / trial deadlines at the right side of the footer (*vide* Chapter 5.3.6), the warning message when logging in and the sending of a reminder e-mail, during the fourth and last month of use.



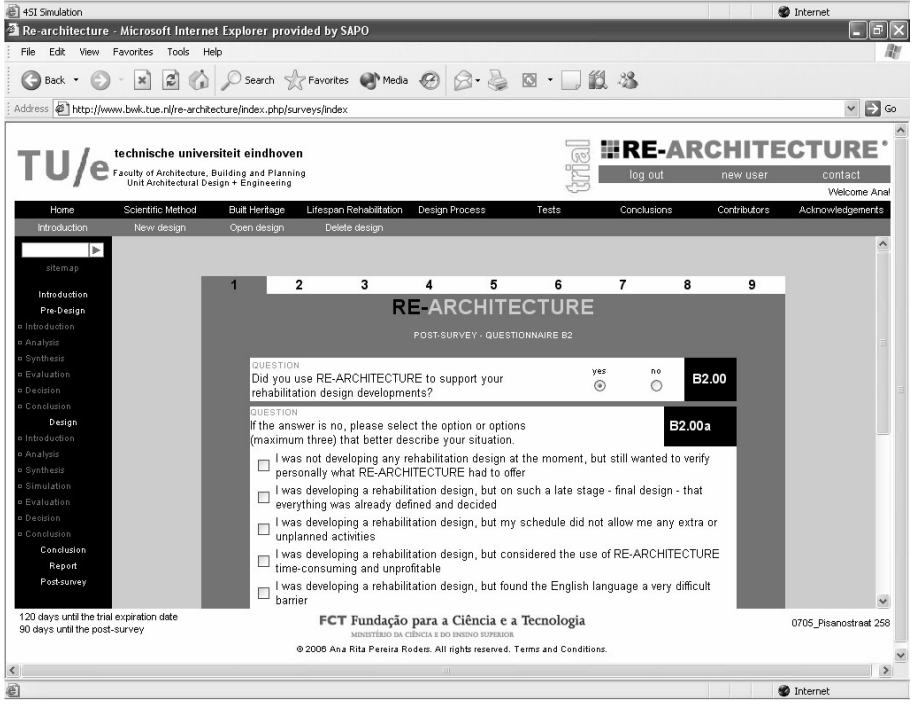


Figure 20 – RE-ARCHITECTURE®: Main navigation system

Figure 21 – RE-ARCHITECTURE®: Post Survey 1/9

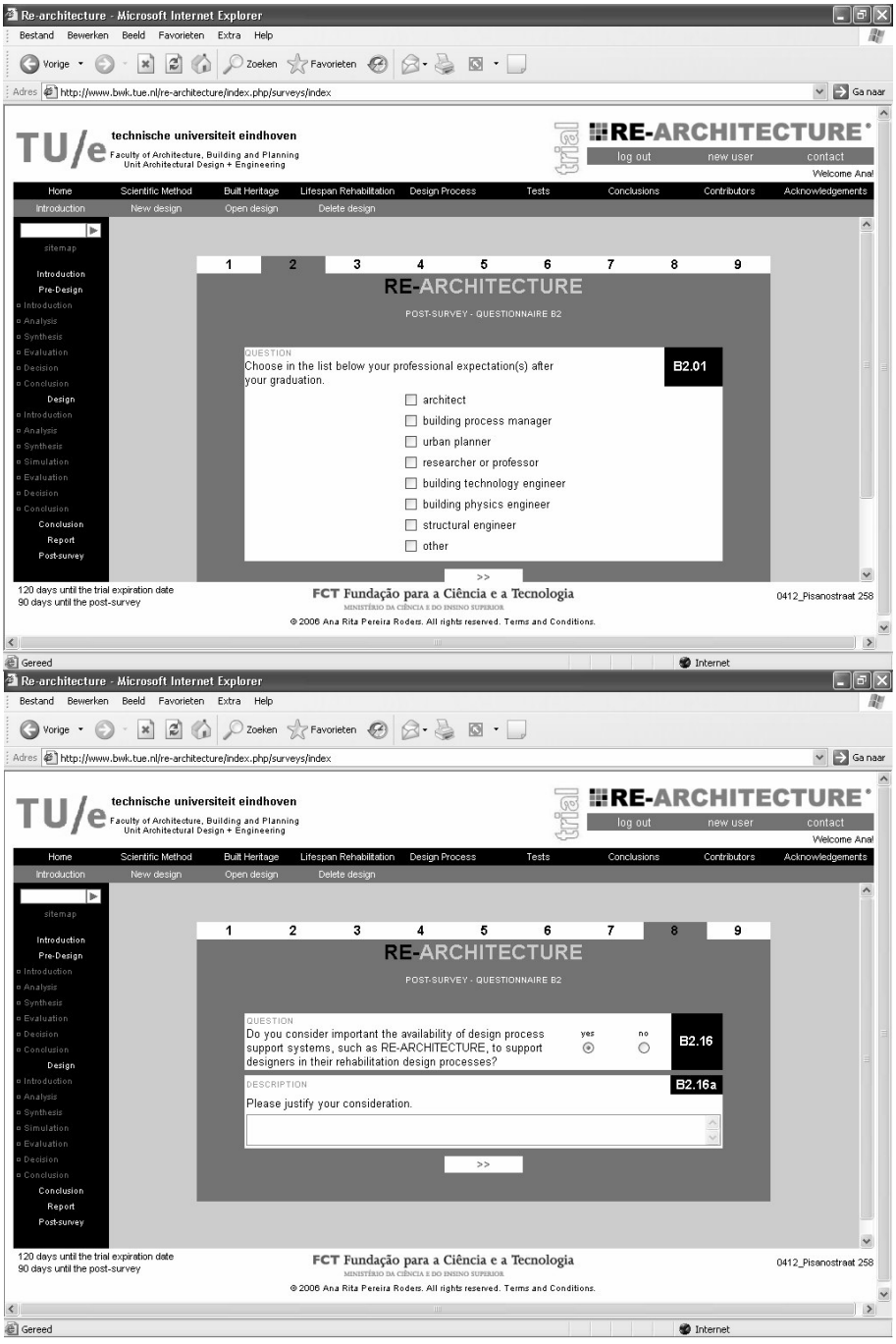


Figure 22 – RE-ARCHITECTURE®: Post Survey 2/9

Figure 23 – RE-ARCHITECTURE®: Post Survey 8/9

5.3.5 CONTENT

The **content** is the central area of the interface where all selections become accessible to the user; including the guidelines and tools. In the conceptual prototype, the model of the theorised design process was at the top of the page, followed by the theory (texts, tables and figures) below, explaining and illustrating each stage, sub-stage and activity. In the preliminary prototype, the theory became accessible through text-based links, which would open de respective PDF documents.

The final prototype evolves from the preliminary prototype, but brings back some ideas from the conceptual prototype (*vide* Figure 24). One attribute that has always remained is the model of the theorised design process, highlighting the stage where the user is. To facilitate the understanding of the importance of the guidelines related to the tools, and to facilitate its usage; the researcher has decided to divide the content in two distinctive areas: the **guidelines** (*vide* Chapter 5.3.5.1) and the **tools** navigation system (*vide* Chapter 5.3.5.2), respectively at the left and the right side of the content area.

Basically, this means that, whenever clicking on the various stages, sub-stages and activities available in the left menu, the user would perceive simultaneously the respective guidelines and tools available for each stage, sub-stage and activity. Moreover, whenever he would select a tool at the **tools** navigation system, the content area at the left side – normally reserved for the guidelines – would provide interface of the selected tool.

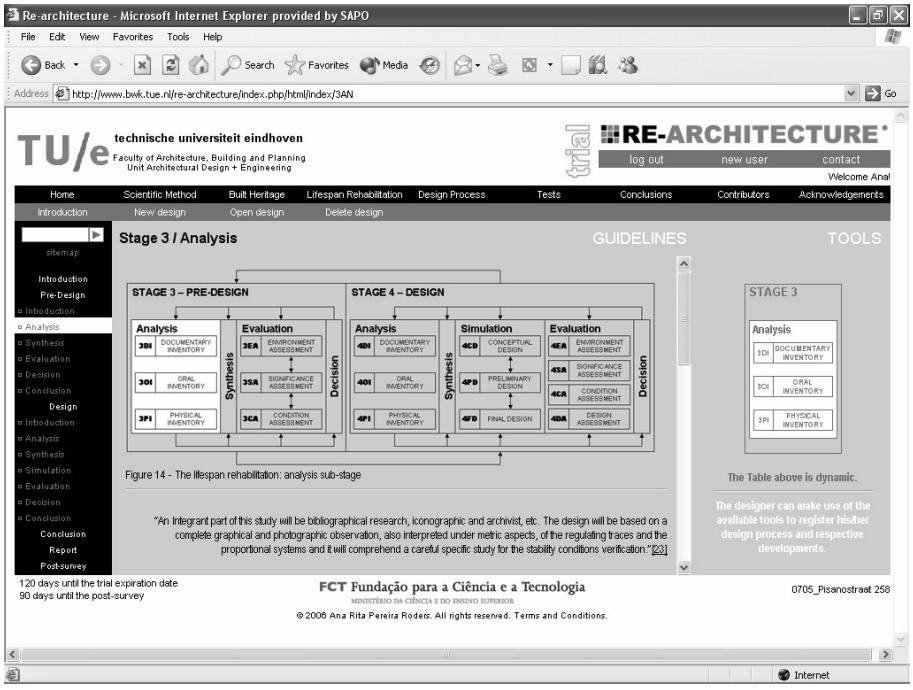


Figure 24 – RE-ARCHITECTURE®: Content

5.3.5.1 GUIDELINES

THE THEORETICAL GUIDANCE

The universe of the guidelines and inherent technical knowledge is fundamental for the users of RE-ARCHITECTURE®, especially in their initial period. Otherwise, when starting first by the tools, the user can get the wrong impression that the theorised design process is too complex and difficult. When consulting the guidelines, the user can get acquainted with the respective fundamental parameters, theorised in each stage, sub-stage and activity.

Then, the user just has to determine how detailed his design process will be and start. Even if the theorised design process describes the ideal stages and respective fundamental parameters; the user can decide which ones to survey and access.

To provide a clearer impression of a visit to the guidelines, the researcher chose an example from the Analysis sub-stage (3AN). When initiating it, the user could visit the guidelines available to sustain the Documentary Inventory (3AN | 3DI) and read what is theorised about it (*vide* Figure 25). While scrolling through the guidelines, the user shall verify that there are always specific parameters, ordered according to the decimal structure (1:9), illustrated in dynamic tables (*vide* Figure 26). These parameters are very important, as they are also used in the tools that sustain these specific activities.

In this case, the primary locations are the illustrated parameters. As earlier referenced, most of those tables are dynamic and the user can click further and learn more about the selected parameter. Figure 27 illustrates the case when the user is interested in the primary location, Energy supplier (3DI | PL8).

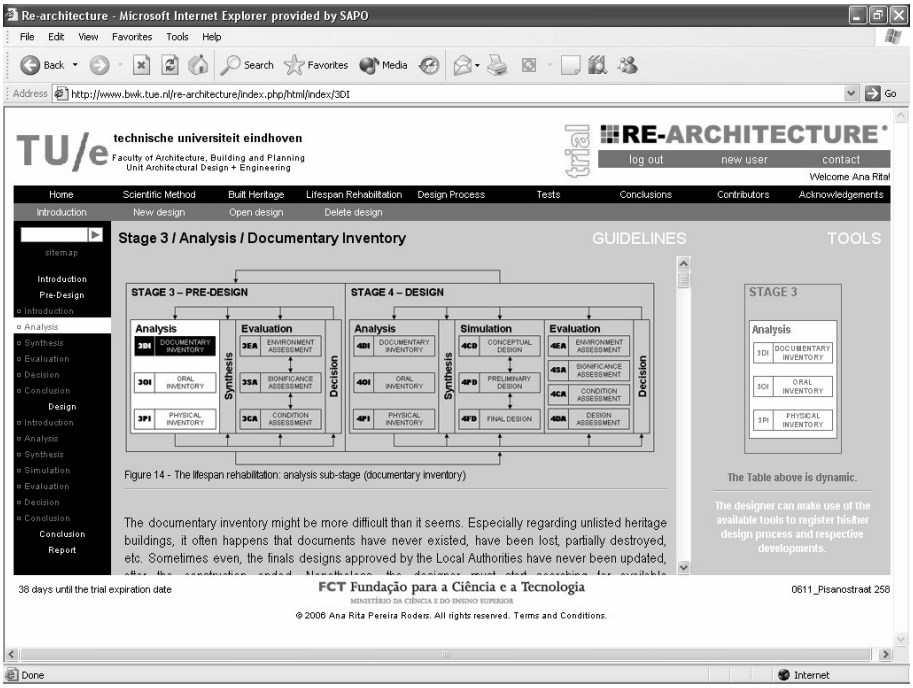


Figure 25 – RE-ARCHITECTURE®: Guidelines / Documentary Inventory (3DI)

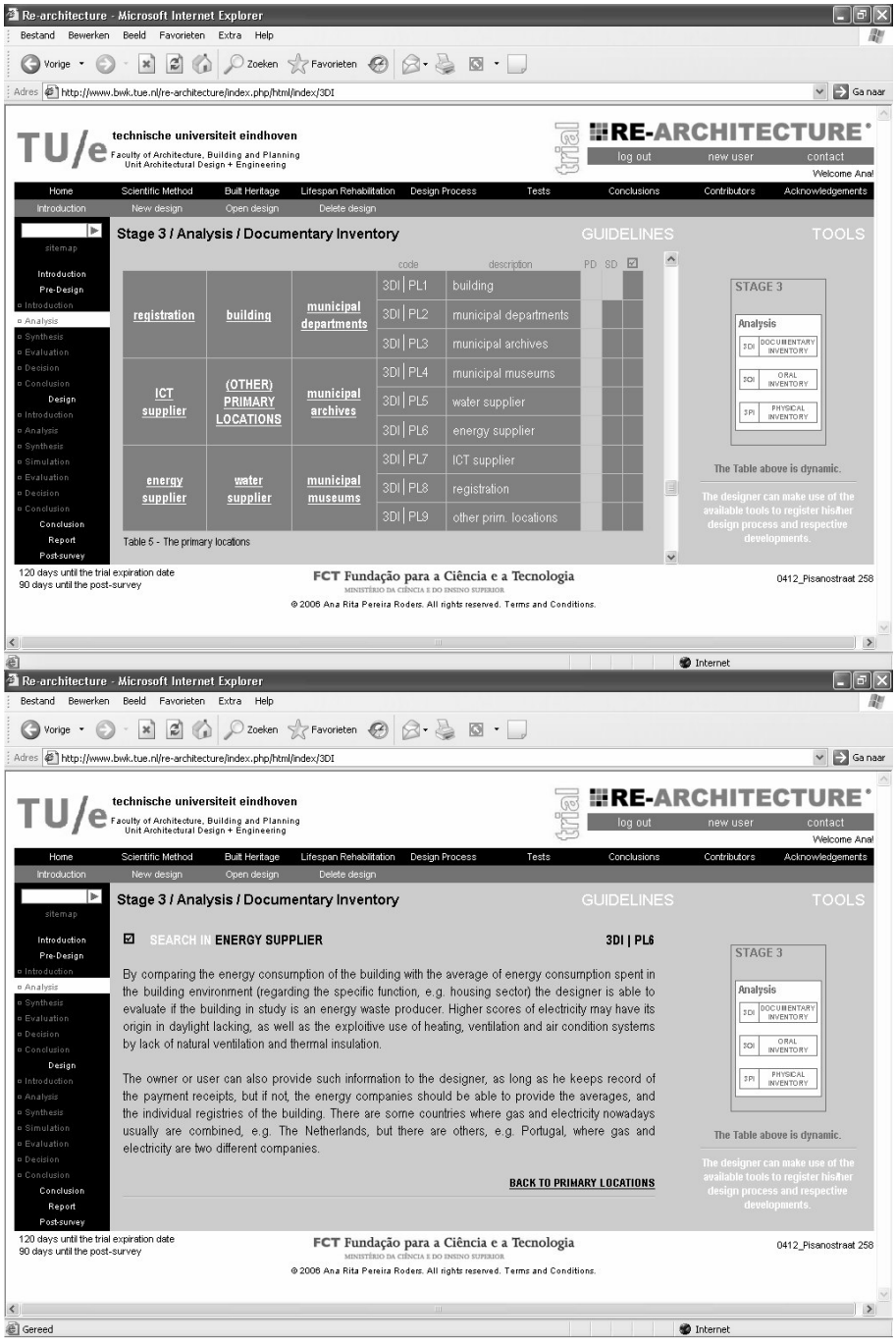


Figure 26 – RE-ARCHITECTURE®: Guidelines / Primary Locations (3DI | PL1:PL9)

Figure 27 – RE-ARCHITECTURE®: Guidelines / Energy Supplier (3DI | PL8)

5.3.5.2 TOOLS

THE PRACTICAL SUPPORT

The tools were produced to support the implementation of the theorised design process, into the daily activities of the designers who became RE-ARCHITECTURE® users. Four different types of tools were developed and produced to support specific activities: the **log book** to support activities of inventory and survey; the **evaluation system** to support activities of assessment, the **database of components** to support activities of design; and the **report** to support activities of report.

- **Log book**

The first tool, named as **log-book**, supports the user registering chronologically the various inventories and surveys developed regarding the building and respective environment (*vide* Figure 28). The log book provides better control on the durations, sources of information, related parameters, retrieved informations, usefulness level, etc. It is particular useful, not only to organize information from current design; but also to preview work load for future designs. So, the more frequent the user registers, the better his time management becomes.

After clicking the button “edit” on the right, information can been inserted and saved (*vide* Figure 29). Figure 30 illustrates the list of activities undertaken by a user, making use of the Documentary Inventory tool.

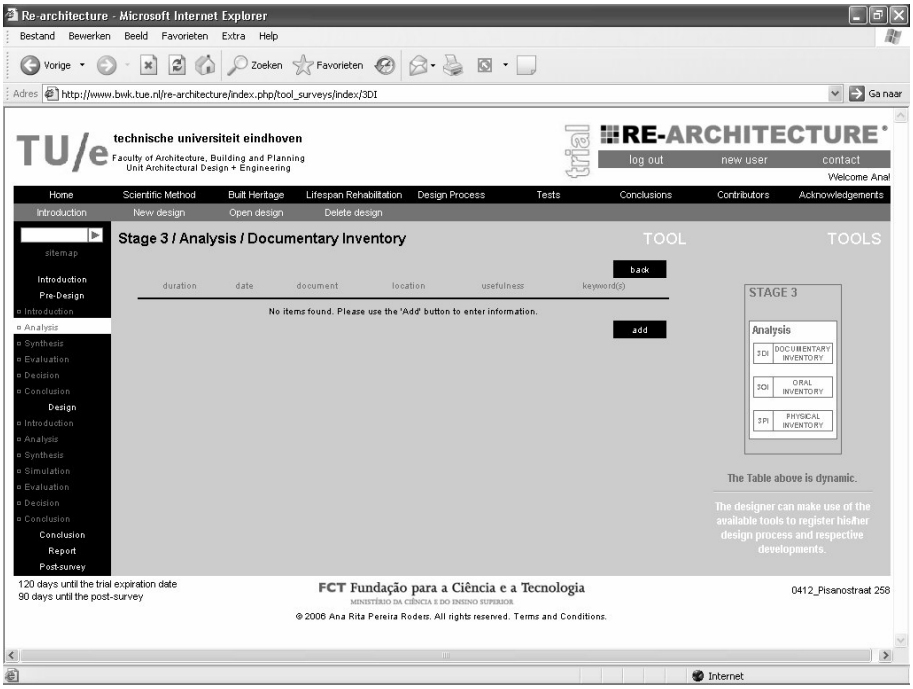


Figure 28 – RE-ARCHITECTURE®: Log book / Documentary Inventory (3DI)

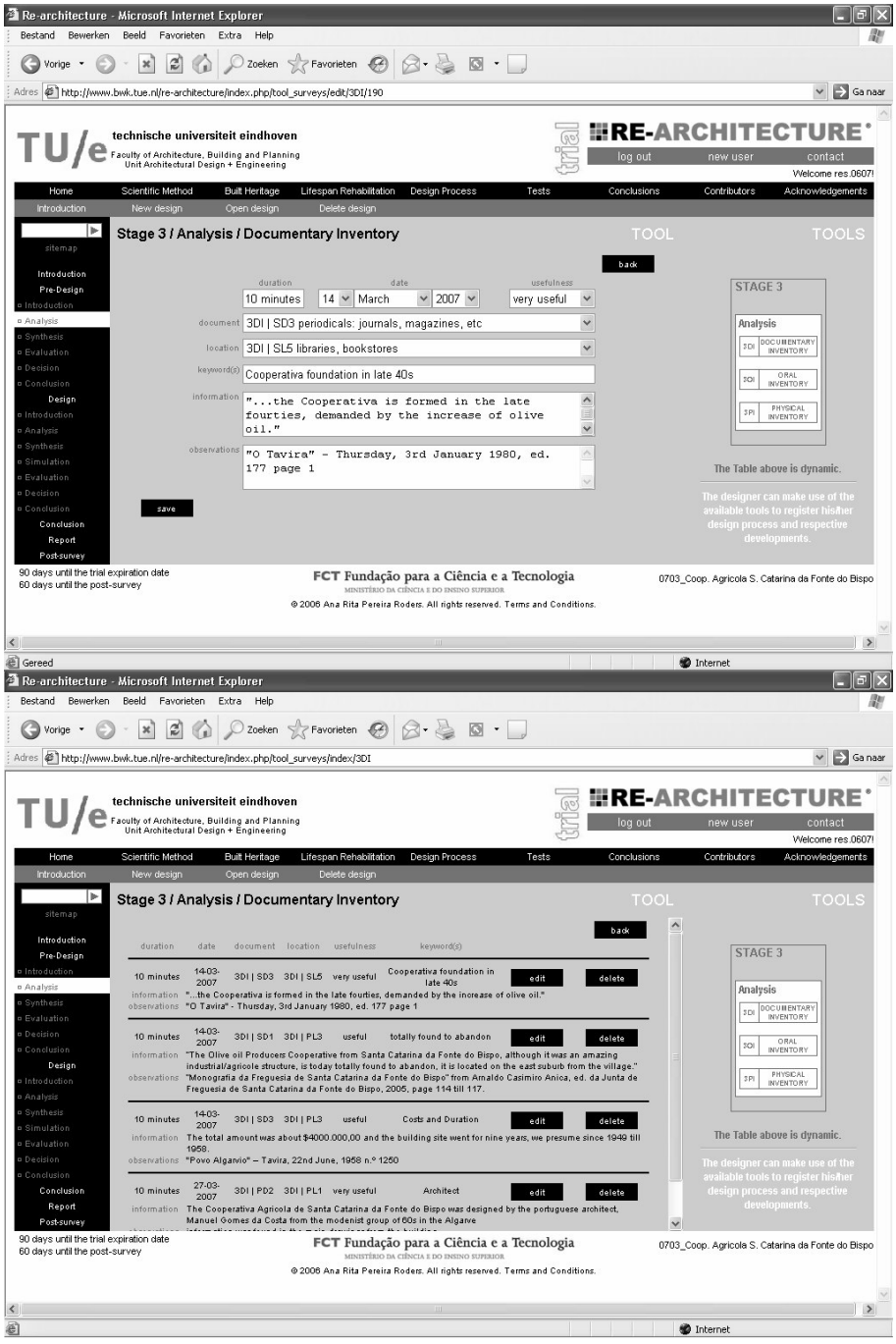


Figure 29 – RE-ARCHITECTURE®: Log book / Documentary Inventory / edit (3DI)

Figure 30 – RE-ARCHITECTURE®: Log book / Documentary Inventory / save (3DI)

■ Evaluation system

The second tool, named as **evaluation system**, was first simulated in the conceptual prototype and did not suffer major changes in the preliminary prototype. Nonetheless, these first two versions were quite static. Moreover, the users would have to rate all parameters in order to save the rates in the system.

An evolution emerged at the final prototype; with the support of the IT expert (*vide* Figure 31). Besides the table of scales that already existed in the previous versions; a new table was added, presenting the respective parameters that are target of assessment. Not all illustrated parameters need to be surveyed, nor assessed by the user. He can assess a minimum of three parameters and a maximum of nine parameters.

When the user would select the assessment rates at the table of scales, the parameters would be highlighted automatically by the respective colour of the assessment rate. The colours are in order from worst till best score: red = one; orange = two; yellow = three; green = four and blue = five. Then, the user would only have to save his assessment rates, storing it at the database, connected to his account and respective design process (*vide* Figure 32).

Particularly, for the significance assessments, in both Pre-Design and Design stages, a utility was produced and implemented to check the demolition risk for the building(s), based on the rates inserted by the user, regarding the cultural values. In this case, the scale of colours was inverted, as due to the language of colours the highest risk is clearly better understood when highlighted in red; rather than when highlighted in blue (*vide* Figure 33). Respectively, high risk became orange, reasonable yellow, low green and very low blue.

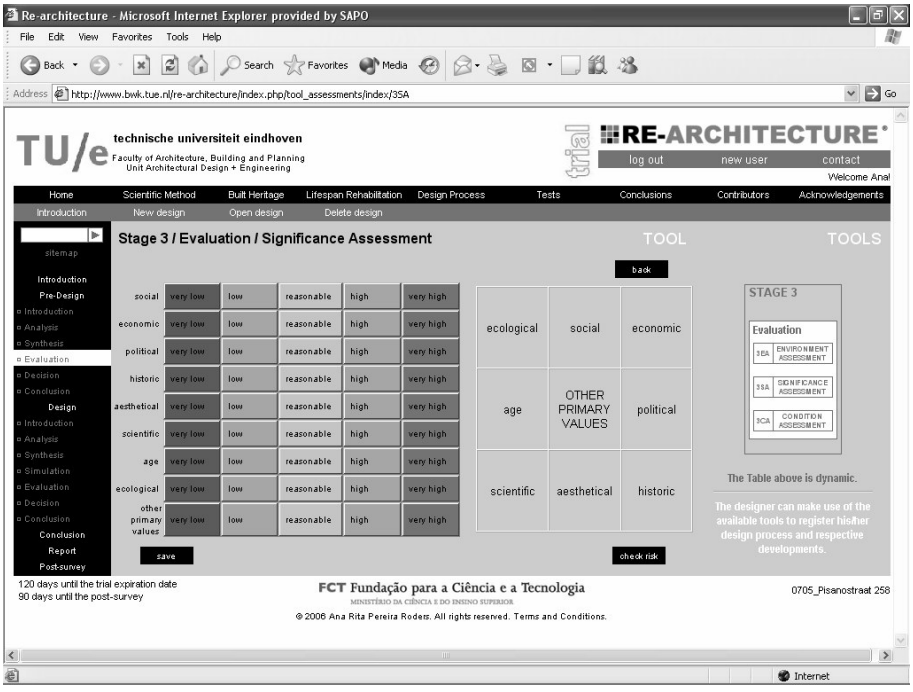


Figure 31 – RE-ARCHITECTURE®: Evaluation system / Significance Assessment

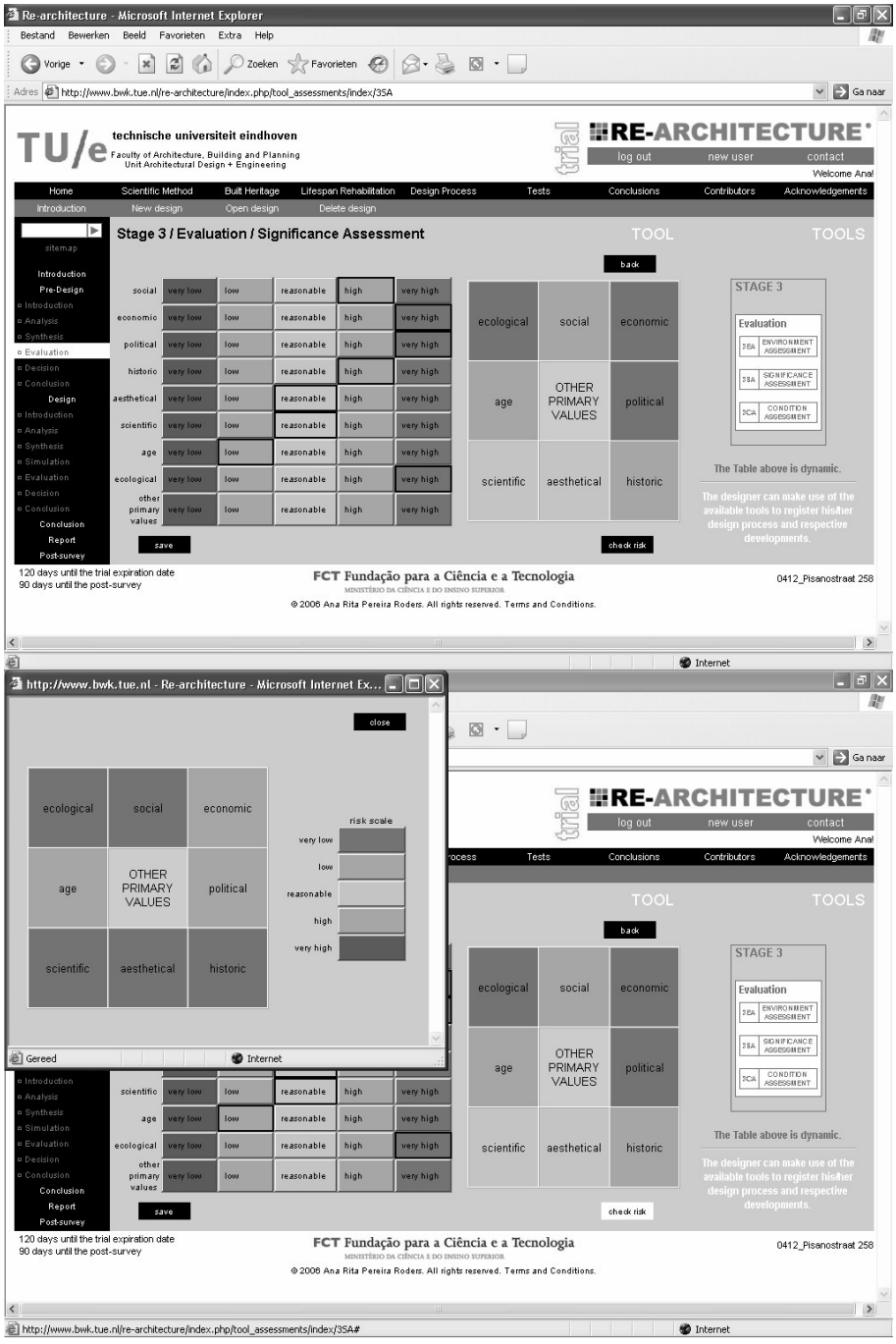


Figure 32 – RE-ARCHITECTURE®: Evaluation system / Significance Assessment / save

Figure 33 – RE-ARCHITECTURE®: Evaluation system / Significance Assessment / check risk

■ The database of components

The third tool, named **database of components**, has been simulated since the conceptual prototype and has enhanced at both preliminary and final prototypes. The researcher considered fundamental to provide lifespan-related knowledge to the users, at the preliminary design, in the sub-stage of simulation, in order to sustain their design decisions.

The table of components (*vide* Figure 34), accessible through the tools navigation system, was ordered according to the first level of the CI/SfB index manual. The user only needs to select the family of components he is interested to survey, e.g. structure, primary elements.

To complement the lifespan-related data; e.g. life, maintenance and replacement cycle values referenced from Huffmeijer (1998); six others technical books (*vide* book II – Chapter 4.4.4.2), were selected to provide information referring to the identified components and respective materials, e.g. ecological ratings, advantages and disadvantages, observations, etc. All this technical knowledge is available, free of charge, to the user in a matter of seconds, independent from the complexity of his choices.

Since the conceptual prototype, the database of components has always had an initial page where the components would appear listed. Difference was on the selected fields of interest. In the conceptual prototype the fields were six and covered a representative **photo** of the component, the **component**'s CI/SfB code, **material**, **characteristics** of the component and the two utilities **compare** the selected components and **add/remove** to the report the chosen ones. The possibility to filter the components according to their code, the fields and sort ascending / descending was also considered by then.

Instead, the preliminary prototype renames the **component**'s CI/SfB code to **(00|00) Aa**, which comprises already the component, material and characteristics (work) converted into the CI/SfB index system. Also, the filter options are reduced to the first level of the CI/SfB (0-) and the material (-a), remaining unchanged during this research.

The **summary table** gained few fields at the preliminary prototype; life, maintenance and replacement values, as well as, the BRE rating. The final prototype only gained the application that allows the introduction of the same component more than once in the design process report; either as subtractions, remainings and/or additions (*vide* Figure 35). Moreover, the text-based link named **more info** located below the photo, leads the user to more information (*vide* Figure 36).

More info presents the user a group of tables with the fields of the summary table, plus some other fields. First, the CI/SfB code is fragmented in its five dimensions and respective descriptions: **(0-)**; **(00)**; **(00|00)**; **(A-)**; **(-a)**; **other description** and **other materials**. The description of the components and respective materials, which the researcher referenced from Huffmeijer (1998) could not be found directly among the standard CI/SfB descriptions.

Furthermore, the user can find at **more info** the references of the six technical books and the respective technical knowledge filtered, according to its type: **characteristics**, **observations**, **advantages**, **disadvantages**, **maintenance** and **replacement**. These six types of technical characteristics are not available for all components that are listed. They will only appear if they have been found by the researcher, during the data collection.

In the summary table, there was also the option to **compare** the technical knowledge of similar components (minimum two, maximum five), before choosing one specific component as addition (*vide* Figure 37). Then, the user makes his decision and can choose which component to subtract, remain or add based on the objective and sustained arguments available in the database of components, rather than on subjective and superficial arguments.

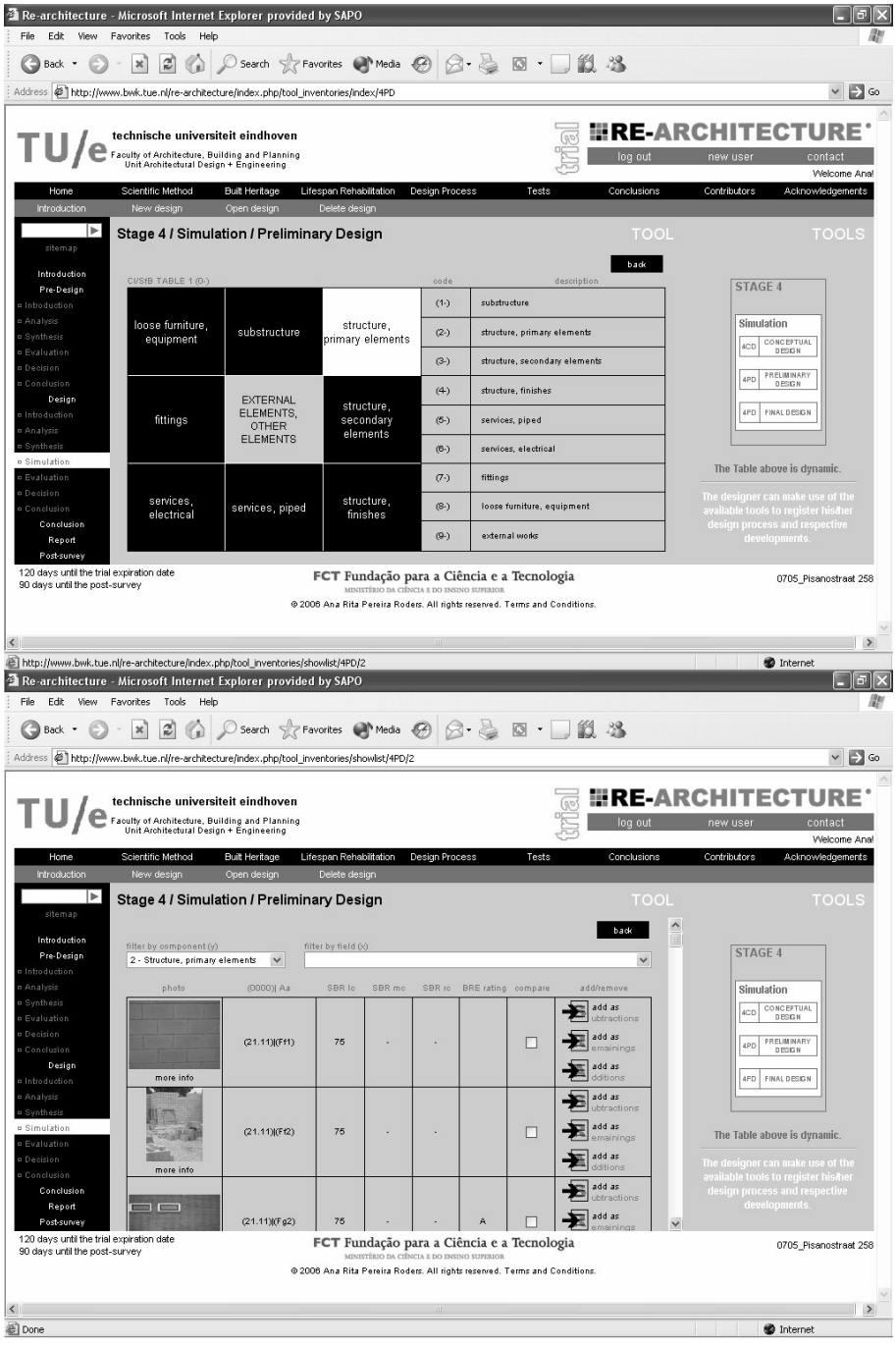


Figure 34 – RE-ARCHITECTURE®: Database of components / access

Figure 35 – RE-ARCHITECTURE®: Database of components / summary table

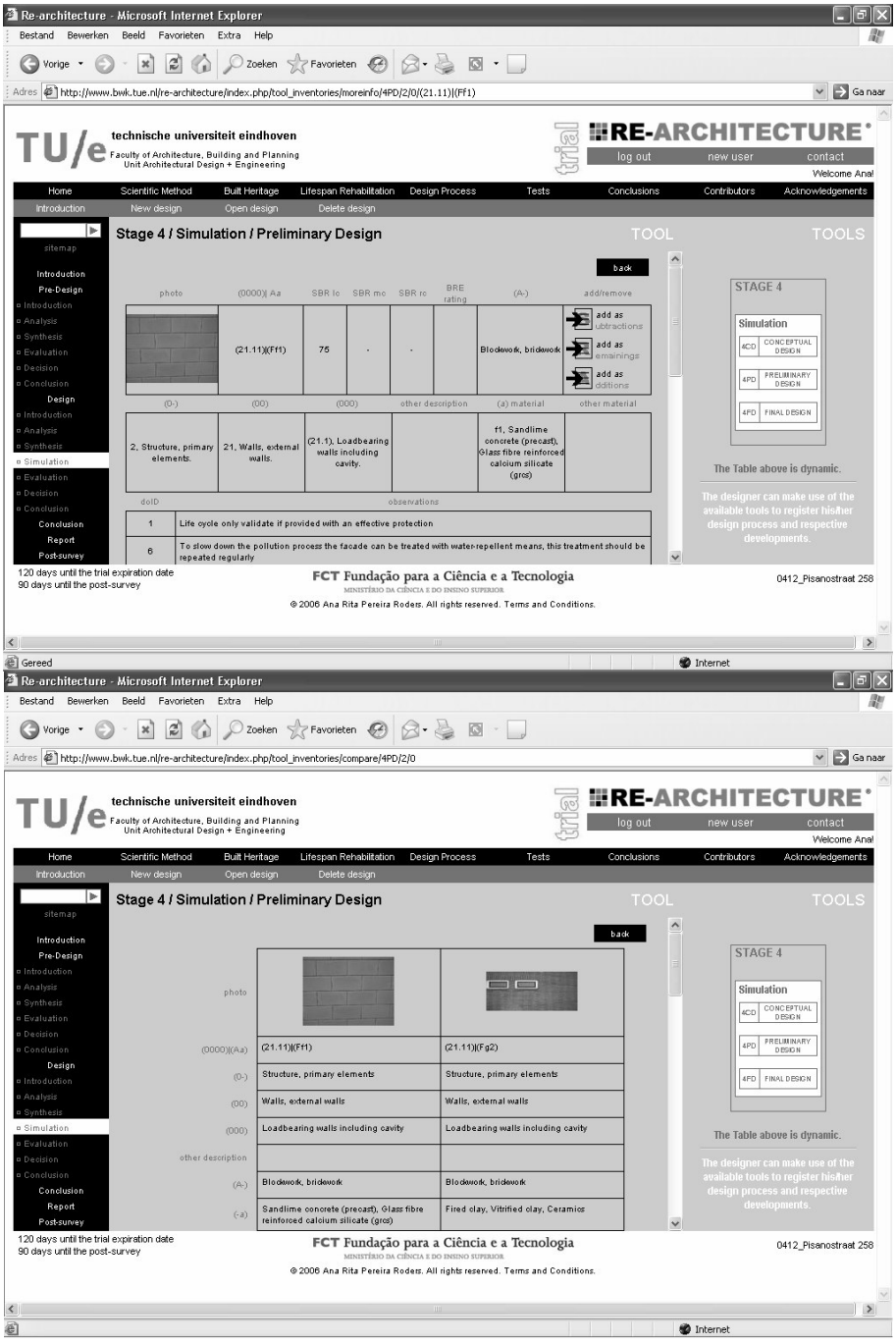


Figure 36 – RE-ARCHITECTURE®: Database of components / more info

Figure 37 – RE-ARCHITECTURE®: Database of components / compare

■ Report system

The fourth and last tool, named **report system**, has been developed and produced to support the two sub-stages of decision, each at the pre-design and design stages. This tool allows the user to create several reports, dependent on the stage which he is currently working in and on the type of results he is willing to present.

Only the results that the designer has registered, with the previously described tools, shall be available at the list of results. From the list of available results, the designer only needs to choose the ones that he wants to add to his report. Promptly the tool produces a report that the designer can print or save as PDF document.

Unlike the report at the preliminary prototype, there was no choice possible for the user, at the conceptual prototype, for. Accordingly, when the user would introduce information into the system, the same system would frame it immediately in the report.

The preliminary prototype brought the advantage into the report system that the designer could chose what results he wanted to add and/or remove from the report (*vide* Figure 38). In such way, the user would never become constrained by his design process results. Each user would determine what and when exactly he would like to print or store as PDF. He could even store a report, any time he would have to present his progresses to the other actors involved in the design process; and or every time he would finish a particular stage; as part of a broader time management strategy.

Figure 39 illustrates the preview of a report in the final prototype, where the chosen results were the ones resulting from the activities of the Pre-Design / Analysis / Oral inventory and from the activities within the Pre-Design / Evaluation / Significance Assessment.

The header of the report is produced on base of the data related to each specific design process. Therefore, the logo of RE-ARCHITECTURE® and respective reference to the trial prototype is accompanied with few identification information, such as the **user**'s name, the **design**'s code and the **date**, when the report was produced. In such way, there is little risk for misunderstandings or for unreferenced reports. When using RE-ARCHITECTURE® with frequency it could even be interesting to compare reports, from different building(s).

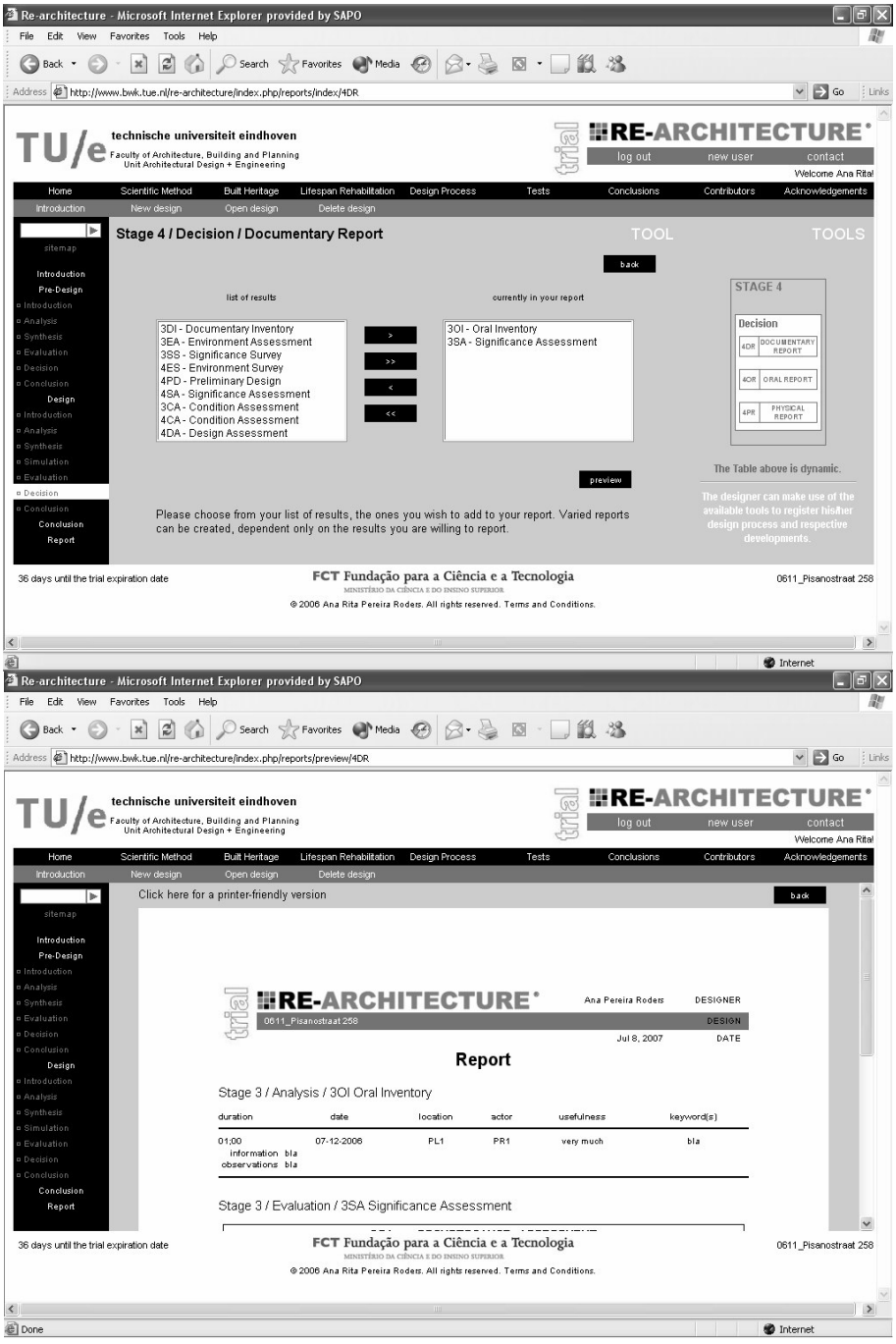


Figure 38 – RE-ARCHITECTURE®: Report / list of results

Figure 39 – RE-ARCHITECTURE®: Report / preview

5.3.6 FOOTER

Without considerable evolutions since the conceptual prototype, the footer is divided into three areas: the area aligned to the left, the area aligned to the centre and the area aligned to the right (*vide* Figure 40).

First, the area aligned to the left contains the two indicative dates: the number of days left until the trial expiration date and the number of days left until the Post-Survey. The idea was to help the user remembering his agreement with the conditions to fill in the Post-Survey and the ending of his trial period.

Second, the area aligned to the centre contains information that refers to three important informations: the *Fundação para a Ciência e Tecnologia*, funding institution of this doctoral research; the researcher as the exclusive copyright holder of RE-ARCHITECTURE®; and the Terms and Conditions, which all users had to agree with before accessing RE-ARCHITECTURE®. When clicking on the text-based link Terms and Conditions, a new window opens and the users can remind themselves of what they first agreed.

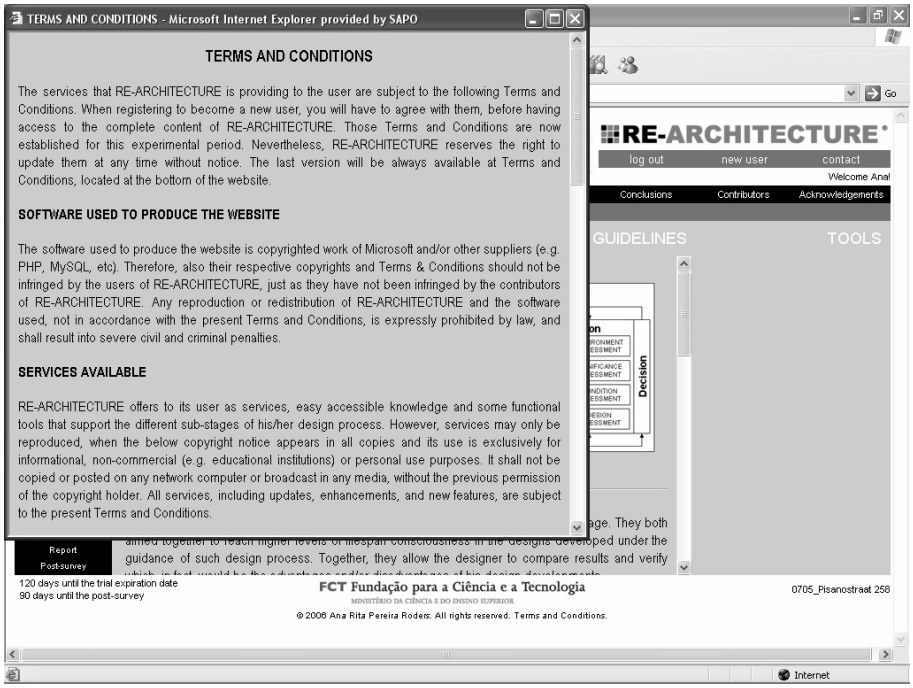


Figure 40 – RE-ARCHITECTURE®: Footer (final prototype)

Third and last, the area aligned to the right contains the design's code, the same one that appears at the reports, whenever the user wants to print or store them. As earlier explained, such code is produced by the system, joining three fields of information that is being provided by the user: the year, month and address of the building being target of rehabilitation intervention.

5.4 Tentative discussion

The production of RE-ARCHITECTURE® was one of the most challenging tasks the researcher had to accomplish during this doctoral research. Coming from a background with experience in IT mostly from the viewpoint of the user; the researcher had no previous formation on programming. So, some hours of study and training were essential to learn the necessary programs and get acquainted with the language, required to produce such frameworks and interfaces.

Nevertheless, the inherent effort was considered worthwhile by the researcher, when keeping in mind what would be gained in return. The implementation of the design process into a design process support system would bring this doctoral research one step further. RE-ARCHITECTURE® was always seen by the researcher as a mean to sustain designers raising the level of lifespan consciousness, in their daily practices when involved in rehabilitation design developments.

As any other theoretical supports, the researcher feared that the theorised design process might end up having the same destiny as all other disperse guidelines, found among the relevant literature survey. Instead, such design process support system could open a new perspective of support which the researcher was very willing to experiment. She believed that it would facilitate the introduction of theory-based activities to designers, used to perform empirically. Moreover, the points of failure and success resultant from this doctoral research would be fundamental for further research.

Due to time constraints, but also due to a methodological strategy, the researcher has chosen not to survey designers on their aims for a support system that would sustain their design processes in rehabilitation design developments, before actually developing RE-ARCHITECTURE®. The researcher was willing to test her concepts, and only later, verify if such idealised support system would be proved useful by the designers.

The preliminary prototype of RE-ARCHITECTURE® was produced while the researcher was still developing the theorised design process. There were even particular moments when the support system has revealed improvements for the design process. Probably, if such tasks would have been divided in time as it happened during the final prototype, the researcher might not have had the opportunity to cross the outputs from the three creative processes: framework, content and interface.

The content was the creative processes which ended up gaining more attention, respectively followed by the interface and framework. The responsibility of developing a consistent framework was shared with the IT trainee and expert that have cooperated with the production of RE-ARCHITECTURE®. Instead, the interface was left at the consideration of the researcher.

The researcher has chosen to produce an honest “functionalistic” support system that would clearly denounce the theorised design process as the whole modelling structure, with the respective stages, sub-stages and activities as the inter-dependent sections one would have to go through in order to fulfil a specific purpose. Purposely, no efforts were taken to research on marketing or diffusion techniques to delude the complexity of the design process and create a more dynamic and user-friendly environment.

Aligned with the “functionalistic” intentions, the work environment was structured in two universes; the universe of the guidelines and the universe of the tools. In the first

universe, the user would be expected to play a passive role and only read and retrieve theoretical knowledge of interest. At this point, RE-ARCHITECTURE® would not differ much from its ancestors that have supplied theoretical support; with the difference that the "search engine" would find for the designer, in a matter of seconds, all pages where he could find the guidelines he would be searching for; instead of him searching for minutes and hours, among the many guidelining pages.

Instead, in the second universe, the user was expected to play a more active role, enabled to introduce and store information in the tools provided in the different stages from the theorised design process and enabled to report the results of his/her design processes, whenever he/she would consider suitable (report system). Then, wherever place or time, the designer would be enabled to illustrate the developments achieved, to the other involved actors, from the internet.

Even if very basic, these tools were designed to enable designers with means to manage their work load and flow, reduce repetitive actions and reach sustained arguments, by the end of both pre-design and design stages. As a platform of knowledge, designers could register all information retrieved from documents, other involved actors and buildings and filter it according to the relevant parameters (log book). That would provide the designer a global overview on the information retrieved, as well as his most used parameters in detriment of others, also theorised in the design process.

Consequently, the parameters which would have enough information could be assessed (evaluation system). This would bring much more accuracy into the design process and the designer would no longer be blamed for assessing parameters subjectively, because no information was found, but still something should be said on the matter. The other parameters would remain, for other buildings where related-information would be found.

Particularly, the evaluation system behind the significance assessment provides a parallel rate of risk to the rate weighting the primary cultural values. After infilling such rates ,the designer can retrieve from RE-ARCHITECTURE® if the building he is dealing with, shall be suffering particular risks due to its inherent cultural values. That could also be done for all other parameters, e.g. condition assessment; however, due to time constraints the researcher has chosen not to go further on these issues.

One might argue that such risk rate is subjective and should not be generalised. Nonetheless, the researcher considered important to raise the attention to such issue. Moreover, it was built by the researcher based on relevant literature. Probably, further research could survey how accurate this risk scale coming from theory is and compare it with results from practice.

Often designers undertake much work, before actually reaching the final results. This work is normally neglected by the other involved actors, much more interested on final results. Sustained by RE-ARCHITECTURE®, designers can start showing the results of all stages they pass trough, till they reach the final design. Such design process reports can, among other advantages, truly contribute to better communication among the involved actors in the design process. Moreover, potential mistakes and errors proceeding from the design stage, denounced at the Problem Field of this doctoral research, could be detectable, while not yet bringing irreversible consequences for the building.

RE-ARCHITECTURE® is the first prototype of a design process support system and hopefully, shall not be the last. Following versions shall be improved based on the results of this doctoral research; on its content, framework and interface. Particularly, for designers the last one is quite essential. For this reason, even if "functionalistic", the researcher has carefully chosen the colours, fonts sizes, areas, planimetries, etc.

Chapter 6 Testing the prototype

6.1 Introduction

Chapter 6 reveals the results achieved in the different experiences organized to survey preceding design processes and to test the prototype of a lifespan rehabilitation design process and its respective implementation by the respective experimental groups. There were two distinct moments: the first period for testing the design theory (*vide* Chapter 6.2) having place during the academic year of 2005/2006 and the second period for testing the design product (*vide* Chapter 6.3) having place during the academic year of 2006/2007.

As above mentioned, Chapter 6.2 reveals the results achieved regarding the design theory. That encloses the results of two main phases, while till defining and redefining the theorised design process. The two distinctive experiments were; the four case studies undertaken to survey preceding design processes (*vide* Chapter 6.2.1) and the two case studies undertaken to survey the lifespan rehabilitation design process (*vide* Chapter 6.2.2).

Chapter 6.2.1 introduces the two architectural offices involved in this experience and presents the **method** used to approach the four case studies chosen to identify preceding design processes in rehabilitation interventions of built heritage (*vide* Chapter 6.2.1.1); the **motivations and assumptions** reveals what motivated the researcher to follow such method (*vide* Chapter 6.2.1.2) and the factual **results** reveal what could be retrieved from the case studies and respective comparison (*vide* Chapter 6.2.1.3).

Similarly, Chapter 6.2.2 introduces the experimental groups and presents the **method** chosen to test the lifespan rehabilitation design process, theorised in this doctoral research, with two groups of architecture students, from the Netherlands and from Portugal; while developing a rehabilitation design (*vide* Chapter 6.2.2.1). Chapter 6.2.2.2 explains the **motivations and assumptions**, while Chapter 6.2.2.3 reveals the factual **results**, regarding the Pre-Survey, the Observation and the Post-survey.

The results of the design product, RE-ARCHITECTURE®, are described in Chapter 6.3. They regard both preceding design processes and their degree of adoption/rejection towards the lifespan rehabilitation design process which are all presented together (*vide* Chapter 6.3.1). Moreover, they join the assumptions retrieved from both architects and architecture students, from the Netherlands and Portugal.

This time, Pre-Survey, Observation and Post-Survey were also complemented with Process Mining methods, retrieved from logging who was using RE-ARCHITECTURE® and what actions they took, while registered. But, before the results are revealed (*vide* Chapter 6.3.1.3); the **method** to achieve such results is illustrated at Chapter 6.3.1.1 and complemented with its **motivations and assumptions** at Chapter 6.3.1.2.

Chapter 6.4 shall present some final remarks and raise some points for **tentative discussion**, correlating potential points of attention from both design theory and product. Correlations shall be drawn and the researcher shall be able to provide sustenance to the conclusions presented at the following Chapter 7.

6.2 Testing the design theory

6.2.1 THE PRECEDING DESIGN PROCESSES

For the purpose of testing and revising the theory involving the theorised design process for a lifespan conscious rehabilitation, the researcher has decided to interview two architectural offices, from the Netherlands and Portugal, and question them about their previous experiences on rehabilitation design developments, regarding both **unlisted** and **listed** buildings, protected by the safeguard Institutions.

As one single architectural office would not be representative of the total number of architectural offices in each country; there was no need to choose randomly. Therefore, the choice was made for two architectural offices, which the researcher was already acquainted with, regarding their lifespan consciousness, confirmed by the expertise field.

They would contribute with their own vision on lifespan consciousness as well as enough evidences of such implemented into practice. Therefore, these two architectural offices can be perceived more as a trend, rather than a representative sample of the common procedures on rehabilitation; even if they shall refer to the common practices along their testimonies.

From the Netherlands, the chosen architectural office was *XX Architecten*, chaired by Jouke Post. There is a brief summary on Prof. Post at Chapter 1.2 (*vide* book I – *basis*), first promoter of this doctoral research. At the time both rehabilitation designs were developed, *XX Architecten* was a medium scale office with four Architect-directors. Those were respectively, Daan ter Avest, Jan Brouwer, Jouke Post and Art Nieuwpoort.

They became particularly famous for the construction of their own office in Delft, previously presented in Chapter 1.3. Project XX was built to last for a period of twenty years, after which could be easily demounted and most materials recycled or wasted (*vide* book I - *basis*). Nonetheless there were more buildings designed with a determined lifespan, such as e.g. Villa Zebra, in Rotterdam, planned to last for a period of five years.

From Portugal, the chosen architectural office was *Victor Mestre | Sofia Aleixo arq. Lda.*, chaired by the architects themselves, since 1997. It is a small scale office with approximately five employees. At the time when the interviews took place Mestre & Aleixo had the collaboration of Arch. Nuno Gaspar and two other trainees.

Mestre & Aleixo explained that the small scale helped them, along these years, preserving their guiding principles and lifespan consciousness. As they were not economically dependent from the designs developed, due to parallel professional activities (e.g. research, education, etc), they could confront the other involved actors, e.g. owners, contractors, etc. and reject the assignment, whenever expected to deviate from their guiding principles.

Similar to Post, Mestre & Aleixo have been acknowledged by their field expertise for their best practices, as well as, for their contributions to research and education. Currently, both Mestre & Aleixo are doctoral researchers at the University of Seville. They have all accepted to expose their design processes on four rehabilitation designs, on both listed and unlisted buildings, for the purposes of finding similarities and differences when compared with the design process theorised in this doctoral research.

Figure 41 – Villa Honingen, in Rotterdam – the Netherlands (Post, 1997)

Figure 42 – Villa Honingen, in Rotterdam – the Netherlands (Post, 1998)

Figure 43 – KRZV 'De Maas', in Rotterdam – the Netherlands (Post, 2002)

Figure 44 – KRZV 'De Maas', in Rotterdam – the Netherlands (Post, 2006)

On the list of rehabilitation interventions, XX Architecten had the **unlisted** *Villa Honingen* and the **listed** *KRZV 'De Maas*', both located in Rotterdam. These buildings managed to survive World War II and further Master Plan developments.

Villa Honingen is now the residence of Jouke Post (*vide* Figure 42). Nonetheless, he insured that in 1996 the rehabilitation intervention was treated by the *XX Architecten* as any other rehabilitation intervention assignments. Of undeniable high significance and low condition (*vide* Figure 41), this building dating from 1875 was found **unlisted** by Jouke Post on the Municipality and *Monumentenzorg*, the Dutch Department for Conservation.

KRZV 'De Maas' is the diminutive of *Koninklijke Roei- & Zeil Vereeniging 'De Maas'* (Royal Dutch Rowing and Sailing Club 'De Maas'). It was founded in 1851and it is one of the oldest yacht clubs in the Netherlands. With Queen Beatrix as patron and more than 2500 members, the "club-building" has been officially open in April 1909 by the Local Authorities and in 1991 it was **listed** as a Municipal Monument (*vide* Figure 43 and Figure 44).

Figure 45 – *Casa Pereira da Silva*, in Moita – Portugal (Mestre & Aleixo, 2003)

Figure 46 – *Casa Pereira da Silva*, in Moita – Portugal (Mestre & Aleixo, 2005)

Figure 47 – *Casa-Estudio Carlos Relvas*, in Golegã – Portugal (Mestre & Aleixo, 2003)

Figure 48 – *Museu Carlos Relvas*, in Golegã – Portugal (Mestre & Aleixo, 2005)

On the list of rehabilitation interventions, Mestre & Aleixo had the **unlisted** *Casa Pereira da Silva*, located in Moita; and the **listed** *Casa-Museu Carlos Relvas*, in Golegã.

Casa Rosario belongs to the parents of Aleixo (*vide* Figure 45). Similar to Villa Honingen, this rehabilitation intervention was treated as any other; and *Casa Rosario* was also found of high significance and low condition. Originally built in 1869 with one floor only, *Casa Rosario* became the building as perceived today, when highly rehabilitated in 1891 (*vide* Figure 46).

Casa-Estudio Carlos Relvas was the photographic studio and residence of the noble Carlos Relvas (1838-1894), nationally and internationally highly acknowledged for his artistic talents as a photographer (*vide* Figure 48). *Casa-Estudio Carlos Relvas* was fully equipped and built in 1875 with the most modern instruments and technologies from the end of the century. Donated by the family to the Local Authorities in 1981, *Casa-Studio Carlos Relvas* became listed as a Building of Public Interest in 1996 (*vide* Figure 47).

These four case studies, further exposed in the following chapters, had their origin at the turn of the XIX to the XX century as one of the common starting points; as well as, the particularity of the unlisted buildings, having the architects and/or close familiars as owners.

6.2.1.1 METHOD

THE MEANS TO VERIFY THE HYPOTHESES THROUGH PRACTICES

Both architectural offices were first contacted, via e-mail, to cooperate with this doctoral research. This channel of communication has been proved efficient and has also been used on further contacts. At the first contact, the researcher already presented the aims of such cooperation and proposed a face-to-face meeting to interview the architects. At that moment they were also informed about the particular interest of the researcher in two rehabilitation designs and that the intended interview would focus on them.

Based on their positive reaction, the researcher prepared Questionnaire A1 and respective Introduction (*vide* Appendix 3). These two documents were sent in advance to both architectural offices via e-mail. As a result, by the time of the meeting, they were already acquainted with its content and prepared the necessary documentation to illustrate both rehabilitation designs. Post was interviewed in August 2005, while Mestre & Aleixo were interviewed in July 2005.

The researcher has previously agreed with the interviewed architects to audio record the interview. Accordingly, none of them would have to feel pressured on filling in all the information demanded at Questionnaire A1, immediately during interview. Back at the office, the researcher would fill everything properly, based on all provided and recorded information. Later on, the respective draft of the Chapter would be sent to them for approval.

Questionnaire A1 did not restrain the meeting, but provided a steering instrument. The researcher chose for such a semi-structured interview; as she would not like to limit the architects. There were points of focus, the two rehabilitation designs; however, architects were free to bring into conversation all aspects that they would consider relevant and/or related to the rehabilitations designs, but that were not directly asked at Questionnaire A1.

The researcher also brought the draft of the doctoral dissertation with her, exposing its structure and guidelines. This action had the purpose to confront the theory with the practical reality in such architectural offices. The interviewed architects commented on the intention to theorise an international design process and the respective developments, that had been achieved until that moment (*vide* Figure 49).

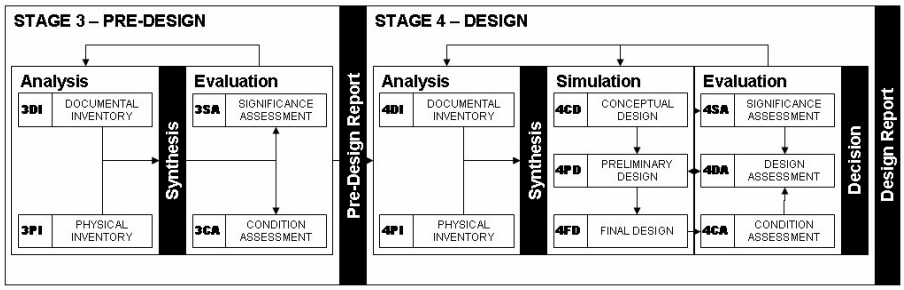


Figure 49 – The lifespan rehabilitation: design process (fifth version)

The outcome of the interviews would allow the researcher to go further with the developments of the theoretical model illustrating the design process considered as lifespan conscious; not only sustained by relevant literature, but also sustained by an acknowledged lifespan conscious practice, in the Netherlands and Portugal.

6.2.1.2 MOTIVATION AND ASSUMPTIONS

THE REASONING BEHIND THE HYPOTHESES

The main purpose of the four case studies was to bring information and knowledge from the practice of rehabilitation interventions, generally into the scientific community, and particularly into this doctoral research. Acknowledged by their lifespan consciousness either when building new and/or when intervening in the built environment, the researcher wanted to verify how the principles of lifespan consciousness were being implemented in practice.

The survey of the problem field revealed clear evidences on the lifespan unconsciousness of several rehabilitation interventions; where either past and/or future were being neglected. Therefore, such effort to combine the experience of designers and the principles of the scientific community could only bring an impulse to the implementation and verification of lifespan consciousness at current rehabilitation design developments.

Such implementation would be revealed through the design processes followed by these two architectural offices on two rehabilitation interventions, one when dealing with a listed building and another when dealing with an unlisted building. The survey shall focus on the following six themes:

1. the involved actors at rehabilitation designs
2. the design processes within the building process,
3. the design processes followed in rehabilitation designs,
4. the appointed successes in rehabilitation designs,
5. the universe of subtractions, remainings and additions, and
6. the interest in the theorised design process.

The themes shall return when presenting the respective results. The aim was to verify the adequacy of the hypotheses theorised by the researcher with the results emerging from the practice, and how much they would differ from each other.

Not all architects who are lifespan conscious follow the same principles. So, it would be interesting to identify which are the common principles that make them different from the current architects that are lifespan unconscious. Moreover, the researcher would be able to compare their design processes with the one theorised in this doctoral research and complement it with suggestions and/or ideas that could emerge along the interview and/or when reviewing their rehabilitation designs.

The researcher could even distinguish activities that are only used in one country, from activities that are quite general and can be found in several other countries than the Netherlands and Portugal. The Interviews, sustained by Questionnaire A1, would provide enough sustenance for the theorised design process to become an international model.

Questionnaire A1 did not have a clear codification or questions, by the time it was established. Nevertheless, the motivation for raising such themes in this period is directly related with the motivation for raising similar themes in the questions at both test periods: through Questionnaire A2 and A3 to test the design theory, and through Questionnaire B1 and B2 to test the design product.

- **The involved actors at rehabilitation designs**

  The actors involved in rehabilitation design developments of listed buildings shall be more varied and specialised than the ones of unlisted buildings.

The identification of all involved actors at the design process besides the interviewed designers; e.g. other designers, approval institutions, owners / user, constructor, etc; aimed to retrieve information enough to provide the researcher with a clear insight at the differences between the involved actors in both rehabilitation interventions of listed and unlisted buildings.

The researcher believed that even if lifespan conscious designers would try their best to act democratically when dealing with listed and unlisted buildings, the differences on the involved actors and their degree of sensibility towards interventions on built heritage, would considerably affect how the buildings would result rehabilitated. Consequently, involved actors would act too protective at listed buildings and too liberal at unlisted buildings.

- **The design processes within the building processes**

  The design process shall play a different and more important role within the building process for listed buildings, than for unlisted buildings.

The identification of general information about the buildings and respective environments, e.g. classification, category, condition, etc allowed the researcher to get more acquainted with them. Moreover, a small description was also asked regarding its most particular characteristics, to better understand the designers' principles, similarly to what was specifically asked to the designers, at the following questionnaires.

When asking about the building process and the role of the design process within, the researcher was able to inventory the life cycle stages of this particular building and order of progression, before and after the design has been endorsed, together with their percentage of time spent; making use of the terms used in this research: Feasibility, Briefing, Pre-design, Design, Construction, Occupation and Intervention stage (future ones).

- **The design processes followed in rehabilitation designs**

  Architects shall have followed in both situations, rehabilitation of listed and unlisted buildings, similar design processes and dealt with similar problems.

Some designers feel too constrained when developing rehabilitation design developments of listed buildings and caustically liberated when dealing with unlisted buildings, of "no value". Consequently, designs result too destructive and lifespan unconscious. The researcher believes that the interviewed architects shall illustrate good examples, where the same coherence and commitment is reflected in both cases.

Some designers sustain that rehabilitation design processes are always different and that no model can be drawn to sustain it theoretically. Through the comparison between the theorised design processes and the one followed by these interviewed architects, the researcher shall be able to establish unlisted activities; and accurately verify similarities and differences.

- **The universe of subtractions, remainings and additions**

  The correlation between subtractions, remainings and additions shall be considered by the designers; even before being presented by the researcher.

Some designers do tend to prioritise the additions they draw for the building's new existence, neglecting the remainings and the respective treatments required for the different anomalies. Consequently, the substances that tend to remain are the ones considered of very high cultural values, in the case of the listed buildings; and/or the ones that do not interfere with the additions, in the case of both listed and unlisted buildings.

Tendentiously, the substances which do interfere with the additions are automatically considered of no value, and result most often wasted. No further consideration is given to what is subtracted and its respective significance and/or condition. The researcher expects to retrieve from the four case studies, good-practice examples that can clearly illustrate particular lifespan conscious principles implemented into rehabilitation designs.

- **The appointed successes in rehabilitation designs**

  Architects shall reveal evidences of lifespan consciousness and respective ecological sustenance on both rehabilitation design developments.

Some designers do have lack of lifespan consciousness, and neglect either past, present, or future of the building target of rehabilitation intervention. Inversely, the interviewed architects can certainly contribute with their experience and acknowledged lifespan consciousness, directly to this doctoral research and indirectly to others designers, who shall make use of the theorised design process model.

This information shall be retrieved during the interview and while filtering their answers, as well as, arguments to sustain their design decisions and results. Again the similarities and differences between their definitions and the definitions theorised by the researcher shall provide better sustenance to the theorised definition of lifespan rehabilitation and respective design process, guidelines and tools.

- **The interest in the theorised design process**

  Architects shall acknowledge the theorized design process, verify its usefulness, and provide direct comments that shall help the researcher proceed with its revision.

Some designers shall be totally incompatible with the theorised design process, arguing that their personal experience and knowledge is enough and that there is no need for a mix approach that joins both theory and practice. The researcher believes the interviewed architects are not such kind of designers and shall express their interest in such approach and the need to sustain rehabilitation designs lifespan consciously.

The researcher believes that they shall gladly contribute with their own design processes and most common activities to the progression of the theorised design process. At that period, such confrontation with the practice shall certainly bring considerable evolutions. As the theorised process would be presented not yet finalised, these architects would feel no constrains to provide direct comments, faults and virtues of such approach.

6.2.1.3 RESULTS

THE HYPOTHESES VERSUS PRACTICES

Before presenting the results from the six themes and relate them to the hypothesis previously exposed, the researcher considered it important to describe the environment of the four buildings chosen as case-study; so that they can be placed and understood in relationship with their surrounding environment.

Instead of mentioning the architectural offices, the researcher has also chosen to use the names of the architects involved in the rehabilitation designs, whenever describing the information and arguments presented by them at the Interviews. Therefore, Post shall be mentioned when describing *Villa Honingen* and *KRZV 'De Maas'* and Mestre & Aleixo when describing *Casa Pereira da Silva* and *Museu Carlos Relvas*.

Villa Honingen and *KRZV 'De Maas'* differ approximately five kilometres from each other, on the northern side of the river *Maas*, in Rotterdam. *Villa Honingen* is mainly surrounded by dense vegetation and other residential facilities (*vide* Figure 50), while *KRZV 'De Maas'* is mainly surrounded by the river *Maas* and boats (*vide* Figure 51).

Rotterdam is the second biggest city in the Netherlands with approximately 590.000 inhabitants. It was one of the cities in the Netherlands which was severely bombed during World War II. Rotterdam became quite a paradox, for deciding not to reconstruct its city centre after such tragic event; but to start from scratch and undertake new master plan strategies.

Figure 50 – Villa Honingen, in Rotterdam – the Netherlands (aerial view)[8]

Figure 51 – KRZV 'De Maas', in Rotterdam – the Netherlands (aerial view)[9]

Casa Pereira da Silva is also located close to a river, the Tagus River, in the parish Rosário from the council of Moita, in the district of Setubal (*vide* Figure 52). Similarly to *KRZV 'De Maas', Casa Pereira da Silva* is mainly sided by the river Tagus and unlike the *Villa Honingen* has hardly any vegetation in its surroundings.

[8] Google Earth (2007) *Villa Honingen,* Aerodata International Surveys: Google
[9] Google Earth (2007) *KRZV 'De Maas,* Aerodata International Surveys: Google

The parish of Rosário is a much smaller parish that the city of Rotterdam. Together with the parish of Gaio, Rosário encountered a total number of approximately 1000 inhabitants; mostly dedicated to activities related to the river e.g. fishing, boat restoration, etc. However, an important point of reference might be the city of Lisbon on the other margin of the river Tagus, only forty-one kilometers away, with approximately 2.1 million inhabitants. Reachable by boat, car or public transportation, many inhabitants from the district of Setubal, on a daily basis go to work in Lisbon, the capital city of Portugal.

Museu Carlos Relvas is located in totally different environment than Rotterdam and Moita (*vide* Figure 53). Golegã is a small town from the district of Santarém, located approximately 100 km to the north of Lisbon towards the interior of Portugal. Mostly oriented towards agriculture, Golegã has approximately 5.700 inhabitants.

Figure 52 – Casa Pereira da Silva, in Moita – Portugal (aerial view) [10]

Figure 53 – Museu Carlos Relvas, in Golegã – Portugal (aerial view) [11]

Similar to *Villa Honingen*, *Museu Carlos Relvas* is also surrounded by vegetation and other residential facilities. But, unlike all other three buildings there is no river in the near surrounding. Therefore, *Museu Carlos Relvas* is the most rural environment from the four buildings, even if located at the urban perimeter of a small town.

From the four buildings, *Casa Pereira da Silva* is the smallest and the only building which is not totally isolated. All others are either surrounded by vegetation or by a river. Instead, *Casa Pereira da Silva* is surrounded by streets at the north, south and west façades; and the fourth façade, east oriented, is shared with another building.

Also, *Museu Carlos Relvas* is the only rehabilitation intervention, from the four buildings, which has converted the former *Casa-Estudio* (House-Studio) into a Museum. All others reused the building, in their former functions. One other similarity is the two floors height. Other similarities and differences shall be described in the following six themes.

[10] Google Earth (2007) *Casa Pereira da Silva,* DigitalGlobe: Google
[11] Google Earth (2007) *KRZV 'De Maas',* DigitalGlobe: Google

■ The involved actors in rehabilitation designs

The actors involved in rehabilitation design developments of listed buildings were more varied and specialised than the ones of unlisted buildings.

Villa Honingen had as involved actors; the **contractor**, the **local authorities** (especially the Building Aesthetics Committee), the **new owner**, which was simultaneously the **architect** and the **principal**, the **neighbors** and the **former owners**. The last two categories of actors have had an important influence on the building and respective rehabilitation intervention, not found in any of the other three rehabilitation designs.

Their opinion was used to force the local authorities to approve the rehabilitation design and to give the construction permit for the rehabilitation intervention. Post threatened that if they would not give him the respective permit, he would demolish the building. Such extreme action of intervention was against the wishes of the neighbors and previous owners, so Post got immediate support for pressuring the local authorities. In fact, the previous owner would only sell the building to whom would be interested on intervening in the building (e.g. restoring), rather then demolishing it.

According to Post, the Department of Monuments from the local authorities, should have been involved in this rehabilitation design process, due to the inherent cultural values of such building, but somehow *Villa Honingen* has been forgotten to be listed with all other buildings that survived World War II and where considered significant enough to survive further Master Plan developments.

The rehabilitation intervention was treated as a regular rehabilitation design, so Post formed a team with a project leader, draughtsman and a calculator. The contractor was the firm *D. van Staveren*. One very special actor in the execution of the construction works was an old neighbor of Post, who happened to be quite a talented **craftsman**. He helped Post with the restoration of the authentic wooden components, which the contractor was unable to do, at least, in such a professional and careful way.

In the rehabilitation design of the unlisted *Villa Honingen*, Post was dependent on the local authorities only for the approval of his rehabilitation design. However, for the listed KRZV 'De Maas', beyond the meetings with local authorities, he had several meetings with members of the *Rijksdienst voor Monumentenzorg* (Department for the Preservation of Monuments and Historic Buildings). This department even had **experts** available for providing consultancy on specific building components, e.g. bricks, tiles, decorations etc.

The **principal** of the rehabilitation intervention was the KRZV 'De Maas'. Jouke Post was the **architect** and *BAM Volker Bouwmaatschappij* was the **contractor**. Also, the **local authorities** of Rotterdam were responsible for the approval of the rehabilitation design. However, they were not allowed to issue the construction permit without a 'monument license', issued by the **safeguard institution**, *Rijksdienst voor Monumentenzorg*.

As earlier mentioned, the parents of Aleixo were the **owners** of *Casa Pereira da Silva*. In fact, the rehabilitation intervention was initiated by her father. Mestre & Aleixo were involved as well, being **users**, **architects** and **principals**. They consulted **engineers** for the water and sewage system, for the gas system and for the construction stability.

For the construction works, they chose not to hire one contractor, but to contract various **craftsmen**, each one from his own field of expertise. For example, to deal with the zinc components from the roof, Mestre & Aleixo managed to find a craftsman that still mastered the traditional techniques. This solution solved the same problem that Post faced when the contractor was unable to undertake the restoration of the wooden components.

Unlike at the rehabilitation designs of *Villa Honingen* and *KRZV 'De Maas'*, the involvement of the **local authorities** was neither strict, nor mandatory in *Casa Pereira da Silva*. They were mostly interested the general aims of the rehabilitation intervention and not how the rehabilitation would be undertaken. The local authorities just wanted to present the architects to plan functions, which would indulge the sense of the village. Thus, getting acquainted with the fact that the rehabilitation intervention would reuse the building and maintain its functions was sufficient information for them.

Instead, in the *House-Studio Carlos Relvas* the **local authorities** were also the **owners** and those who would approve the rehabilitation design. They were the ones contracting the **architects** Mestre & Aleixo to develop the rehabilitation design of such particular building. This rehabilitation design was developed in close cooperation with the **safeguard institution** IPPAR, *Instituto Português do Património Arquitectónico* (Portuguese State Institute for Architectonic Heritage), which has *House-Studio of Carlos Relvas* listed as a "building of public interest".

Particularly, Mestre & Aleixo have consulted various **engineers** for the more technical designs. In the documentary or oral inventory of information related to Photographic Studios, they counted with the information of **field experts**, from the Portuguese Institute of Photography (IPF). The construction was carried out by the **contractor** A. Ludgero de Castro and coordinated by the engineers João Appleton, Vasco Appleton and Pedro Ribeiro.

It is very interesting to verify how procedures for dealing with rehabilitation designs can vary from country to country. Particularly, with this comparison it was possible to discover that both countries require an approval for the safeguard institution that has listed the building besides the approval from the local authorities. Moreover, more experts are involved in a rehabilitation intervention on a listed building, rather than on an unlisted one.

Another interesting aspect which differs in both countries, is the fact that in the Netherlands, the experts from the safeguard institution determine which substance of the building is considered of 'monumental value' and should remain; and which substance can be subtracted in the new existence proposed with the rehabilitation design. This substance of 'monumental value' can vary on scale, depending on the building and respective environment. It can range reach the scale of a component e.g. chimney, or a form e.g. façade, or of a whole group of buildings.

In Portugal, architects have more freedom, in the sense that the safeguard institution decides if a building in its totality is a monument; and later on, after some visits and meetings provides an official opinion on the proposed rehabilitation design. The architect has the freedom to report within the building what substance is considered of less or more significance and decide what should be subtracted and what should remain.

KRZV 'De Maas' and *House-Studio Carlos Relvas* proved that there is much more control and expertise sustenance for listed buildings than for unlisted. For *KRZV 'De Maas'* this expertise came from the *Rijksdienst voor Monumentenzorg.* While for *House-Studio Carlos Relvas* this expertise came from IPPAR, IPF and from all other involved designers, from their different fields of expertise, e.g. engineers. Even the chosen contractors are often certified with enough rehabilitation interventions as background experience.

Nonetheless, the lifespan consciousnesses of Post, Mestre & Aleixo made them consult experts e.g. engineers, and hire craftsmen in both situations, even if not common for unlisted buildings. Indeed, they were more interested in qualitative results and chose not to leave *Villa Honingen* and *Casa Pereira da Silva* at the mercy of common contractors, who are mostly not prepared to undertake rehabilitation interventions with the required quality.

■ **The design processes within the building processes**

The design process had a different and more important role within the building process for listed buildings, than for unlisted buildings.

There was not much information available about *Villa Honingen*; except for what could be retrieved from the building and respective environment, some bureaucratic documents e.g. property registries and some illustrations found abandoned at the attic of *Villa Honingen* (*vide* Figure 54). However, the information retrieved from those bureaucratic documents was very important.

The original **construction** of *Villa Honingen* was dated 1875; followed by several other **rehabilitation** interventions. Post discovered that *Villa Honingen* had been extended several times in different **use periods**, changing the form of the building, e.g. the horizontal addition at the southern side and the vertical addition of one more floor. All those additions were even more evident by the respective joints, when the construction works started taking place; by the difference between the emerging technologies, materials, etc.

Figure 54 – Villa Honingen (southern façade), in Rotterdam - the Netherlands (Unknown Author, s.d.)

Figure 55 - Villa Honingen (western façade), in Rotterdam - the Netherlands (Post, 1996)

After a short **feasibility** study, Post recognised the potential of the house: "(…) it was very well located and it was such a lovely building". So, he decided to approach the former owner and buy it. As he was going to design the **rehabilitation** intervention and *Villa Honingen* would become his own residence, Post considered no need for loosing time with briefing or contracting, before the **design** developments.

The **construction** works started immediately after the approval of the design proposal of the rehabilitation intervention, by the local authorities (*vide* Figure 56). The designs required further surveys; however, due to time pressure, Post was not able to finish the **design** process completely. Consequently, during the construction works he discovered few discrepancies in the design developments, which he corrected in the design proposal.

Figure 56 – Villa Honingen (southern façade), in Rotterdam - the Netherlands (Post, 1997)

Figure 57 - Villa Honingen (northern addition), in Rotterdam - the Netherlands (Post, 1998)

When aware of the changed design, the local authorities have stopped the construction works and only allowed them to continue, after having approved the design proposal with the corrections. The design process took about six months. Instead, the construction works took about a year. But, by 2007 a new **use period** started in *Villa Honingen* (*vide* Figure 57).

KRZV 'De Maas' had certainly more information than *Villa Honingen*. It was **designed** by the architects Michiel Brinkman & Barend Hooijkaas and **constructed** with clear Art Nouveau influences. First opened to the public in April 1909, *KRZV 'De Maas'* soon became a place to meet for the high society. Hooijkaas was also himself there a member.

In 1935 *KRZV 'De Maas'* was target of a **rehabilitation** intervention, designed by architect Van den Broek, transforming the ceiling from a cross vaulting into a barrel vaulting. Moreover, the ceiling decorations evidencing the distinctive Art Nouveau style were simply covered and/or erased, under the influence of the Modern Movement.

In the years that followed, the building suffered many more **interventions**, e.g. extensions, functional reorganizations, etc. But the main form of the ceiling, and the sober modernist decoration remained unchanged. Meanwhile, in 1991 *KRZV 'De* Maas' was **listed** as a Municipal Monument, at the local authorities of the city of Rotterdam.

KRZV 'De Maas' soon became a *rijksmonument* (royal monument), listed in 2001 by the *Rijksdienst voor Monumentenzorg* as an exemplary building in the category of 'younger architecture and urban planning from the period 1850-1940'. From then on, any **intervention** in *KRZV 'De Maas'* would have to be undertaken together with the *Rijksdienst voor Monumentenzorg*. The design process, as well as, the construction works would have to be continuously monitored by them.

In 2003, when the *KRZV 'De Maas'* was again requiring some maintenance intervention, the board of *KRZV 'De Maas'* decided to choose for a **rehabilitation** intervention instead, and give the assignment to the architectural office *XX Architecten*. Post was asked to research the potentials of such intervention (*vide* Figure 60).

Figure 58 – KRZV 'De Maas' (interior), in Rotterdam - the Netherlands (Unknown Author, s.d.)

Figure 59 - KRZV 'De Maas' (interior), in Rotterdam - the Netherlands (Post, 2003)

This preliminary research was submitted to *Rijksdienst voor Monumentenzorg* and after **approval**; Post developed the technical drawings and the cost-estimations (*vide* Figure 60). Moreover, he also developed a construction work description, specially oriented to the contractor. The implementation of this construction work description was agreed as a solution to instruct the contractor and insure quality in the construction works.

Often, technical drawings and book of specifications are considered too complex for the contractors or any other involved actor which is not a field expert. So, Post decided to add a construction work description with enough illustrations and descriptions of the different activities to be undertaken and the respective location in the building where those activities should be undertaken.

In the whole **design** process, the developments involving the interior were separated from the developments involving the exterior of *KRZV 'De* Maas'. The **construction** works were also organized accordingly. The contractor started with the rehabilitation intervention of the exterior of *KRZV 'De* Maas' in the beginning of 2005 and finished in the summer of the same year. After, the rehabilitation intervention of the interior of *KRZV 'De* Maas' took place, finishing on the summer of 2006 (*vide* Figure 61).

RECENT PHOTO

Figure 60 – KRZV 'De Maas' (interior), in Rotterdam - the Netherlands (Post, 2004)

Figure 61 – KRZV 'De Maas' (interior), in Rotterdam - the Netherlands (Post, 2007)

Casa Pereira da Silva original **construction** is dated 1869. *Casa Pereira da Silva* had the function of a small commercial facility for selling maritime equipment; suitable for sustaining the demands of the fishing activities among others, occurring in the proximity at the bay of river Tagus.

In 1891, the first **rehabilitation** took place and the first floor was **constructed**, functioning as a residential facility. The ground floor instead, remained as the small commercial facility until 1969. After the death of the owner of *Casa Pereira da Silva,* the grandfather of Aleixo, her mother inherited the building and decided to close the commercial facility to convert it totally to a residential facility. The first floor, though, remained unchanged.

When renter of the ground floor moved in 1995, the parents of Aleixo decided to not rent it anymore (*vide* Figure 62). The ground floor was in quite a low condition. So, a **rehabilitation** intervention would be required to make it inhabitable again. Similarly, when the renter of the first floor died in 2000, the parents of Aleixo decided to start the rehabilitation intervention of the first floor as well, including the replacement of the roof which was also in very low condition (*vide* Figure 63). Mestre & Aleixo re-started the design process in 2001.

Figure 62 – *Casa Pereira da Silva* (kitchen ceiling), in Moita – Portugal (Mestre & Aleixo, 1996)

Figure 63 – *Casa Pereira da Silva* (attic), in Moita – Portugal (Mestre & Aleixo, 2000)

In October of that year, the roof was replaced (vide Figure 64), followed by the construction works on the first floor, from June 2002 till October 2004. The Christmas celebrations of the family Aleixo could finally take place in the newly rehabilitated *Casa Pereira da Silva* (*vide* Figure 65).

The original **construction** of *Casa-Estúdio Carlos Relvas* was built in 1872, by architect Henrique Carlos Afonso (*vide* Figure 66) and under the close guidance of Carlos Relvas (1838-1894), its owner and most frequent user. Originally **designed** as a photographic studio for his leisure time, this particular building became also his residence in 1887. Consequently, there were undertaken **construction** works to **rehabilitate** the building and convert it into a mixed-used building, hosting both photographic and residential facilities.

Almost one century after his death, in 1981, the family **donated** the building to the local authorities of Golegã. In 1996 *Casa-Estúdio Carlos Relvas* became a **listed** building, classified by IPPAR as *Building of Public Interest*. This classification included also the surrounding gardens and respective fittings; for their evident inherent value for history of architecture and photography. Carlos Relvas was a national pioneer on photography.

Figure 64 – *Casa Pereira da Silva* (attic), in Moita – Portugal (Mestre & Aleixo, 2002)

Figure 65 – *Casa Pereira da Silva* (attic), in Moita – Portugal (Mestre & Aleixo, 2005)

Due to the very low condition of the building, the aim was to initiate the rehabilitation intervention as soon as possible after the competition (*vide* Figure 67). So, even before starting with any design or study, the architects planned a pre-intervention that would protect the building from further degradation, during the period of the **design** process. They have creatively covered the whole building with a transparent box **constructed** of scaffolding finished with a layer of plastic. Such structure would not only protect the building during the period of the design process, it could also be reused later during the construction works of the rehabilitation intervention.

After the first studies in 2000, the **design** developments followed in 2001. The **construction** works took place from April 2002 *(vide* Figure 68) till January 2003 (*vide* Figure 69). At the time of the interview, the *Museu Carlos Relvas* was not yet functioning, waiting for being equipped and fitted. The website from the local authorities of Golegã, announced the official opening on April 2007.

Figure 66 – *Casa-Estúdio Carlos Relvas*, in Golegã – Portugal (Relvas, 1870s)[12]

Figure 67 – *Casa-Estúdio Carlos Relvas*, in Golegã – Portugal (Mestre & Aleixo, 2000)

[12] Relvas, C. (1970s) *Estúdio Fotográfico Carlos Relvas,* Lisboa: Instituto Português do Património arquitectónico (IPPAR), available at: http://www.ippar.pt/pls/dippar/pat_pesq_detalhe?code_pass=74450 (ccessed on 04-11-2007)

Figure 68 – *Casa-Estúdio Carlos Relvas*, in Golegã – Portugal (Relvas, 2002)

Figure 69 – *Casa-Estúdio Carlos Relvas*, in Golegã – Portugal (Mestre & Aleixo, 2003)

The lack of information regarding the previous rehabilitation interventions, among the four case studies, is probably consequent from the liberty to not present accurate plans of the interventions undertaken on the built environment. From the smaller scale to the bigger scales of interventions, the local authorities and respective experts could help sustaining the involved actors with lifespan consciousness.

As hypothesised, the design process played a different and more important role within the building process for listed buildings, than for unlisted buildings. Both safeguard institutions have played a fundamental role in the design process; in the Netherlands more influential on specific design decisions than in Portugal. Moreover, they also have to assess the quality of the design proposal, together with the local authorities and for listed buildings, no major difference was found at this specific stage of the building process.

Even if the level of lifespan consciousness remained the same from the listed to the unlisted buildings in the arguments presented; truth is that the pre-design reports were much more elaborated for the listed buildings than for the unlisted buildings. However, not always it is possible to develop a design process as complete as aimed due to e.g. time constraints, lack of information, etc. It is not only the quantity, but also the quality of the surveys and their sustenance in the design decisions that reveal how lifespan conscious designers are.

Similarly, in the two cases of unlisted buildings, Post chose for a common contractor and one neighbour specialised in wood restoration; while Mestre & Aleixo choose for specialised craftsmen that would be assigned for the construction, depending on the level of developments. Much different was the construction period of both listed buildings, where both safeguard institutions have controlled it as well.

In fact, Post found the solution of the construction work description with enough illustrations and descriptions of the different activities to compensate the lack of knowledge some contractors have for interventions in existing buildings. Instead, Mestre & Aleixo were more fortunate; as the contractor Ludgero de Castro is nationally acknowledged for the high quality construction works, undertaken in listed buildings.

Unsurprisingly, the duration of the construction works were longer in Portugal, than in the Netherlands. But, that regards the construction sector in general and not only the rehabilitation interventions. Mestre & Aleixo also mentioned their interest in developing further the design proposals and specific execution details together with the craftsmen. Accordingly, they are often far more acknowledged in their craftsmanship and it always useful to learn from such craftsmen. After all, it is practical knowledge that is vanishing.

■ The design processes followed in rehabilitation designs

Architects have followed in both situations, rehabilitation of listed and unlisted buildings, similar design processes and dealt with similar problems.

Post developed a brief **feasibility survey**, before buying *Villa Honingen*, to determine if his aims for buying such building and the required rehabilitation intervention would be feasible. Such survey, even if not yet part of the design process was of great importance and utility for the design developments. Unfortunately, due to time constraints, the resultant information was merely sensorial (e.g. visiting the building and environment, speaking with the involved actors, etc) and was not summarised in any report or document.

The only original documents found were **few photographs** on the attic of *Villa Honingen*. They were of great contribution to understanding the building. **Drawings** did not exist anymore, as in World War II the City of Rotterdam suffered severe fires and all drawings of the Municipal Archives were burnt. There were only found some **documents** at the **notary**, but they were not important for the design process.

Post also made a **geometric survey**, measuring all areas and distances within the building. When asked about this particular survey, he answered that it was inevitable for developing a good design. Because "Otherwise you cannot draw", he says.

As an inherent part of the geometric survey, Post has also made a **three-dimensional model** of *Villa Honingen* to facilitate the search for the correct dimensions and compositions. He used this model more as a testing object, rather than a presentation mean to convince the other involved actors about his ideas. Furthermore, he has **sketched**, **designed** and **detailed**.

The **material** and **pathological survey** were found quite important for the design developments, as well as the **colour survey**. In order to find the suitable colour for *Villa Honingen*, Post surveyed several **secondary buildings**, in other cities, and **interviewed their owners** about the colours which the building have had along time. His aims were to define the colour to use, based on the colours inventoried in other similar buildings.

Post mentioned the **aesthetical values** and the **social values** playing an important role in the design developments of *Villa Honingen*. As it was going to be his own residence, he was emotionally involved (emotional / social values) with the design developments and with the future of the building after the rehabilitation intervention. The **ecological values** were not the main priority in this rehabilitation intervention or in his design process. Nonetheless, Post improved these values by placing solar panels on the roof of *Villa Honingen*.

Villa Honingen was mostly evaluated with 'low' or 'very low' **condition**, except for its **substantial form** and **aesthetical performance**. The **lifespan performance** of the house was low. According to Post, all the inherent materials were identified already far beyond their predicted lifespans. Therefore, the design developments would have to make *Villa Honingen* become a pleasant place to live. So, the main aim of the intervention was to improve all **substances**, **features** and **performances**, in order to bring them on a 'high' or 'very high' scale. The substantial form and aesthetical performance, however, had to be maintained. The **technical performance** had a lower priority than the aesthetical one.

Post described the design process as a compromise between the pre-existence and the new existence. For example, he said that technically, he should have changed the windows and doors near the balcony, but he decided not to do it, due to the fact that such action would diminish its character and the respective inherent **aesthetical values**.

Also, the **significance assessment** of the design developments has shown considerable improvements from the pre-existence to the new existence. The **economic**, **political** and **ecological** values that have been rated as 'reasonable' in the pre-existence, have been rated respectively 'high' and 'very high', in the new-existence, together with all other cultural values.

When compared to the design process followed by Post at *Villa Honingen, KRZV 'De* Maas' was much more complex and required other level of surveys. The design developments were controlled by the *Rijksdienst voor Monumentenzorg* and they would require some mandatory surveys. For example, Post was asked to develop a thorough **chronological survey**, before starting the design phase. Accordingly, this chronological survey had a close connection with the evolution of the interior of the building and respective evolution of the aesthetical styles.

Post has also surveyed other aspects of the **physical inventory**, in order to have a good sustenance for his design decisions. The **aesthetical**, **material** and **pathological** surveys were undertaken for both exterior and interior of *KRZV 'De* Maas'. Particularly, the **colours** and **materials** of the exterior (façades and roofs) have been deeply surveyed.

All findings of the **physical inventory**, **significance assessment** and **condition assessment** were presented in a **report,** which served as a document to illustrate his decisions to the experts of the *Rijksdienst voor Monumentenzorg*. The report also contained the assessment results of the **technical** and **aesthetical** performance, which shall sustain further design strategies. This report was made before the first design developments. In fact, according to the *Rijksdienst voor Monumentenzorg,* the design process could not start, until their approval was conceded, based on the report.

The main aims of the Board of *KRZV 'De* Maas' regarding its rehabilitation intervention and which Post was willing to subscribe were to maintain its **function** as a meeting centre and restore its original pride and grandeur. It is these **social values** that have highly contributed to the social status of the Royal Dutch Rowing and Sailing Club 'De Maas'.

Instead, the experts of the *Rijksdienst voor Monumentenzorg* aimed differently. They were most concerned about the façade and respective **technical performance**. They have recommended a high scale restoration, respecting the aesthetics of the natural stone, ornaments, window openings, coloured brickwork, etc. Especially the large quantity of natural stone was remarkable, according to the them.

More interventive actions were reserved for the interior, where e.g. the "modern" tunnel vaulting was restored to the "art nouveau" cross vaulting. Consequently, the respective "art nouveau" decorations were restored; which was allowed because physical inventory of the pre-existence showed enough evidences of this period.

When comparing the design process followed for *Villa Honingen* with that, for *KRZV 'De* Maas' the second one denounces much more the subdivision of the design process in two stages: the stage where many surveys were undertaken towards the pre-existence and the stage towards the new existence than the first. There are also other surveys, e.g. chronological survey, required by the *Rijksdienst voor Monumentenzorg,* which were not undertaken at *Villa Honingen*.

Particularly, for *KRZV 'De* Maas' the combination between common and special surveys allowed Post to accurately perceive the valuable components of the original construction from the beginning of the century. Post followed his own design process; nonetheless, the control of the *Rijksdienst voor Monumentenzorg* has influenced many of the design decisions. Its experts would be the ones evaluating the rehabilitation according to their own settled boundaries.

Back to the unlisted buildings, but now in Portugal, Mestre & Aleixo were very well acquainted with *Casa Pereira da Silva*; even before the parents of Aleixo have shown interest to rehabilitate it. Despite the familiarity, they have undertaken a **survey of the pre-existence**, just as in any other rehabilitation design assignment.

Similarly to Villa Honingen they could not find much **technical documentation**. They mostly retrieved information from neighbours and close family, who were willing to share their **memories** about *Casa Pereira da Silva* and its environment. In the search for information, they also went to the **municipality**, but there they found nothing. There was found no registry archived from earlier interventions at *Casa Pereira da Silva*.

Most information Mestre & Aleixo could retrieve was, similarly to Villa Honingen, from **old photographs**. Difference was that in *Casa Pereira da Silva* they could hardly find photographs specifically focused on the building. So, they had to search further among the **family photographs** taken on special occasions, e.g. wedding photographs, where the building has served as background. They also managed to retrieve an **aerial photograph** by searching on **internet**.

Mestre & Aleixo made a **geometric survey** of the whole building and new drawings of the façade, the roof and the interior spaces. At the **colour survey**, they have discovered that *Casa Pereira da Silva* has had several colours along time (pink, light blue, bordeaux), but according to Aleixo's mother, who still remembered from her childhood, the original colour was pink, just has it was last painted.

When asked about the differences of importance between the various surveys for the design developments, they found it complex and unnecessary to elect the most influential surveys. Mestre & Aleixo had been working on all surveys without isolating one aspect from the other, in terms of importance. Nonetheless, they did mention the **functional survey** of less importance, as the pre-existence has been previously converted to a residential facility, one apartment per floor.

Even if not explicitly surveyed in the pre-existence, the **social values** of *Casa Pereira da Silva* were found very high, especially because of the emotional values. But according to Aleixo, it should even have been higher: "Scale ten! This scale is very small!"

Also the **economic values** were rated high, but mostly influenced by its location. According to Mestre, when releasing the building from the emotional values and the principles of two architects deeply interested in built heritage, it had to be admitted that: "The value of the building was not in the building itself, but in the location with a view". The **aesthetical values** were considered of low importance, as the architects said: "It's of current value; it is not a brilliant object".

Like *Villa Honingen*, *Casa Pereira da Silva* was generally degraded. Mestre & Aleixo have lowly rated the **condition** of the **components**, **materials**, **climate**, **technical** and **lifespan performance**. So, consequently the design developments would have to improve such insufficient condition. Mestre & Aleixo did not see the need to aim for improving the **cultural values**, as they were rated quite high already.

When analysing the aims of the rehabilitation, the **substantial form** and the **aesthetical values** of the building had to be maintained. The **function** had to be restored. But the **components**, **materials**, **climate**, **technical** and **cost performance** had to be improved. Some **components** and **materials** had to be even replaced by either traditional or contemporary ones (i.e. the sandwich panels on the roof and the zinc finishings). The production complexity was maintained, except for the new roof; purposely designed to be **modern**, **reversible**, and **discernible from the pre-existence**.

Unlike *Casa Pereira da Silva* and like *KRZV 'De* Maas', there was much more information available regarding the *Casa-Estúdio Carlos Relvas*. Mestre & Aleixo did an extensive **documentary inventory**. They consulted IPPAR for all available **texts** and **photographs** referencing and illustrating the building. IPF provided them very important **information**, both **documentary** and **oral**, about the history of photography.

Moreover, in order to understand more about the functionality of a contemporary photographic studio, they have visited **secondary buildings**, counting particularly with the cooperation of Studio FotoVicente to illustrate them the relevant issues of a photographic studio. In **bookstores** they also found **books** about Carlos Relvas, the former owner of the *Casa-Estúdio Carlos Relvas*. Much information about the building they also retrieved from the **original registries** which the owner, Carlos Relvas, had kept for his own administration.

In the **physical inventory,** Mestre & Aleixo paid a lot of attention to the **geometric survey**, because they had obtained one from IPPAR, but that one required few corrections. Mestre and Aleixo developed several surveys, among which **aesthetical** and **pathological** surveys could be found, with no less importance than the **geometric survey**. In fact, to insure accuracy, the pathological survey undertaken in the pre-design stage, was complemented during the construction works.

The pathological survey has also included some **laboratory tests** and **consultation** for identifying the correct pathology and determining the most suitable treatment, e.g. plasterwork. During the pre-design stage it was not possible to undertake the **colour survey**, as most illustrations were back-and-white. The original colours were only traceable on the walls of the building, during the construction works, supported by field experts.

When asked about the significance of the building as pre-existence, Mestre & Aleixo assessed the **historic** and **scientific values** of *Casa-Estúdio Carlos Relvas* 'very high'; because such building is not only part of the history of the region and part of art history, but its construction combines various innovative XIX century techniques. Instead, the **political** and **social values** were rated relatively low, when compared to the other values.

Although the building was considered of high importance to the photographic community, who would come to Golegã exclusively to visit the building from all over the world; *Casa-Estúdio Carlos Relvas* was neglected by the majority. In fact, the raise of interest from the local community only occurred after the rehabilitation intervention. That was, stated Mestre & Aleixo, the reason for such low assessment on its inherent social values.

Accordingly, the general condition of the building was low. It needed intervention on almost all levels of performance. The only feature, presented by the researcher which was assessed of high condition was the **production complexity**, as the building contained a lot of industrial products. Nonetheless, such assessment is somehow related to the **scientific values** of the building, rather than with its effective condition.

Due to the fact that the rehabilitation intervention was won by Mestre & Aleixo in a competition: *Metodologias de Intervenção* (Methodologies of Intervention), the **pre-design results** were asked to be presented in a **separate report**, to be delivered to the **safeguard institution** IPPAR, the organizing commission of this competition. But, Mestre & Aleixo also emphasised that pre-design reports are normally not a common requirement in rehabilitation design developments.

The main aim of the rehabilitation design of *Casa-Estúdio Carlos Relvas* was to emphasise its identity, enabling its contemporary use from a different perspective, more contemplative and museological. Unlike all other case studies, the **function** was converted from House-Studio to Museum and Documentation Centre.

Consequently, at the design stage, the architects surveyed more deeply few **secondary buildings**, with the support of IPF. But, this time they focused on the development and requirements of a contemporary photographic studio, as well as, of photographic museums. Moreover, to complement such visits, they have also searched in **libraries**, for **books** and **publications**, referencing contemporary photographic museums. Information about related legislation was found on **internet**.

In order to match the building with the new function, the main strategy in terms of condition was to improve the **substances** (physical), **performances** (technical) and few other **features**, in order to bring them till the level high or whenever possible, 'very high'. The **materials**, **aesthetical performance** and **production complexity** could be maintained, because they were already highly evaluated in the pre-design stage.

In fact, in the design stage, many values did not decrease nor increase, because they were already on a high level. Particularly, the **political values** increased due to the president of the **local authorities**, who started using *Museu Carlos Relvas* as a symbol of his political ambitions, while before the local authorities have shown no particular interest in the building. Although already on a high level, due to the soil price, the economic values have increased, because the same valorous soil was now hosting the valorous *Museu Carlos Relvas*.

Even if the local community raised its interest for the recent *Museu Carlos Relvas,* it was not enough to raise of the social values. Therefore, Mestre & Aleixo have decided to keep the **social values** as reasonable. Inversely, the overall condition of the **substances**, **features** and **performances** has increased, generally from a low to a high evaluation.

When the construction work was finished, Mestre & Aleixo produced a **final report**, together with the contractor. This report was delivered to the safeguard institution, IPPAR. The drawings were not changed after construction work, because it was carried out strictly according to the final design.

■ The universe of subtractions, remainings and additions

The correlation between subtractions, remainings and additions was considered by the designers; even before being presented by the researcher.

As earlier mentioned, *Villa Honingen* was found in quite a bad condition. In order to improve its condition and due to time constraints, the architect was forced to take some rigorous decisions, e.g. demolishing the pavement at the ground floor in order to enable the reinforcement of the foundations. The **subtracted** pavement was not reused, but sent to a recycle installation, which is obliged in the Netherlands.

The rehabilitation of the balcony caused several discussions, again with the constructor. Even if it was clearly in very low condition, it was considered by Post of high significance, so he did not want to substitute it completely, as naturally proposed by the constructor. Post ordered him to only substitute the lower part, which was unfortunately in such a state that would not allow any possible restoration intervention. Instead, the upper part with the wooden decorations **remained**.

The brick walls, as well as, the window frames **remained** at *Villa Honingen*. The roof tiles were replaced by new ones; but Post designed all **additions** with the clear aim to maintain the inherent aesthetical values. The interior spaces were adapted to the future inhabitants of the house, only two people. In order to have a more spacious and comfortable room upstairs, Post chose to create a connection between two rooms through a small

opening in a partition wall, and convert them into one bigger room. Also, one room was changed to a bathroom.

Facing the established program, Post has chosen to design an **addition** to the building. This new functional area integrated the kitchen and dinning room, at the back side of *Villa Honingen*. An existing window was used to create the connection between the living room and this **added** functional area. Such choice has also avoided further interventions to integrate the modern requirements of a kitchen in the pre-existence, reducing unnecessary **subtractions**.

During the rehabilitation of *KRZV 'De* Maas' the **additions** dated 1935, characteristic from the modern movement were **subtracted** from the building and the **remaining** original (1910) elements were restored, as much as possible. There were also some parts that had disappeared during the years, e.g. the horizontal ceiling panels. These had to be reconstructed, based on photographs.

Also some of the wall panels were removed during earlier rehabilitations. As there were still a few left, these have served as example for the ones to be reconstructed. The biggest reconstruction, however, was the one of the constructive part of the ceiling.

A very interesting element Post discovered was the original woodcarving ventilation grille. This was covered by plasterwork on wire netting **added** by a previous rehabilitation intervention. This plasterwork was planned to be **subtracted** and the new ventilation system was connected to the original grille.

At the exterior, Post designed the replacement of the joints between the bricks, due to their low condition. Instead, the *Rijksdienst voor Monumentenzorg* was afraid such action would damage the building aesthetics. So, together they decided to carefully repair the joints; accepting the fact that this was a less durable solution and that every two years the joints would had to be controlled for degradation. Instead, the roof has been completely reconstructed and the tiles were replaced, but the original green colour was maintained.

At a similar scale, Mestre & Aleixo have chosen to **subtract** most pre-existence of *Casa Pereira da Silva* which would be assessed of too low condition and significance. In 1995 with the rehabilitation intervention on the ground floor, that was the case of the tiles finishing the walls and floors; which were not only outdated, as they were promoting unacceptable water infiltrations.

They have also designed the replacement of the fix fittings, from both kitchen and bathroom. In order to facilitate maintenance activities to the beams of the first floor and **add** a new layer of sound insulation, the existing ceiling was **subtracted** and afterwards gypsum boards were placed to cover the **added** layer of insulation.

The original window frames, made of wood, were found too degraded. So, they had no other choice than to **subtract** them. The **added** window frames were made of aluminium, but chosen with the same thickness as the original wooden ones, so that the visual aspect of the façade would be maintained. They also **added** aluminium hatches, to better shield both windows and indoor climate.

In 2001, with the rehabilitation intervention on the first floor, Mestre & Aleixo designed not so much intervention in the interior of *Casa Pereira da Silva*. Mainly, they have removed all the painting of the wooden plinths, interior hatches and doors and applied clear varnish. The windows were replaced. Mestre & Aleixo managed to apply the same profiles they had used 6 years ago for the ground floor. They also **remained** original wooden hatches.

They also designed a kitchen and bathroom that would fit the modern requirements. Originally, only sleeping rooms were built with the construction of the first floor. With the sub-division of the building in two apartments, a temporary kitchen and bathroom were **added**.

Nonetheless, as many temporary solutions, these ones lasted longer than expected and did not have the proper conditions.

As the roof was found too degraded, it was completely **subtracted**. The architects decided to place contemporary elements as metal sandwich panels on a new wooden structure. They also **added** a metal belt around the house, on top of the walls, to spread the load of the new roof. After placing the new roof elements, they have reused the original tiles, properly **subtracted** to be cleaned.

Mestre & Aleixo discovered on photographs that the roof in earlier times had a window opening. Its structure was still there, but it had been hidden from sight by the roof covering. By replacing the roof, the window opening was placed again. They also took the opportunity to bring back the zinc elements, produced on the traditional way by an old craftsman.

When comparing the **subtractions** with the **remainings**, Mestre & Aleixo gave more importance to the **remainings** and to the connections between additions and remainings. Accordingly, except from the new kitchen and bathroom there were hardly **added** elements. The roof was also completely **subtracted**, but afterwards a new roof was **added** on the same place. The **additions** were inside the building and connected (kitchen, bathroom). The connections of the ceiling, however, were made reversible as well as the roof construction, which only contained dry connections.

Similar to Post at *KRZV 'De* Maas', Mestre & Aleixo, **subtracted** the **additions** from earlier rehabilitation interventions at *Casa-Estúdio Carlos Relvas*, in order to bring the building back to its original state, the innovative Photographic Studio of Carlos Relvas. The priority in the design was to restore the **remainings** with much attention and accuracy.

However, the building had to be made compatible to its new function, as *Museu Carlos Relvas*. Therefore, the architects **added** an underground tunnel – a gallery for temporary exhibitions - where all technical infrastructures would be located, connecting the main building with the photographic studio, at the Garden Pavilion. A new nucleus of stairs was also drawn in harmony with the nucleus of stairs at the main building.

Such allocation of all technical infrastructures has strongly contributed to a minimal impact on the main building. Purposely, most **additions** were located outside and apart from the original building, so that the pre-existence would also not be affected by the modern aesthetics of the **additions**. Moreover, the underground tunnel was located deep enough to not even touch the foundations of the pre-existence.

The **remainings** were mostly consolidated. The connections between the **remainings** and the **additions** were made chirurgically and mostly reversible. Another particular example of the lifespan consciousness of both architects was the partial relocation of the roof tiles, from the main building to the roof of the Garden Pavilion. The exceeding roof tiles were stored in a municipal archive, in case future interventions would decide to add them to the main building again.

- **The appointed successes in rehabilitation designs**

  Architects revealed evidences of lifespan consciousness and respective ecological sustenance on both rehabilitation design developments.

A common starting point from both Post and Mestre & Aleixo was their unanimous agreement with the researcher that the position of an architect dealing with an unlisted building should be no different than when dealing with listed buildings. Accordingly, buildings

are different and so are the legislated requirements, for both categories of buildings. Nonetheless, architects should be able to treating all buildings equally.

Post is very experienced in rehabilitation designs and lifespan-oriented buildings. In *Villa Honingen* however, he stated not to have focused on lifespan principles, but on carefully integrating the past with the present. By lifespan-principles, he meant the ones he would normally apply for new lifespan-oriented buildings. Nonetheless, on the perspective of this doctoral research, he has clearly shown proofs of lifespan consciousness, finding a balance between decisions involving the building's past, present and future.

Denouncing his lifespan consciousness toward the future, Post stated that he has had various discussions with the contractor. For example they argued about substituting wooden columns by steel columns covered with wood, because of the construction safety. The architect was sure that no steel was needed; the wood had sufficient strength, because in history contractors have always used it and there were enough evidenced of its quality. Calculations proved he was right and convinced the contractor.

Post did not particularly plan future changes and also no specific measures were applied to the volume added in the new existence, e.g. to make it more or less expandable. This choice was made purposely, to reduce the risk of harming the building in favour of allowing possible changes. He just wanted to keep the connections "clean and clear", to enable deconstruction and that was again a clear evidence of his lifespan consciousness.

Accordingly, the appointed successes in the rehabilitation intervention on *Villa Honingen* lay on several aspects. One is the recognition of the building and respective significance (e.g. appearance, façades, character, etc). Other is the ability to maintain such significance in the design developments; mostly involving social, historic and aesthetical values. Another is to combine such recognition of significance, with the respective adaptation to the modern requirements and possibilities of use for the future.

The appointed successes were found similar in both *KRZV 'De* Maas' and *Villa Honingen*. Nonetheless, there was one considerable difference and that was the involvement of the experts from the *Rijksdienst voor Monumentenzorg*. Right from the beginning, they have been involved in the design process.

Post mentioned the dilemma facing the original building and the "modern" intervention of 1935. The *Rijksdienst voor Monumentenzorg* had to decide whether to accept Post's strategy to restore the building back to its original state or to define the rehabilitation of 1935 as point of departure. In these cases the experts of the *Rijksdienst voor Monumentenzorg* were objectively looking for the qualities of the building and not to the new existence planned by both architect and owner, to rehabilitate its significance and condition of both building and environment. As Post said: "They are not interested in what we want with it, they are interested in what they think is important in the building".

The decision was made to restore it back to the situation of 1910, with the cross vaulting, because it had enough well preserved original parts hidden behind the elements of the later renovations. Even the end parts of the cross vaulting were found still in tact, with their original decorations.

Moreover, he has mentioned a very interesting aspect of rehabilitation interventions in listed buildings; which shall also be mentioned further on by Mestre & Aleixo and that has attained the attention of the researcher on the first years of this doctoral research, while surveying the relevant literature. Post stated that the opinions of the experts about the way interventions are undertaken differ in time. He even joked about it, saying: "Sometimes you can better wait for some years (in order to have your vision accepted)".

The rehabilitation of *KRZV 'De* Maas' was focussed on restoring the aesthetical values of the original building (1910) and with that, revealing its age values. The oldest elements of the building, those from 1910, have been covered in 1935 due to modernistic principles. Now, with a more eclectic perception over style, Post had the honour to uncover them through his design developments. The lifespan of the building would be comprehensible and accordingly, "everyone could perceive the real age of the building".

Moreover, even if the function remained unchanged, the social values were improved with this intervention. Therefore, taking in consideration that such achievement was one of the main aims of both architect and board of *KRZV 'De* Maas', not only the architect was pleased with the end result; but also, its owner has decreed it as a successful rehabilitation intervention.

During the interview, Post has also mentioned another rehabilitation design; which clearly denounces his lifespan consciousness and ecological awareness. "They had renovated it ten years before, and they changed the window frames from wood to plastic, but I changed it back [to wood]. Because it was a problem for the environment to throw away such plastics, we relocated the plastics on the backside of the houses, so one could no longer see it. (…) We changed the building so, that it looked like it was".

Casa Pereira da Silva gained a new live with the rehabilitation intervention of Mestre & Aleixo. The condition of the pre-existence was considerably low. Water was entering in the building through varied places, e.g. roof, window frames, etc; and especially the first floor was found without a proper bathroom and the kitchen was not equipped according to the demands of the XXI century. The rehabilitation intervention undertaken in 1995 had excluded the exterior from the construction works, e.g. exterior walls, roof, etc.

By intervening thoroughly in 2001, *Casa Pereira da Silva* turned into two apartments of full value. The one located at the ground floor is being used by the parents of Sofia Aleixo, while the upper apartment is used as the weekend house, for the architects. After this rehabilitation, the building will last technically and functionally at least one generation again.

Therefore, it can be stated that thanks to the periodical rehabilitation interventions, *Casa Pereira da Silva* has remained in the family of Aleixo for already four generations; first attaining the needs of her grandparents, then of her parents and most currently of herself and her children. This is a true evidence that unlisted buildings can last longer than their estimated lifespans, as long as the involved actors perceive their significance and are willing to challenge those same lifespans.

Evidences of their lifespan consciousness are present on every decision taken during this design process; even if as with Post, they do not realise how particular their methods are. Their choices to maintain what of high condition and significance and restrict the subtractions to what of low condition and significance is not so common to find. Particularly, their openness to accept that sometimes choices, considered most adequate, can be found unsuitable later and that there is always something new to learn from the involved actors.

Not only Post, but also Mestre & Aleixo considered the importance to perceive the real age of the building and respective evolution. For this reason, the same dilemma which emerged at *KRZV 'De* Maas', has also emerged in *Casa-Estúdio Carlos Relvas*. Curiously, both architects have chosen to restore the building till its original status.

Mestre & Aleixo considered both *Estúdio* Carlos Relvas and *Casa-Estúdio* Carlos Relvas of equal significance. If one would recall the innovative photographic studio built in the end of the last century; the other would recall how exactly Carlos Relvas would live and work in the same environment. Accordingly, they are also part of the history of the building. Therefore, they did not want to waste them, even if they would have to be subtracted.

The lifespan consciousness of Mestre and Aleixo is clearly illustrated by the way they treated the subtractions. The solution was to store all which would not be relocated, in a municipal archive elsewhere in the village. Consequently, future interventors could not only follow the complete evolution process of the building, fully documented by the pre-design and design studies undertaken by Mestre and Aleixo. They could also find the subtracted substances, well preserved evidences of the past, in the Municipal Archive.

This solution would even enable future generations to restore the building, till the situation before Mestre & Aleixo rehabilitated it; in case time would change the public opinion and their intervention would be considered harmful, if society would give, more significance to the substances the architects subtracted, rather then to the ones that were remained.

By giving the building a more public function, the high level of aesthetical values could be shared with more people, then the family of Carlos Relvas or the neighbours. The rehabilitation made the building become more valuable for the present society. The spaces needed for this new function, which would not be compatible with the main building, were located in a separate building, the Garden Pavilion.

The Garden Pavilion was located about 10 meters away from the main building. Consequently, in future, changes could be made to one of the buildings, without influencing and/or compromising the other. The main building, however, is still not well prepared to host large groups of people. Such hosting performance would bring too much intervention.

So, Mestre & Aleixo have created a functional structure, where the Garden Pavilion would host all public intensive functions, while the main building would only be visited when necessary and carefully monitored. This was the best solution found to conserve the pre-existence as much as possible.

The ecologic concern is not explicitly a trade mark of Mestre & Aleixo, but as they are intrinsically concerned with the building as an object, that should not be wasted, their designs implicitly have a high ecological value. According to Mestre, the presence of containers on a site “to throw away the building, is for us a symptom that something is going wrong, because the (building) parts cannot have such a disparaging value that whole buildings can be dismounted and sent away in containers to another place”.

In both rehabilitation designs, Mestre & Aleixo are used to work with a team of engineers and consultants. Their opinion is, that their “execution designs are not merely architectural designs, but designs of all specialties in architecture”. Eng. João Appleton is one of the engineers, with whom they like to work; always designing the construction integrated in the architecture, and vice versa. In one project the design was so well integrated that they said to themselves that they “just invented the architectural construction”.

They also mentioned the importance of proceeding with the design process during the construction works. Accordingly, the final adjustments can better be done together with the contractors and craftsmen. Mestre even stated: “The work starts. But the design continues. When the work finishes, the design is finished!” Unfortunately, this behaviour is misunderstood by engineers and constructors, in Portugal, used to rigid hierarchy.

When Mestre & Aleixo approach the craftsmen, often the engineers and contractors leading the construction works feel out of control. There have been complicated situations, where the workers were even forbidden to speak with the architects.

Mestre & Aleixo also complained that the time pressure under which the craftsmen have to finish their jobs is very high, resulting in inferior quality of the building. Mestre designed the intervention undertaken in *Palácio Marquês de Fronteira*. It took six years, and the workers were all volunteers with ages ranging from 60 to 75. But they went there every day fully enthusiastic and in the end they had a wonderful work done.

Post has also mentioned the progression of the design process during the construction works, in *Villa Honingen*. Nonetheless, in this case, such progression did not only provoke changes (and consequently delay and extra costs) for the contractor as the local authorities were not satisfied with these unexpected changes and stopped the construction works, until Post managed to convince them with the revised designs.

- **The interest in the theorised design process**

  Architects acknowledged the theorized design process, verified its usefulness, and provided direct comments that helped the researcher proceed with its revision.

When acquainted with the design process theorised by the researcher and her aim to develop a design process support system, Post stated that he believed that such "tool" would really support architects, particularly more the less lifespan conscious ones, enabling them of means to "recognize what is important". Such "tool" would help them developing rehabilitation designs "in a sure way"; so that they would control the advantages and disadvantages of their own methods and consequential results.

Post considered such theorised design process of great sustenance for both listed and unlisted buildings. Although in cases of listed buildings, he emphasised, architects should be aware of the influence of the experts of the *Rijksdienst voor Monumentenzorg* on the design decisions. Also, as they are involved obligatorily, automatically the architect is required to be more sensible, otherwise the rehabilitation design shall never be approved.

Also, after presented by the researcher, Mestre & Aleixo were convinced that the theorised design process would contribute to the quality of the rehabilitation design developments. Their opinion is that one can never have enough information about a building, when is developing its rehabilitation. In 25 years of practical experience, they have created a collection of approximately seventy thousand images, black and white and coloured.

This conscious way of working can also be traced in their designs. It is quite different from many other actors in the building process, which causes them a terrible construction phase. They are "accused" for having too many drawings, in which they have drawn everything until the last detail.

When they first saw the questionnaire to sustain the interview and respective theorised design process, Mestre & Aleixo were a bit frightened by its apparent rigidity. Nonetheless, after the interview, noticing that there was enough space and flexibility to put attention to the 'romances' of the design developments, they considered it very valuable.

At the moment of the interview they considered that there was still some complexity in the way of presenting the theorised design process, probably due to the fact that was still being developed and revised, but were confident the researcher would solve such complexity and develop a design process and respective implementation, RE-ARCHITECTURE®, that would sustain architects very well.

6.2.2 THE LIFESPAN REHABILITATION DESIGN PROCESS

For the purpose of testing and revising the design theory involving the theorised design process for a lifespan conscious rehabilitation, the researcher decided to supervise two groups of students, one from the Netherlands and one from Portugal, while developing a rehabilitation design development.

The **Experimental Group**, from the Netherlands, was formed by ten BSc. students attending the Architectural and Technology profile (AT) at Eindhoven University of Technology (TU/e). This was a T6 project (second year), during September – November 2005. As the researcher integrated a group of tutors, lecturing the same project, it was possible to ask the cooperation of the other tutors and create a **Control Group**.

The **Experimental Group**, from Portugal, consisted of eighteen MSc. students attending the "Urban Rehabilitation" course (fifth year), at *Instituto Superior Teixeira Gomes* (ISMAT), during January – March 2006. Such international experience was only possible due to a Socrates / Erasmus Protocol (European Commission Program), signed especially to join these two Institutions for this particular experience and exchange of knowledge.

Dr. Eng. Ad Vermeltfoort (TU/e) and Arch. Isabel Valverde (ISMAT) accepted the challenge to cooperate with this research and test with their students the design process (still a model) theorized in this research. As earlier referenced (*vide* Acknowledgements), trainee Bruno Godinho has also assisted the researcher and the Arch. Isabel Valverde tutoring the second experimental group.

Figure 70 – The water tower, in Helmond (TU/e, 2005)

Figure 71 – The water tower, in Vila Real de Santo António (Pereira Roders, 2006)

As the Coordinator of the AT – T6 project had already chosen the Water Tower in Helmond (*vide* Figure 70), as case study for the rehabilitation design, the researcher and Arch. Isabel Valverde organized a pre-research, undertaken by the students from Portugal, to identify all existent Water Towers, in the region of Algarve, Portugal. The outcome of this pre-research and some lectures, was that the water tower in Vila Real de Santo António (*vide* Figure 71) would became their case study.

Even if the two experimental groups differed on the level of graduation and respective acquired knowledge, the researcher did not expect that such difference would influence the final results. Depending on the academic year, the tutors and the courses followed by each student; there are, unfortunately, high probabilities that such student arrived to the MSc. level without ever having been lectured and/or developed rehabilitation interventions.

Architecture programs are still mainly focused on building new, rather than providing knowledge on all different scales of intervention on the built environment. So, their level of graduation and respective acquired knowledge would not necessarily mean that their previous experiences would allow them to perform differently. Nonetheless, even if both had the same assignment, the results expected were not equally assessed. At this point, their differences were taken into consideration.

6.2.2.1 METHOD

THE MEANS TO VERIFY THE HYPOTHESES THROUGH PRACTICES

To better control the evolution of the students, the researcher developed two questionnaires to be filled in by the involved students: Questionnaire A2 (Pre-Survey) before being acquainted with the design process (stimulus) and Questionnaire A3 (Post-Survey) after the stimulus. The differences between the answers would determine how useful the theorised design process could be for designers involved in rehabilitation design developments.

The control group filled in both questionnaires, just as the experimental group, before and after performing the same rehabilitation design development. However, they did not get acquainted with the theorized design process (no stimulus). Figure 72 illustrates the test method and how it enables varied comparison and correlation levels between the results extracted from both questionnaires.

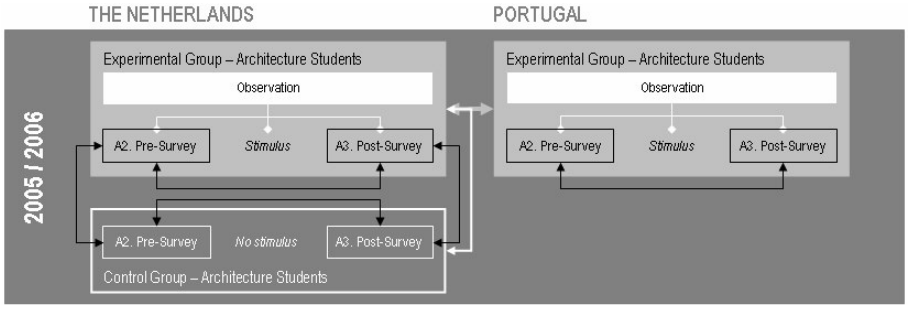


Figure 72 – The test method (2005/2006)

As these experiences were being undertaken during the period, when the researcher was constantly developing and revising the theorised design process; the model provided to the experimental group from the Netherlands (*vide* Figure 73) was not the same presented to the experimental group from Portugal (*vide* Figure 74). The main differences are the introduction of the Oral Inventories and the Environment Surveys and Assessments.

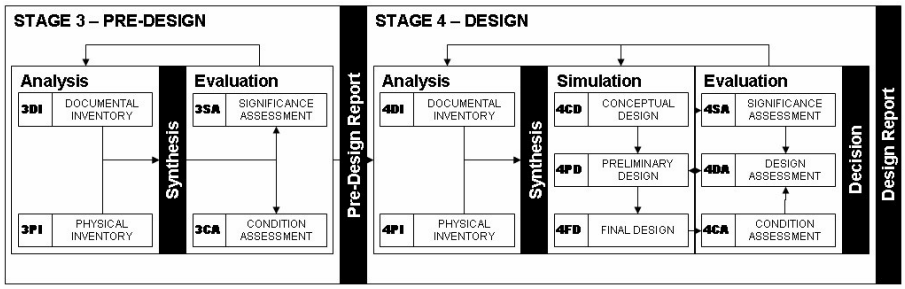


Figure 73 - The lifespan rehabilitation: design process (fifth version)

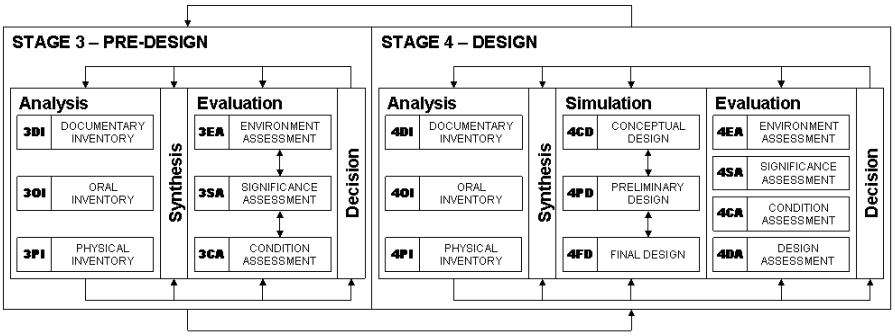


Figure 74 – The lifespan rehabilitation design process (last version)

Even if both groups followed a similar schedule of ten weeks, the orientation of the experimental group from Portugal was quite different from the one of the experimental group from the Netherlands; again trying to learn from the previous experience. While the experimental group from the Netherlands was tutored week by week, following a small reader explaining the theorised process; the experimental group from Portugal was initially lectured theoretically, stage by stage; before initiating the design process.

There were two main reasons for such difference on the orientation methods. One was the fact that the students from the experimental group from the Netherlands not always understood what one stage would require from the reader, but would also not always ask the researcher what to do. Second was the fact that the researcher would only visit the experimental group from Portugal, at the beginning of the semester.

So, this was the method found where the researcher would optimise her limited time in Portugal and immediately capture the students' doubts on specific stages to explain them personally what to do. Even if later, the researcher would be available online during the whole semester, there is nothing better than a clear beginning. Moreover, many principles which the researcher did not have time to register and that shall emerge with the publication RE-ARCHITECTURE *scapus* could be easily transmitted orally.

Initiated with the experimental group from the Netherlands, but consolidated with the experimental group from Portugal, the researcher used a team work method, with which the Pre-design report would be the produced with the contribution of all students. Such method would enable the transmission of information through all stages and activities, through all

involved students. Therefore, in every activity from a particular sub-stage (e.g. significance assessment) there would be always students from the three previous ones (documentary, oral and physical inventory).

Table 1 illustrates the team work method used with the experimental group from Portugal. There were eighteen students, a perfect number for applying such method. The group representatives highlighted in light grey (students 1, 2, 7, 8, 13 and 14) would insure the integrity of the group through the various mutations.

Instead, the remaining students highlighted in dark grey (students 3, 4, 9, 10, 15 and 16) and the students in white (students 5, 6, 11, 12, 17 and 18) would act as informers. Their responsibility was to take the information retrieved from the previous group to the next one.

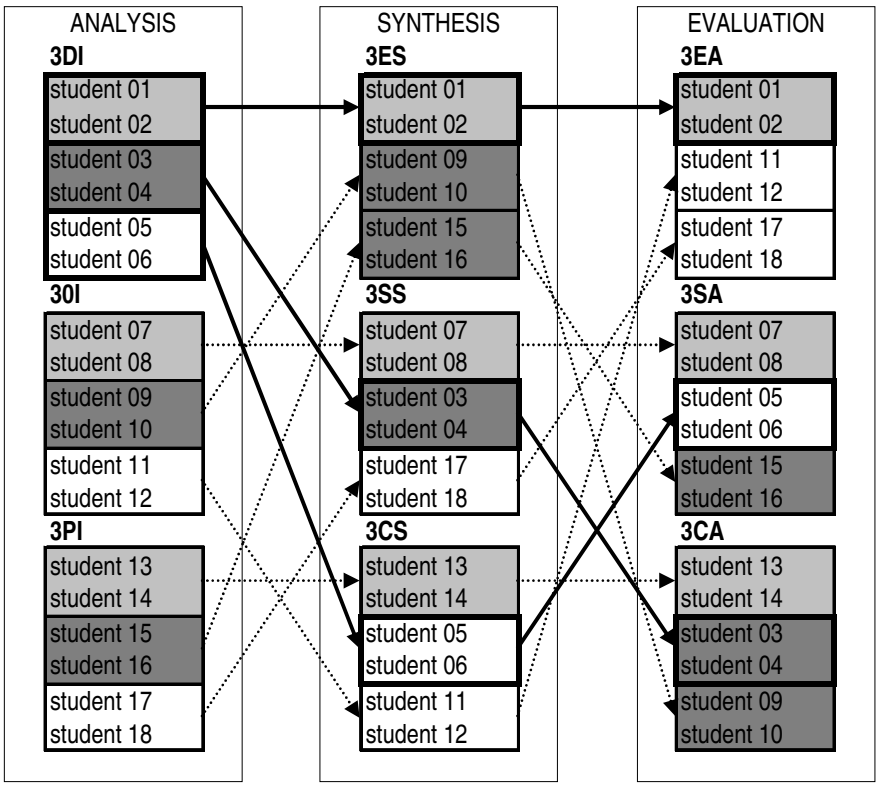


Table 1 – Team work method for the Pre-design stage

Also the education methods changed in the two stages of the design process. At the pre-design stage tutors would clarify the uncertainties of the students and comment their developments of the previous week activities, instructing them on what to do during the following week and respective related theory and guidelines. At the design stage, lessons had no longer the main purpose to instruct the students theoretically, but to provide critics and guide their design developments.

6.2.2.2 MOTIVATION AND ASSUMPTIONS

THE REASONING BEHIND THE HYPOTHESES

The theorised design process had clear motivations, resulting from the aim to contribute to the preservation of both natural and built heritage through lifespan conscious rehabilitation design developments of obsolete built heritage. However, so far, lifespan consciousness did become neither regular, nor evident at current rehabilitation design developments.

This experience and respective retrieved information shall allow the researcher to evaluate the effective need for sustaining designers of lifespan consciousness and to determine the effective contribution of the theorised design process, respective guidelines and tools. Faults and virtues shall be identified and shall certainly sustain the researcher on the optimisation of the current developments that shall be retested and verified again, at the next test period.

The control group and the two experimental groups, from the Netherlands and Portugal, represented two different European cultures and respective reactions. Tendentiously, the researcher assumed that the students from the Netherlands would be more open to lifespan consciousness than the students from Portugal. They had the advantage to be raised and educated in an environment where lifespan consciousness and ecological awareness has been proved successful by several prototypes and case studies. However, at least these two experimental groups have proved it differently.

The Pre-Survey (Questionnaire A2) shall provide the researcher with information enough to survey the initial level of lifespan consciousness presented by the students. For the students at the experimental groups, this shall reveal the status before getting acquainted with the theorised design process (stimulus). For the students at the control group, this shall reveal the status before the beginning of the 'common' rehabilitation design developments.

The Survey (Observation) shall bring extra information to sustain the researcher reaching conclusions that cannot be reached exclusively with the information provided by the answers to the questions at both Pre-Survey and Post-Survey. The researcher has registered such information during the design developments and the weekly meetings with the students at both experimental groups.

While the students from the Netherlands were observed directly, the students from Portugal were observed at distance, making use of the modern communication technologies (e.g. Skype). The researcher has only visited them at the beginning and end of the trimester. Nonetheless, they were attentively followed and oriented by Arch. Valverde and the trainee Godinho, who were enough acquainted with the theorised method and aims of this doctoral research.

Moreover, the researcher organised a mini-conference for the mid-term presentation of the students from Portugal, which most students from the experimental group from the Netherlands also attended. This exchange allowed the students to receive comments and to advance with their rehabilitation design developments.

The Post-Survey (Questionnaire A3) shall provide the researcher with information enough to survey the final level of lifespan consciousness presented by the students. For the students from the experimental groups, this shall reveal the status after getting acquainted with the theorised design process (stimulus). For the students from the control group, this shall reveal the status moment after the conclusion of the 'common' rehabilitation design developments.

The motivations and assumptions involving the method to collect data from a Pre-Survey (Questionnaire A2), Survey (Observation) and Post-Survey (Questionnaire A3) were subdivided into the following eight main themes. To enable a global understanding, just as in the previous Chapter, these same themes shall reappear at the results (*vide* Chapter 6.2.2.3).

On some details, the Questionnaires A2 and A3 differed slightly. The consequence is that the same question can have a different question number in Questionnaire A2 and A3. The correlation however, is made based on the questions and not on the question numbers.

- **The experience in developing rehabilitation designs**

  Students with experience in developing rehabilitation designs shall answer more lifespan consciously, than the inexperienced ones.

The researcher planned to identify the experience in developing rehabilitation designs, and to verify if such experience would influence the quality of the answers provided by the sampled students. Hence, question **A2.01** allowed the researcher to survey all data and information retrieved through the variable **experience**, which had only two possible values: **yes** or **no**.

Such variable could become relevant or not, dependant on the similarities and differences identified in the answers of students from the same group and/or different groups. In addition, it would also provide an indication to the researcher on how frequent students from these groups developed rehabilitation designs at their own faculties.

- **The perspective on developing rehabilitation designs**

  Students with different perspectives than the pure architecture-oriented ones shall react differently to the theorized design process.

Similar to question **A2.01,** question **A3.01** enabled the researcher to survey all data and information retrieved through a variable. However, this time the variable was **perspective** and had a total number of eight values: **architect**, **building process manager**, **urban planner**, **researcher / professor**, **building technology engineer**, **building physics engineer**, **structural engineer**, and **other**.

This variable could become particularly important for the students, at both experimental and control group from the Netherlands; as at the BSc. level students aiming for different graduations attend the same design studios. Instead, this would not be relevant for the students from Portugal, as they were MSc. architecture students in their last year of graduation. Such information could justify perspective-related deviations of the answers.

- **The interest in developing rehabilitation designs**

  Students shall show interest in developing rehabilitation designs; however, they shall mostly prioritize the novelties and required additions.

Question **A2.02** meant to discover if students found their previous design interesting, and most important of all, aimed to identify the student's considerations about their rehabilitation perception and motives to consider it interesting. For purposes of synthesis their

considerations were filtered according to the relationship between the pre-existence and the new existence (subtractions, remainings and additions).

When, re-questioning it again in question **A3.02,** the researcher would be provided with feedback on the design studio and retrieve enough data and information to accurately compare the arguments and identify respective similarities and differences. Already at the arguments used to sustain the answer to this question, potential raises of lifespan consciousness can be traceable, whenever present.

- **The design processes followed in rehabilitation designs**

  Students shall have followed similar design processes and dealt with similar problems, already before following the theorised design process.

To reach better conclusions regarding the design processes followed in rehabilitation designs, by the sampled students; three questions were placed in Questionnaire A2 and repeated in Questionnaire A3. Question **A2.03** / **A3.03** would identify if the design process followed by the students was tutored by the tutor, decided by the student or a mixture of both; its stages, approximate time (hours) and usefulness (yes/no).

Question **A2.04** / **A3.05** would identify if there were particular aspects, which were less successful in their design process. This could mark potential problematic stages that require more/less time, theoretical support, etc. Last, Question **A2.05** / **A3.06** shall allow the researcher to identify particular stages with more need to theoretical support; common sources of knowledge and the potential for a theoretical support through the internet.

- **The universe of subtractions, remainings and additions**

  The correlation between subtractions, remainings and additions shall not be considered by the students; but shall grow while following the design process.

To better control the perception of the students regarding the universe of the subtractions, remainings and additions; the researcher introduced seven main questions in Questionnaire A3. Question **A3.10** aimed to supply the researcher with the importance given by the students to these three realities; as well as the importance given to the connections between remainings and additions, in the new existence.

Instead, questions **A3.11** till **A3.14** aimed to inventory more information about their design decisions related to these four realities, as well as few illustrative examples from their own rehabilitation designs. Last, questions **A3.15** and **A3.16** would supply the researcher with the approximate percentual relation between subtractions and remainings and between additions and remainings.

- **The importance of rehabilitation interventions**

  The importance of rehabilitation interventions shall achieve much more sustenance on ecological arguments by the students, rather than other cultural-oriented arguments.

At this level, students were not only asked about the importance to rehabilitate existing buildings, but also about the arguments that support such judgement. Question **A2.06** / **A3.07** allowed the researcher to filter the answers of all students, and depict the most

inherent cultural values, inclusive from the answers of the inexperienced students, derived from the previous questions.

In Questionnaire 3, an extra sub-question was added to question **A3.07**, with the purpose to make the students express clearly their judgement on which existing buildings should be rehabilitated and which should be demolished. Even if this sub-question was not explicit in Questionnaire 2, students have argued accordingly and the researcher was willing to identify a possible correlation with the previous sub-question.

- **The appointed successes in rehabilitation designs**

  Students shall easily identify successful rehabilitation designs; however, their definitions and appointed successes shall seldom match.

Question **A2.07** / **A3.08** aimed to identify if the students would be able to reference rehabilitation designs and respective architects, which they would consider as successful. Further, they would be asked to define a successful rehabilitation design; which would provide the researcher the required arguments necessary to understand their choices of reference, as well as compare them to the rehabilitation theorised as lifespan conscious.

To support advanced conclusions, Question **A3.09** focused on their self-evaluation, appointing successes in the rehabilitation design described in Questionnaire A3. Intentionally, this question was placed just after Question **A3.08** so that not only the researcher, but also the student could eventually formulate logic correlations. After all, the appointed successes in other designs should be comparable to their ones appointed in their own designs.

- **The interest in the theorised design process**

  Due to its apparent rationality, students shall first confront the theorized design process and progressively verify its usefulness.

Exclusive from Questionnaire A3, question **A3.04** asked the students about getting theoretical support, concerning the different stages and/ or activities of the design process (methodology). While for the control group, the question was if it would have helped; for the experimental groups the question was if it did help; becoming more conscious of the building lifespan and its environment, raising the quality of your rehabilitation design.

The aim of such question was to identify how students would react or how they did react to the support through a theorised design process, with pre-established stages and/or activities. Particularly, the answers of the students from the experimental groups would reveal the advantages and disadvantages of such approach, its contribution to the raise of lifespan consciousness and respective raise of quality in the rehabilitation designs proposed.

6.2.2.3 RESULTS

THE HYPOTHESES VERSUS PRACTICES

This Chapter summarises the results of the experimental and control groups, through the answers of the students on Questionnaire A2 and A3, as well as through the Observations registered by the researcher on both experimental groups. Questionnaire A2 had a total number of seven main questions and eight sub-questions (*vide* Appendix 4); while Questionnaire A3, sixteen main questions and twenty-one sub-questions (*vide* Appendix 5).

Consequently, some of the themes which shall be surveyed in this chapter and that were already presented at the previous chapter do not find sustenance on all three sources of information, but only two of them, e.g. pre-survey and observation or observation and post-survey. This fact shall be dependent on the questions that sustain such theme.

First time for many students, this AT - T6 project was also for some the second trial (named as *inhaalproject*). Arch. Walraven and Arch. Hauben tutored **group 1** and Arch. Hauben and Eng. Lamers tutored **group 2**. The researcher and Dr. Eng. Vermeltfoort tutored **group 3**. Thirty-four students applied for this project. Group 1 and 2 had both twelve students (35%) and group 3 had ten students (30%). From Portugal, **group 4** had initially nineteen students and was tutored by the researcher together with Arch. Valverde.

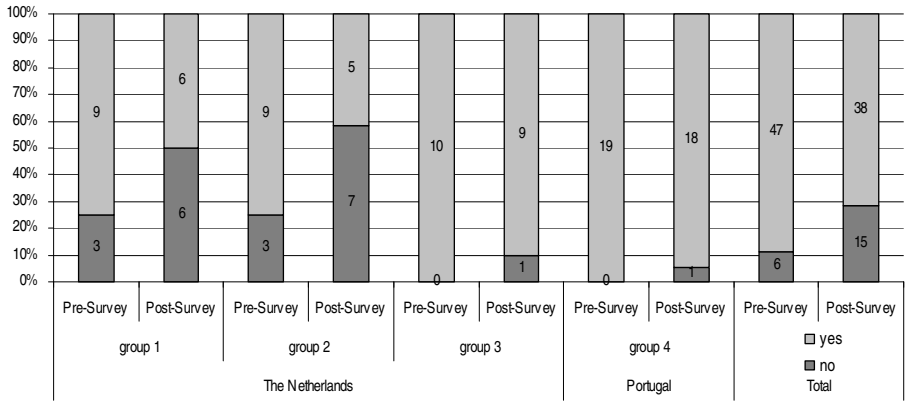


Figure 75 – The overview of the students that participated at the surveys

In order to reach a comparable sample between the experimental and control groups, the researcher verified how many students from each group filled in both Pre and Post Survey. As the characteristics of group 1 and 2 (both control groups from the Netherlands) were equal, the researcher decided to join them.

The smallest number of students that filled in both surveys was found in group 3, the experimental group from the Netherlands, where nine students filled in both surveys. So, the limiting sample was set to nine. The sample number in the control group from the Netherlands (group 1+2) and in the experimental group (group 4) from Portugal, was reached by excluding several students from the Survey, first due to inexperience in rehabilitation designs (question A2.01) and the reduced contribution to the Survey with their answers.

■ The experience in developing rehabilitation designs

Students with experience in developing rehabilitation designs did not answer more lifespan consciously, than the inexperienced ones.

When asked about their experience in developing rehabilitation designs, predictably, not all students answered positively. From the experimental group, such inexperience was stated by more students from The Netherlands than from Portugal. From the control group, even less students confirmed the same inexperience in developing rehabilitation designs (*vide* Figure 76). In Questionnaire A2 all inexperienced students were asked to go directly to question A2.6. Therefore, for the following themes, the answers given by those with previous experience in rehabilitation design developments shall only be surveyed.

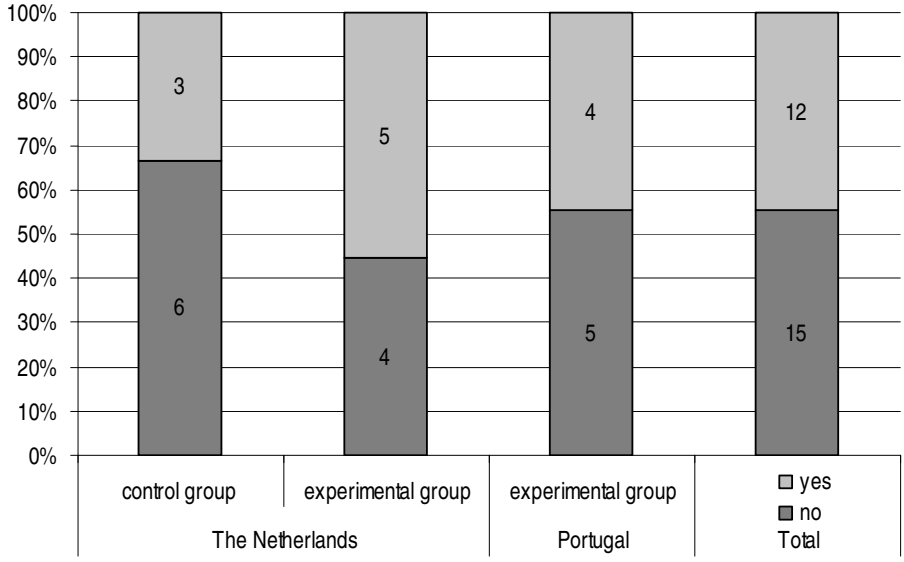


Figure 76 – The experience in developing rehabilitation designs

These results sustain the alert for architectural education this doctoral research is willing to transmit. This may not be as serious for the students from the Netherlands as they were still at the BSc. level; but it becomes serious when the students from Portugal are inexperienced in developing rehabilitation designs on the last year of their graduation. Soon, they would become architects, probably developing rehabilitation interventions, without any proper education.

Therefore, independent from their answers being true or not, the students choose to answer 'no' on statement if they had experience in rehabilitation developments. There is a possibility that they did not understand the question or did not want to answer correctly (in order to skip some questions to answer), but for the researcher this denounces the priorities of the educational programs, mostly oriented towards building new than towards the built environment.

That was not only perceptible at Questionnaire A2, but also during the trimester, through the observations. Unaware of the techniques and guidelines involving rehabilitation interventions nor most other interventions in the built environment, students would try to implement the techniques and guidelines of building new, which they considered themselves to be fully acquainted of, after being lectured on the last years of their graduation, as well as constantly publicised through media as practices of success (e.g. magazines, television, etc).

Moreover, through Observation, the researcher realised that there was not much relationship between lifespan consciousness and the designer's experience in developing rehabilitation interventions. Most students would present themselves very confident about their own principles; independent from their previous experience, even if often such principles would not have strong sustenance, nor be clearly understandable.

Inexperience would not necessarily mean lifespan unconsciousness, but instead, their behaviour and guiding principles could lead them towards such unconsciousness. At this point, there were clear differences of behaviour between the students from the Netherlands and from Portugal. While the first challenged and denied the guidelines, the second were more motivated and committed to the challenge of testing a pioneering design process and respective guidelines. Probably that had to do with maturity. After all, the students from Portugal were MSc. Students, as well as working-students. Nonetheless, students at the BSc. level should be more open to new experiences and not consider their own methods already sufficient and successful, right at their first years of graduation, without even trying to learn from other methods, respective advantages and disadvantages.

- **The perspective on developing rehabilitation designs**

  Students with different perspectives than the pure architecture-oriented ones reacted similarly to the theorized design process.

When asked about their professional expectations in Questionnaire A3, all students from the experimental groups answered that becoming an architect was their first choice. Instead, at the control group, there was one student who chose building technology engineer and another student who did not answer the question (*vide* Figure 77). Other professional expectations were also referenced, but not by all students. There were referenced three other professional expectations by the control group and six by the experimental group from the Netherlands; and five by the experimental group from Portugal (*vide* Figure 78).

Probably, students from Portugal did not select any Engineering-related option because Architecture and Engineering are not as strongly connected in Portugal as they are in the Netherlands, where several Faculties of Architecture are both programmatic and physically attached to the Faculties of Building Physics, Civil Engineering, etc.

The parameter **professional expectation** was to denounce if in fact, students with different perspectives would accept the theorized design process better than the pure architecture-oriented ones. However, neither on their answers to the Post-Survey, nor through their behaviours observed during the trimester; the researcher has identified influences which would result from such parameter.

The researcher has hypothesised that such difference would emerge particularly at the students from the Netherlands. But, in fact, that was not the case. Again, as described in the previous theme, lifespan consciousness would not serve influences on this matter. Probably, because lifespan consciousness is not restricted to architects, but to all actors of the building process.

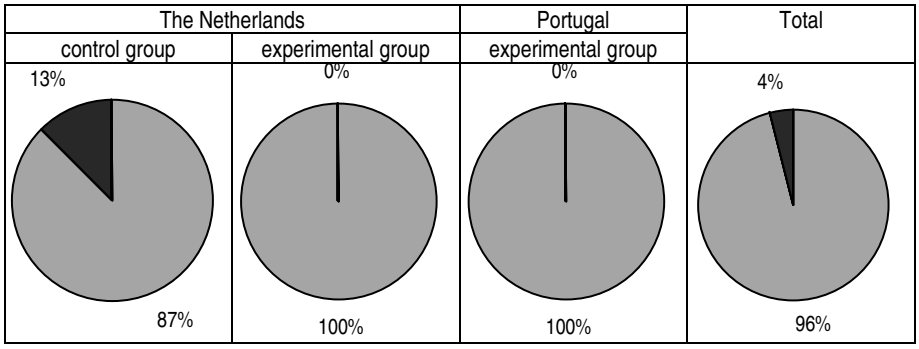


Figure 77 – The first choice at the professional expectations of the students, after graduation

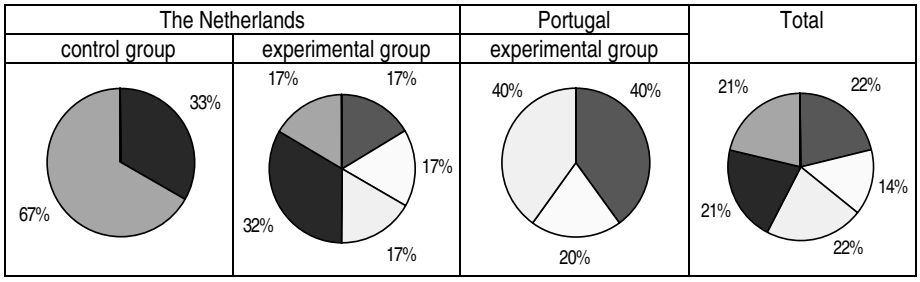


Figure 78 – Other choices at the professional expectations of the students, after graduation

Moreover, the students from the sample have revealed a stronger tendency towards architectural developments, and until a certain limit, have also shown inclination to understand how their aims could be implemented technologically. But, in this case they are not the only ones to blame. The time factor has also influenced the final results, tendentiously wider on the architectural, than on the technological developments.

But, again there were few differences between the Netherlands and Portugal. Due to their work experience, students from Portugal did not have much time available, but still they were enough motivated. Particularly at the pre-design stage, some students even brought the related-knowledge from their work, e.g. costs management, and shared it with the group.

- **The interest in developing rehabilitation designs**

  Students showed interest in developing rehabilitation designs and learned to consider past and future even if still mostly prioritizing present and respective novelties.

Most students have stated their interest in developing rehabilitation designs in Questionnaire A2 (*vide* Figure 79). Nonetheless, from the Netherlands there were two students from the control group and one from the experimental group, who found it uninteresting. Only one student, from the control group presented sustaining arguments.

The motive for such disinterest was the degree of complexity and unattractiveness of the assignment, as well as, the incompatibility between what was functionally supplied by the pre-existence and what was required for the new existence. The first argument sustains the argument presented by the researcher regarding the lack of attention towards the different scales of intervention on the built environment in the architectural education program.

Moreover, the second argument on functional compatibilities is quite relevant and challenging. Unfortunately, functional compatibilities are too often neglected in the feasibility stage, normally preceding the design process in rehabilitation interventions. Consequently, such incompatibility results in very intrusive rehabilitations, when converting the modest pre-existence into the pretentious new-existence.

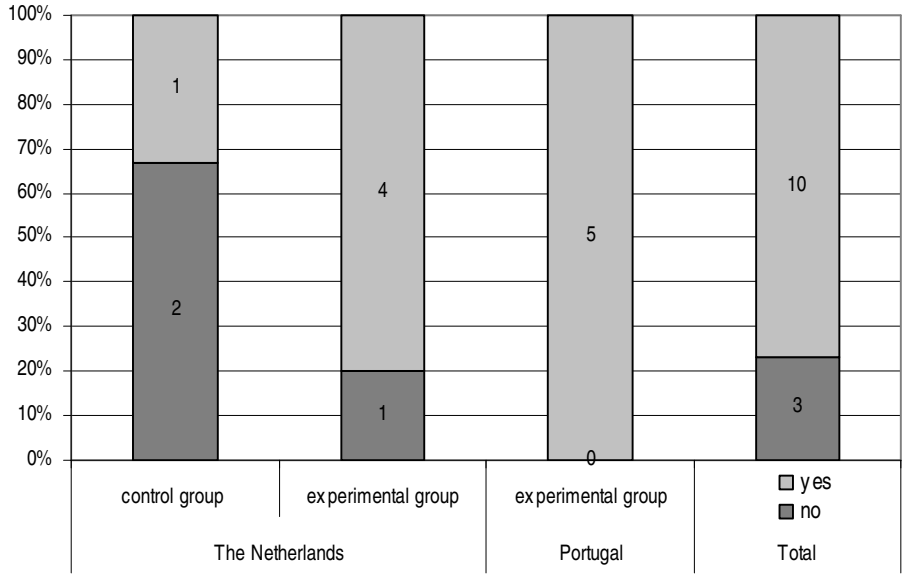


Figure 79 – The interest of the students on developing rehabilitation designs

The arguments presented by the students stating their interest, revealed a very important dichotomy every designer involved in rehabilitation interventions has to deal with: pre-existence versus new existence. Some students referenced more than one motivation, so the following synthesis joined more arguments than the total number of students.

When comparing their arguments, it is remarkable to verify that there were hardly any mentioned which would be solely related to the pre-existence. The closest argument is the one presented by two students from Netherlands, who mentioned the challenge to determine what to subtract and what to remain from the pre-existence.

Instead, both experimental groups argued the interest in dealing with the new existence related to the respective additions. In this category, the challenge to add new functions / requirements and spaces was most referenced. This means that they were mostly interested in the present, rather than the past or future. A second point of agreement was the interest to connect remainings and additions.

Lifespan consciousness in rehabilitation interventions is reached whenever designers harmoniously consider the past, present and future of the building and respective environment in their design developments (*vide* book I – *basis*). Therefore, and facing the initial state of "lifespan unconsciousness", the researcher was curious to verify if such experience would raise their initial state to a higher state of "lifespan consciousness".

While observing the students from the experimental groups, purposely dealing with unlisted buildings which would be generally considered by society as obsolete and valueless, the researcher has noticed a progressive raise of lifespan consciousness in their behaviours, as well as in their design developments. Nonetheless, it was curious to verify that their arguments would tendentiously refer to the present, e.g. what they could do with the building, prioritizing all novelties and benefits, etc; mostly reflecting the new-existence.

Even stronger among the students from the Netherlands, than among the students from Portugal, the pre-existence would not be as perceptible as the new existence in their sustaining arguments, when presenting their design developments. Nonetheless, by the end of the trimester there were already more references to both past and future than at the beginning of the trimester. So, that achievement was a truly point of success.

Unlike the students from the Netherlands, the students from Portugal were particularly more interested in testing the theorised design process and discover in how it would influence their lifespan consciousness and respective arguments. Therefore, it is no surprise when the students from Portugal present higher raises of lifespan consciousness that the ones from the Netherlands; fighting till the end for the importance of present achievements and neglecting the consequences for both past and future.

When the trimester ended and students were asked again about their interest in the rehabilitation design developed, in Questionnaire A3, the most curious situation occurred. Students argued their interest not only on the building and respective rehabilitation intervention. They have also argued their interest in the experience itself, as well as on the theorised design process. While the students from Portugal mostly argued either on the new existence (56%) or on the design process itself (44%), all students from the Netherlands argued on the design process, and – as more answers were possible – also a reasonable number on the new existence (78%).

Regarding the arguments related to the building and respective rehabilitation, students from the three groups argued the interest in the **past** and on dealing with respective remainings from the pre-existence. Unsurprisingly, the students from the Netherlands have directly prioritised the remainings together with the additions and respective present achievements. This behaviour confirmed the previous observations.

Nonetheless, when comparing the control group with the experimental groups, it is possible to identify more lifespan consciousness on managing the subtractions, a more minimal design; and particularly exclusive from the students from Portugal, the interest in designing with new / alternative energies and adequately add the new functions and services.

Regarding the arguments which are design process-oriented, the only two negative were presented by students from the Netherlands. First argument was its rigidity and the second was the extension of the Analysis. The researcher believes, that on the last argument the student was mentioning the Pre-Design stage.

As positive arguments, both groups mentioned the level of knowledge raised during the design process; the adequacy and importance of such design process; and the positive influence of the clearness of the assignment, boundaries and schedule on the final results. Moreover, one student from the Netherlands emphasised the importance of taking decisions,

based on the Pre-Design stage; while three students from Portugal argued its sustenance on keeping track on all aspects / steps to be considered.

Back to their rehabilitation interventions, Questionnaire A3 has also asked the students about the advantages of their design developments. When ordering their arguments according to the primary aims (*vide* book II – *scapus*); it is interesting to verify that, few were the arguments found reflecting aims to decrease (3%) and restore (5%); when compared to the aims to maintain (29%) improve (35%) and replace (28%).

The most referenced advantage was the aims to replace areas, functions and/or services, followed by the aims to maintain the building characteristics and/or features. The aims to improve the building areas, functions and/or services; as well as, the social values of its surrounding environment were particularly mentioned by both experimental groups.

The students from the experimental group from the Netherlands emphasised the importance of the building identity, style and status through their aims to maintain and improve it, in sight of both building and environment. From Portugal, instead, one student denounced aims to decrease demolition and consequent loss of resources; while two others mentioned the importance to restore the materials lifespans. They have also mentioned the importance to restore and/or maintain the inherent cultural values of both building and environment, among which the ecological values were mentioned too.

When asked for the most important factors, which have clearly influenced their designs, students who presented architectural factors related them more to the pre-existence (46%) than to the new existence (12%). Inversely, the ones presenting technological factors related them more to the new existence (33%) than to the pre-existence (9%).

The “essence and/or original qualities” of the pre-existence was the only factor found referenced by the three groups. In fact, unsurprisingly, the three groups have presented several factors related to inherent aesthetical values of the pre-existence, e.g. its “verticality and height”, “construction”, etc. Both groups from the Netherlands have mentioned building physical aspects; e.g. natural ventilation, etc.

The experimental group from Portugal has pointed the building physics, particularly regarding renewable energies, introduced in the new existence; together with the control group. Moreover, they have also emphasised the new existence, through its “reversible constructions”, “sustainable constructions”, and “recycled and/or reused materials” from the pre-existence into the new existence.

Therefore, not only have architecture students from the Netherlands and Portugal shown interest in developing rehabilitation designs; during the process they have started to open their horizons beyond the present and respective novelties. Even if it still remains as priority number one, students became more aware about the building’s past and future and the raise of lifespan consciousness is also noticeable in their arguments.

■ The design processes followed in rehabilitation designs

Students followed similar design processes and dealt with similar problems, before and while following the theorised design process.

In Questionnaire A2, most students answered that the guidance in their preceding design processes was a compromise between the one instructed by the teacher and their own (*vide* Figure 80). From the Netherlands, only two students from the experimental group affirmed to have followed their own design process; and one student from the control group admitted to have followed the design process (methodology) instructed by the teacher.

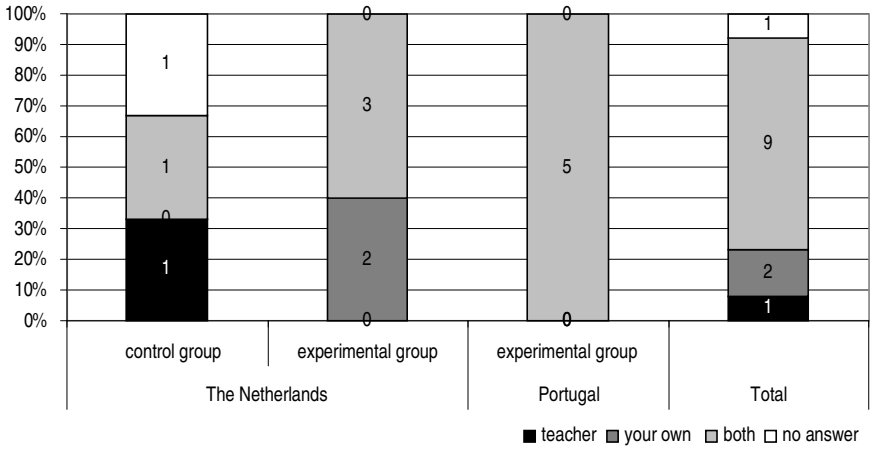


Figure 80 – The design process followed in rehabilitation designs

From their preceding design processes, the students described more activities related to the Design, than to the Pre-Design stage (*vide* Figure 81). Some particular sub-stages were not even found mentioned. Those were the evaluation (3EV) and decision (3DE), in the Pre-Design stage and the analysis (4AN), in the Design stage.

Within Pre-Design stage, the three groups identified activities of analysis (3AN) and both experimental groups identified activities of synthesis (3SY). Within the Design stage, all students mentioned activities of simulation (4SI), reaching a percentage incomparable to all other sub-stages. Synthesis (4SY) and evaluation (4EV) were mentioned by both experimental groups; and decision (4DE) was only mentioned by students from Portugal.

Together with the description of the activities, students were asked about the time and usefulness of each activity. Nonetheless, as some answered in hours, others in weeks, it was not possible to survey the relationship between the time dedicated to each sub-stage within their preceding design process, to later compare it to the theorised design process.

Despite the lack of information regarding time, the activities were considered as useful by all students, except by one from the control group. Accordingly, he considered the Analysis sub-stage as useless, however, he also stated to have spent two hours for it. No Analysis, with such short duration, can be considered useful for the design developments.

Most students (83%) answered yes, when asked in Questionnaire A2 if, looking backwards, they would have followed a different design process. The one student from the control group, who has previously affirmed to have followed the design process tutored by the teacher, here states that he would have followed his own way, “a more architectural view for the design instead of a physiological way”. Still from the control group, another argued “more importance to the analysis and to better integrate the concept in the design”.

Both experimental groups argued better time management strategies. Students from the Netherlands particularly argued the need for “an explicit evaluation moment after my preliminary design”, and the interest in different design processes. Instead, students from Portugal have argued improvements on their simulation activities, e.g. conceptual design, “decisions at the material level”, etc.

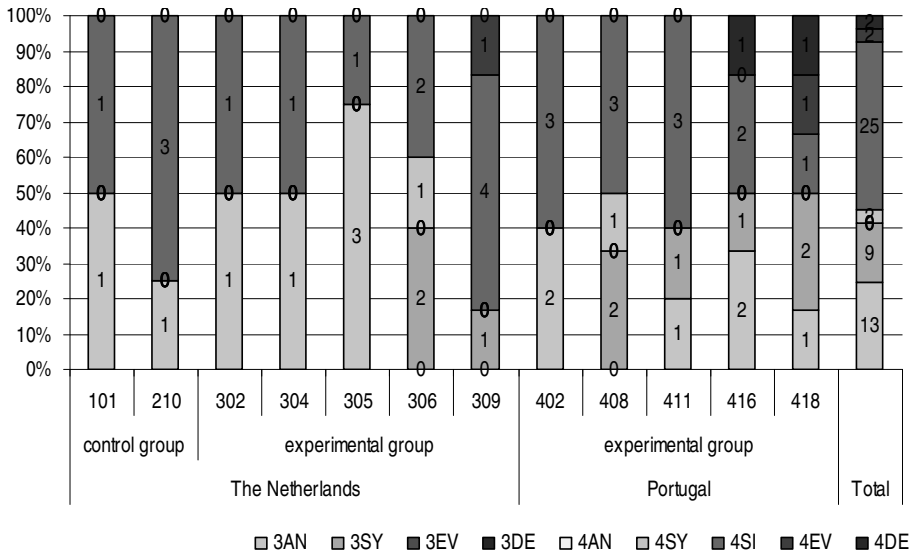


Figure 81 – The activities within the preceding design processes

Most students stated to have needed extra-support in any stage of the design process. Extra-support by the teacher was the most referenced at all three groups. Students from the Netherlands referenced their colleagues as extra-support; while the students from Portugal preferred to get extra-support from books and/or from the expertise, e.g. contractors, architects, historians, etc. Curiously, no student from the Netherlands has mentioned books as extra-support. Instead, internet was mentioned by both experimental groups.

Not all students defined a specific sub-stage or activities where they required extra-support, but the few that actually described it, mostly referenced the simulation sub-stage.

Generally, during the trimester the researcher has observed clear time management difficulties, related to the fact that often students would have to go forward to the next sub-stage, without having completed the previous sub-stage. Due to its newness in design processes and to not having been instructed previously, the difference between the sub-stages of analysis and synthesis, as well as of evaluation, at both pre-design and design stages, had to be constantly explained.

Particularly, the students from the Netherlands showed clear difficulties surveying all inventoried data, which method was deliberately not explained. Inversely, when explained, students from Portugal have shown clear progresses. The similar situation happened at the evaluation sub-stages, where the students from Netherlands denoted more difficulties playing a passive role, disregarding their own opinion and taste.

The answers to Questionnaire A3 showed that curiously, even after having followed a theorised design process during the whole trimester, most students maintained their methods of reaching a compromise between the theorised and their own design processes (*vide* Figure 82). Also, resulting from Questionnaire A3, when comparing the activities described by the students, the researcher could conclude that the Design stage has gained even more importance with the theorised design process, than it had at the preceding design processes (*vide* Figure 83).

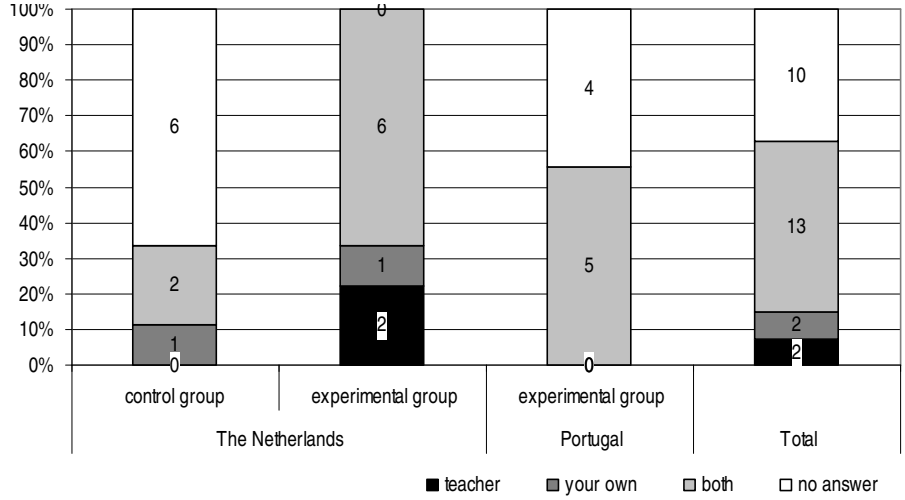


Figure 82 – The design process followed by the students

Nonetheless, such assumption can not be taken so literally, for the simple reason that; both groups from the Netherlands have considerably increased their number of activities, to an average of six activities each. Probably, this means that most additional activities were undertaken in the Design stage, instead of in the Pre-Design stage (*vide* Figure 83).

At this point, the distinction between the control group and the experimental groups becomes very clear. The control group identified only the activities of the analysis sub-stage (3AN), while both experimental groups identified activities from all other theorised sub-stages; respectively, synthesis (3SY), evaluation (3EV) and decision (3DE).

Regarding the design stage, again all students have identified a considerable number of activities of simulation (4SI), almost half of the total number of activities (48%). This time, activities of synthesis (4SY) and decision (4DE) were referenced by the three groups; while activities of analysis (4AN) were only described by both experimental groups; and activities of evaluation (4EV) by the experimental group from Portugal.

In Questionnaire A3, students have answered properly the periods of time spent in each activity/stage, due to the introduction of the time scale with the values - **0-5**; **5-10**; **10-20**; **20-40** and **>40** hours. Even if these results cannot be compared with the preceding design process, they shall be comparable to the following ones.

In the pre-design stage, most students have spent more time at the analysis sub-stage than at any other sub-stages; the control group spending 10-20 hours and the experimental groups 20-40 hours. A similar pattern can be found in the simulation sub-stage of the design stage, with all groups spending >40 hours. As at the preceding design process, most students have classified the activities they developed as useful.

When asked if they would have followed a deferent design process, most students stated yes (58%). However, those were not only from the experimental groups, but from the control group as well. Time management was again their common argument and most activities affected fall again in the simulation sub-stage of the design stage.

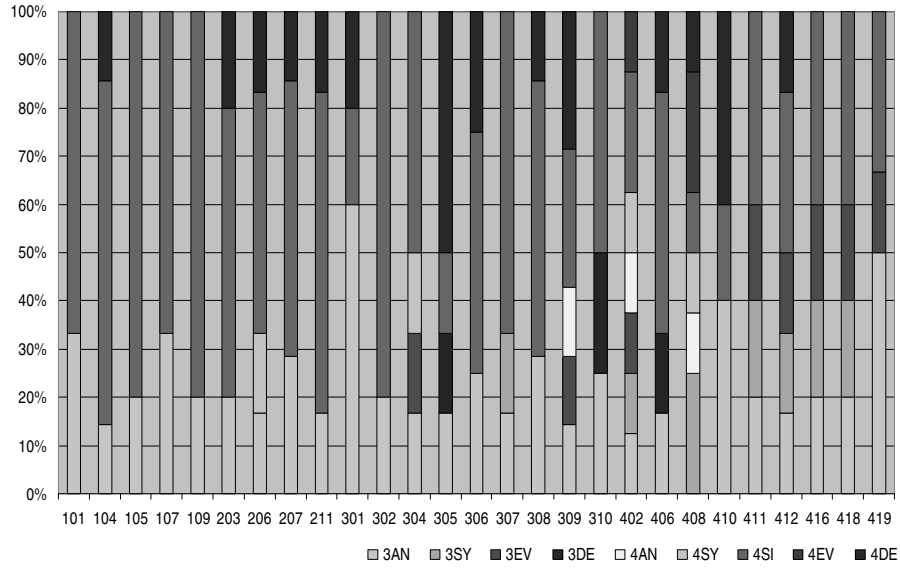


Figure 83 – The activities within the theorised design processes

From the Netherlands, also the sub-stages of analysis and report are mentioned; but curiously while some students complain to have had too little, others complain to have had too much time. Instead, students from Portugal mentioned the need for more time at the sub-stages of synthesis and evaluation. Those are, exactly the same stages for which they have searched for extra support.

Most students stated to have needed extra-support; and again, the teacher was the most referenced. Difference is that the library (e.g. books, technical catalogues, etc) and colleagues were referenced by students at the three groups, together with the internet. The students from Portugal have also mentioned experts.

Therefore, beyond the common concern for the sub-stages analysis and simulation; students from both experimental groups became more aware of other sub-stages, within the theorised design process. Moreover, students from Portugal have even tried to discover more about such "new" sub-stages, of no less importance than the most referenced ones.

- **The universe of subtractions, remainings and additions**

  The correlation between subtractions, remainings and additions was not considered by the students; but has grown while following the design process.

When asked to value the importance students have attributed in their design decisions to the building subtractions, remainings, additions and connections between remainings and additions (*vide* Figure 84); most students have chosen positive values (reasonable, high and very high), rather than negative values (low, very low).

In fact, the subtractions was the only that got few negative evaluations (37%). All other got hardly any negative evaluations (7%). All groups considered the **remainings** of high importance. From the Netherlands, students considered **additions** of very high importance, and the **connections** of reasonable / high importance.

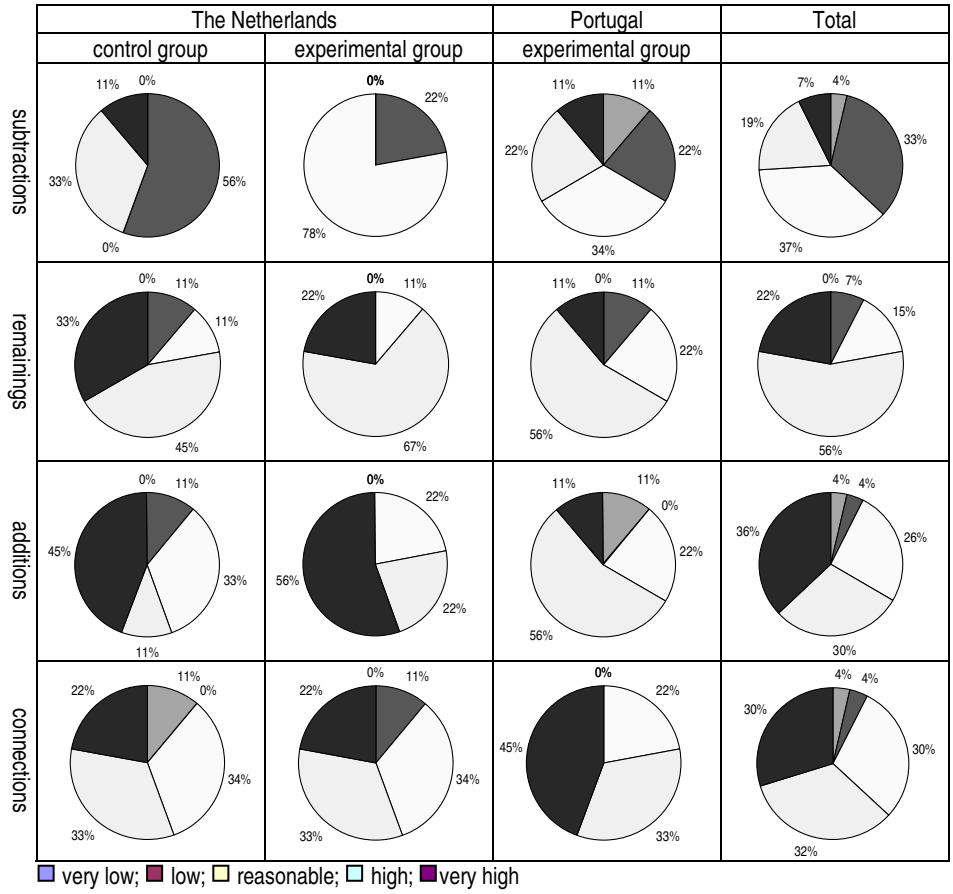


Figure 84 – The importance given to the subtractions, remainings, additions and connections

Only the **subtractions** were considered of low importance by the control group and of reasonable importance at the experimental group. Instead, From Portugal, students considered **subtractions** of reasonable importance, the **additions** of high importance and the **connections** of very high importance.

When asked in Questionnaire A3, most students (89%) at the control group affirmed to not have planned what to do with the building **subtractions**. In fact, even the ones who answered positively did not provide examples from their own design developments. Inversely, at the experimental groups, most students from the Netherlands and all students from Portugal affirmed to have planned what to do with the subtractions.

Students were also asked about their main aim towards the subtracted substances (*vide* Figure 85). Most students selected first to **recycle + reuse** at (building and site); followed likewise by to **reuse** (building) and by **re-use** (site), and last by to simply **recycle.**

At the experimental groups, students from the Netherlands have most selected to **reuse** (building), while the students from Portugal have most selected to **recycle + reuse** (building and site). Similarly, both groups followed with the main aims to **reuse** (site) and to

recycle + reuse (building and site). The least selected from the Netherlands was to recycle and from Portugal was to **reuse** (building). Portugal did not reference to recycle.

The examples provided at both experimental groups, mostly referred to the reuse of components, e.g. parts of roof, walls, etc; as well as recycle + reuse, e.g. concrete, bricks, glass, etc. There were also few particular cases of reuse of forms. From the Netherlands, one student reused the roof on the bicycle shads. From Portugal, one student reused the roof of the reservoir as the basin of a lake, at the garden surrounding the building.

Most students (81%) affirmed to have planned what to do with the **remainings**, however, more at both experimental groups than at the control group. More students selected to **consolidate** than to **repair** the remaining substances at building. However, the least chosen options were; to **reinforce** and the main aim to **arrest decay** (*vide* Figure 86).

From the Netherlands, students at the control group had as their main aim to **consolidate** followed by to **repair**. Instead, at the experimental group the main aims were similar to the most students. These last also referenced few examples; e.g. “repairing window frames” and “reinforcing the thermal insulation”.

From Portugal, more students had as their main aim to **repair** and less to **arrest decay**, **consolidate** and **reinforce**. The examples from their designs referred to repair the finishings / coating layer of the façades (e.g. stone, paint, etc), the metallic elements (e.g. grids, stairs, windows) and the existing structure; to consolidate the “finishings and the existing structure”; and to reinforce the “grids” and “thermal insulation”.

Unsurprisingly, all students answered to have planned what to do with the additions. As illustrated in Figure 87, the most chosen main aim was to locate the additions **outside (apart)** from the pre-existence (remainings); the second was to locate the additions **inside (connected)** to the building; the third was to locate the additions **inside (demountable)**; and the least referenced was to locate the additions **inside (loose)**.

Students at the control group have chosen the additions being mostly located **outside (apart**). The remaining students have chosen **inside**; either **connected**, **demountable** or **loose**. Their examples regarded the additions mostly located outside, e.g. a second tower “with contrasting materials”. Regarding additions inside the building; students referenced e.g. “loose floors with independent structure”, “demountable structural elements” and “fixed stairs”.

Still from the Netherlands, but at the experimental group students have only selected two main aims; to locate the additions **inside (connected)** and **outside (apart)**. Examples were similar to the ones at the control group. Nonetheless, they have particularly detailed the additions inside (connected) e.g. windows, extensions of floors, new floors, partition walls, thermal insulation materials.

Similar to the control group and to most students, the students from Portugal have mostly chosen to locate the additions **outside (apart)**. Then, they also chose to place them **inside, demountable** and **connected**. For the option to locate the additions outside (apart), one example was the exterior floors. Instead, for the option to place additions inside the building, students referenced the new apartments at the level of the reservoir, the new staircases, metal additions (e.g. mezzanines, stairs, walls, etc) and floors.

Most students (89%) affirmed to have particularly planned the connections; and they have first chosen for connections where the additions are **punctually fixed** to the remainings; together with the connections where the additions are **demountable**, easily detachable from the remainings. Third most chosen were the connections where the additions are **totally fixed** to the remainings. The least chosen were the **loose** connections (*vide* Figure 88).

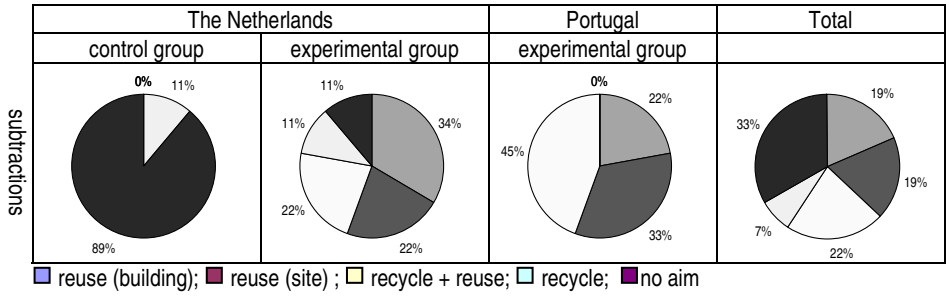


Figure 85 – The main aims towards the subtractions

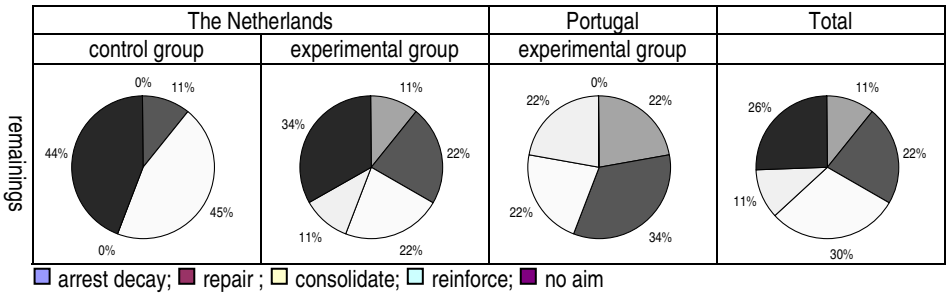


Figure 86 – The main aims towards the remainings

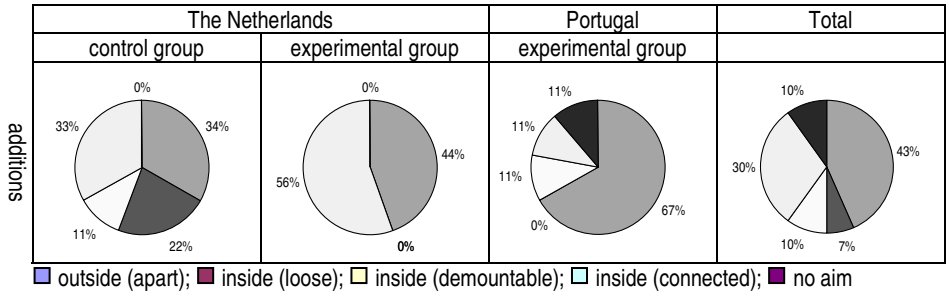


Figure 87 – The main aims towards the location of the additions

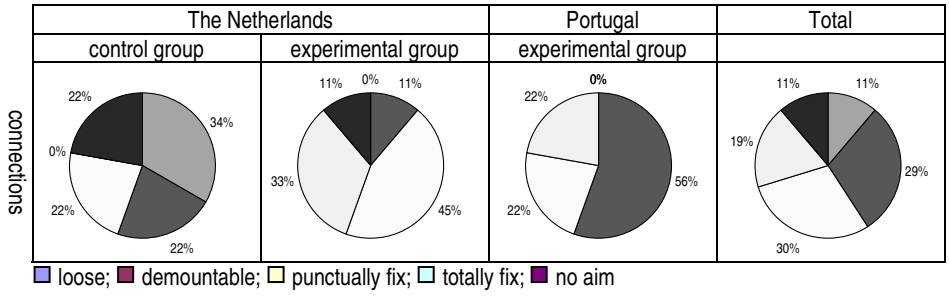


Figure 88 – The main aims towards the connections

Inversely to the total sample, students at the control group have first chosen for **loose** connections, followed by the **demountable** and **punctually fixed** connections, between the additions and the remainings. In their examples, students described new boxes and the public stairs loose from the façade; new demountable floors and the photovoltaic panel system; and punctually fixed floors and steel structures, framed into the existing structure.

At the experimental group from the Netherlands; students preferred **punctually fixed** connections, followed by **totally fixed**, and ending with **demountable** connections. The only example for demountable connections was an added wooden structure. All other examples regarded punctually fixed connections, e.g. floors supported by a concrete structure, movable partition walls; and totally fixed connections e.g. floor extensions, stairs and elevators.

Last, students from Portugal chose as their main aim connections, where the additions are **demountable**. Equally chosen were the **punctually** and **totally fixed** connections. Their examples were the new structures and new stairs for the demountable connections. For the punctually fixed connections, students referenced the new tower, the accesses (metal structure) and the new vertical accesses, where elevators and stairs can even be demountable.

Even if the examples provided by the students from the three groups were not especially detailed and innovative; generally, all groups argued the importance to develop loose, demountable and or punctually fix additions; so that future rehabilitation interventions are enabled without much demotion waste.

The connections between remainings and additions might initially seem a small detail, but actually when well considered facing the two components being connected and respective degree of compatibility, they can prevent many demolition and consequent destruction in case one of the components starts presenting anomalies. Also, it can prevent future interventive rehabilitations; as most additions are reversible and replaceable.

When asked about the percentual relation between subtractions and remainings, taking the original building plan as the full surface, most students have selected the scale **5-25** (%) for the subtractions (*vide* Figure 89).

The only difference among the three groups is the highest level reached; **5-25** (%) at the control group; **25-50** (%) at the experimental group from the Netherlands, and **50-75** (%) at the experimental group from Portugal. Instead, when comparing the percentual relation between additions and remainings, taking the original building plan as the full surface, most students (56%) have selected the scale **25-50** for the additions (*vide* Figure 90).

From the Netherlands, students have also introduced additions **05-25** (%) and **50-75** (%). From Portugal, values were more varied among the students. Therefore, only the most interventive scale **75-100** (%) was not selected.

Having observed them along the whole trimester, the researcher concluded that, despite of their answers to Questionnaire A3, the students from the Netherlands did not show much particular efforts to determine among their design decisions, what to plan for the subtracted and remained substances; at least, not as much as they did with the additions.

The tutors often asked for their arguments and direct correlations to the pre-design stage, but most frequently there were not so much concerned. Particularly, this group was too much attached to formalisms and functionalisms, without dialoguing with the pre-existence. The most important was to fit the new program, independent from the consequences.

Instead, the students from Portugal reacted differently to the experience and consequently achieved different results. They were also not perfect, but facing their initial level of lifespan consciousness and their end results; it can be stated that their progress was considerably higher than the progress of the students from the Netherlands.

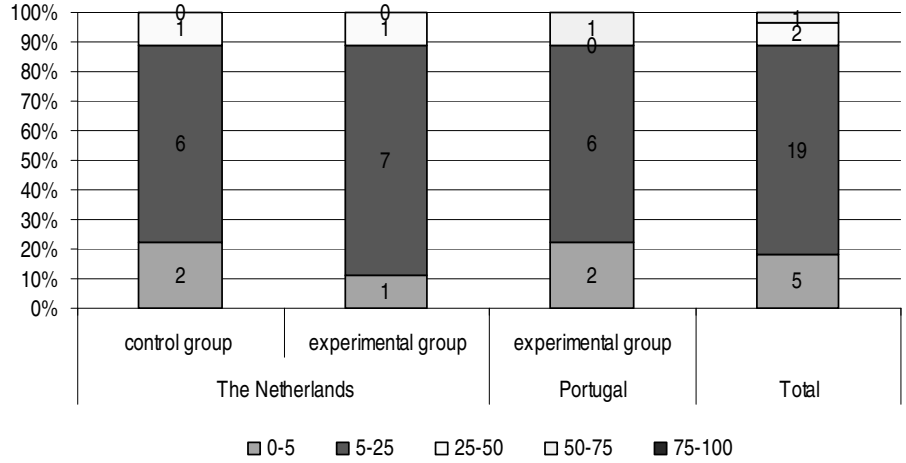


Figure 89 – The subtractions, within the relation between subtractions and remainings

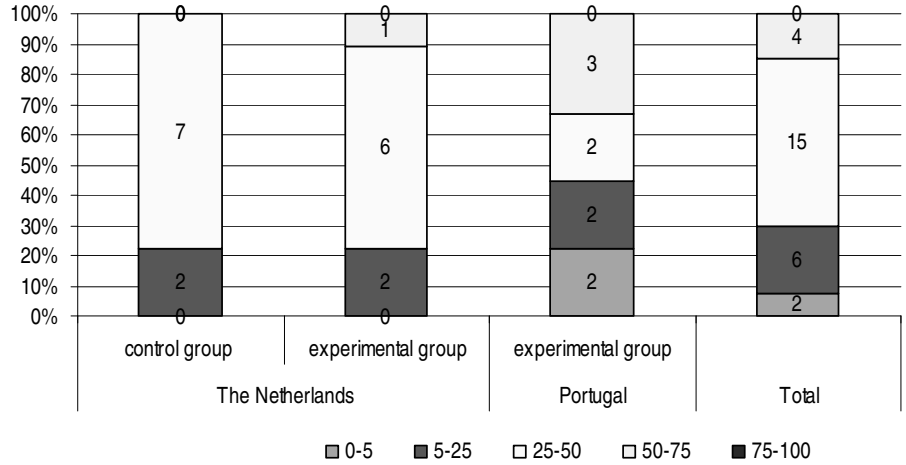


Figure 90 – The additions, within the relation between additions and remainings

They have, together with Arch. Valverde, established an extra aim and that was: WASTE ZERO. They were challenged to rehabilitate the building with the least construction & demolition waste possible. Moreover, they would be constantly reminded to consider all realities important. Not all were willing to consider its importance, but few students ended simulating very interesting solutions to add the subtracted substances into the new existence.

- **The importance of rehabilitation interventions**

  The importance of rehabilitation interventions has achieved much more sustenance on ecological arguments by the students, rather than other cultural-oriented arguments.

All students considered important to rehabilitate existing buildings, in Questionnaire A2, except for one student from Portugal. Accordingly, he stated that a building was like a human being, who had throughout its natural process a "moment of birth, of life period and of death". He did not believe in maintenance "at the cost of 'cosmetics'" and also disagreed with "identity changing", comparing it to the genetically code.

When ordering the arguments presented by all other students, according to their primary aims (*vide* book II - scapus), it was possible to verify that to **maintain** was the most referenced aim (48%), followed by to **decrease** (35%), to **improve** (13%), and last, to **replace** (3%). There were no arguments reflecting aims to **restore**.

The aim to decrease the usage of economic resources of the building was referenced by students at the three groups; together with the aim to decrease the need for new construction. Third and last common aim was the ability to maintain buildings considered as historically valuable. This argument is also related to few others, where students correlate the importance to rehabilitate existing buildings to their inherent cultural values.

From the Netherlands, students referenced quite some ecological arguments; e.g. the aims to decrease the usage of natural resources at the environment level; to maintain man-made resources at the building level; to improve the building's lifespan and respective sustainability. They also referenced that buildings with high condition should be rehabilitated; otherwise, it would be a major waste of manufactured resources. The common argument between one student at the control group and other from Portugal was the contribution of rehabilitations to decrease the energy required to building new.

The control group has particularly referenced the contribution of rehabilitation to the decrease of demolition and/or waste of resources. The experimental group from the Netherlands stated the importance to replace the building's areas, functions, services, etc. Students from Portugal stated the importance to maintain socially valuable environments, as well as, their identity, image and/or status.

On a global level, it can be stated that the aims to decrease were mostly raised at the control group; the aims to maintain and to improve the building, as well as to replace were mostly raised at the experimental group from the Netherlands; and the aims to maintain the environment were mostly raised at the experimental group from Portugal.

To better reveal the sustenance of such aims, the researcher has ordered them according to the primary values (*vide* book II - *scapus*). From the **cultural** values, the **ecological** values (PV8) were referenced two times more by the control group than by the two experimental groups. Also referenced by the three groups were the **social** (PV1), **economic** (PV2) and **historic** (PV4) values (*vide* Table 2).

Both experimental groups have mentioned arguments reflecting **aesthetical** (PV5) and **scientific** (PV6) values; while both groups from the Netherlands have reflected **age** values (PV7), together with the general reference to the cultural values. Curious enough, the **political** values (PV3) were not found reflected in any presented argument.

		pv 1	pv 2	pv 3	pv 4	pv 5	pv 6	pv 7	pv 8	pv 1:9	total
The Netherlands	c. g.	1	3	-	2	-	-	1	9	4	20
	e. g.	3	4	-	2	2	1	2	3	2	19
Portugal	e. g.	8	2	-	2	3	2	-	4	-	21
total		12	9	-	6	5	3	3	16	6	60

Table 2 – The cultural values beneath the preceding importance of rehabilitation interventions

Such ecological awareness, stronger among the students from the Netherlands, was observed by the researcher at the beginning of the trimester. That came to sustain the initial hypothesis of the researcher stating that students from the Netherlands would be more receptive towards lifespan theories than students from Portugal.

Nonetheless, that was not the case. Indeed, they have presented more ecological arguments; however, both experimental groups soon became comparable along the trimester; and at the end, the researcher observed a higher level of lifespan consciousness at the students from Portugal, than at the students from the Netherlands. Probably, that had to do with their behaviour. The last ones have tried to implement such principles; while the first ones have, only with many difficulties and after much debate, understood the motivations to apply such lifespan consciousness and ecological awareness in their design processes and resultant design developments.

During their design developments, students were asked to think about what would exactly make a building become significant. They all concluded that, depending on the criteria, all buildings could be considered significant. Even if that conclusion was taken by all students while debating, truth is that for students from both experimental groups, often the simple action to rehabilitate, (providing new lives, etc) was enough to consider a design sustainable. They were not conscious about the fact that their rehabilitation intervention could be considered more or less lifespan conscious, with more or less evidences of ecological awareness implemented in their design process. Especially, in unlisted buildings, which both water towers were, students would somehow begin with the pre-established idea that as it was not listed (officially culturally valuable) then everything was possible, without even questioning the advantages and disadvantages of such design decisions.

Of course, such behaviour has changed and by the end of the trimester most students were more aware of their influence as designers on the environment and on what they could better do to contribute towards its preservation.

In fact, in Questionnaire A3, all of them have reaffirmed their considerations regarding the importance of rehabilitation interventions, except for one student. The student from Portugal who has initially considered it not important to rehabilitate in Questionnaire A2, this time has considered it important. There was, however, one student at the experimental group from the Netherlands, who stated “It depends on the quality of the building. The importance depends, through the analysis of the building, whether to rehabilitate it or to raze it”.

Such arguments reveal a higher level of lifespan consciousness, even if the answer to the question was negative. Rehabilitation is indeed important, whenever both condition and significance of the building and respective environment allow and require such intervention. Otherwise, when arriving too soon or too late in the lifespan of the building; such effort might bring serious consequences for the environment.

When ordering once more (based on Questionnaire A3) the arguments sustaining the importance to rehabilitate, a slight raise at the aim to **maintain** (51%) and to **decrease** (35%); could be verified, and consequently a slight decrease of the aim to **improve** (9%) and to **replace** (3%); even if slight, such evolution traces a progressive path towards the less intrusive aims; especially because the aim to decrease was used by the students as aim to reduce the less positive aspects, most often regarding its impact in the environment.

All groups referenced three common aims, the first two targeting the environment scale and the third targeting the building scale. First common aim was to decrease the need for new construction, second was to decrease the usage of natural resources; and third was to maintain built heritage and/or all buildings, which are somehow considered culturally valuable for future generations.

From the Netherlands, both groups have referenced the aim to decrease unnecessary demolitions and respective waste of resources. Instead, both experimental groups had the common aims to maintain man-made resources and to restore areas, functions and/or services at the building scale. Students from Portugal and at the control group also had the common aims to maintain buildings which would be considered as historically and/or architectural valuable and to improve the building's lifespan and sustainability.

Particularly, one student from Portugal has referenced the aim to decrease the usage of energy resources; while two others referenced respectively the aim to maintain the groups of buildings and/or environments who are considered respectively historically or socially valuable. Last, two students, still at the same group referenced the aim to improve the areas, functions and services, still at the scale of the environment.

When ordering their arguments again according to the primary values, the **ecological** values remained the most identified ones among the three groups; followed by **cultural** values in general – considering that a building should be valuable, but without clearly discriminating which would have to be exactly the inherent values (*vide* Table 3).

		pv 1	pv 2	pv 3	pv 4	pv 5	pv 6	pv 7	pv 8	pv 1:9	total
The Netherlands	c. g.	-	2	-	1	3	-	1	6	7	20
	e. g.	2	1	-	-	-	-	-	8	5	16
Portugal	e. g.	2	1	2	2	1	-	1	8	2	19
total		4	4	2	3	4	-	2	22	14	55

Table 3 – The cultural values beneath the subsequent importance of rehabilitation interventions

Purposely to crosscheck arguments, Questionnaire A3 asked students which buildings should be rehabilitated and which should be demolished. Curiously, not one single argument was found sustained by **age** and **ecological** values; but all three groups have most referenced the need for particular **cultural** values, as well as, the absolute **historic** and **aesthetical** values. At the experimental groups, **social** and **scientific** values were mentioned by students from the Netherlands and the **political** values were mentioned by students from Portugal.

Therefore, even if the cultural values have risen among the arguments of the students, as a group of values which are important to consider before determining the destiny of a building; the unreferenced of the ecological and age values decrees a certain degree of inconsistency. Probably, that inconsistency is exactly what makes them understand the importance to rehabilitate for the environment, but not implement it much further.

- **The appointed successes in rehabilitation designs**

  Students identified successful rehabilitation designs; however, their definitions and appointed success seldom matched.

Most students confirmed their awareness successful rehabilitation (*vide* Figure 91). Nonetheless, the few students that did not know successful rehabilitation designs also did not specify if they did not remember names of buildings and/or architects, or if instead they considered that current rehabilitation interventions were not successfully. Therefore, only the arguments together with examples were further surveyed.

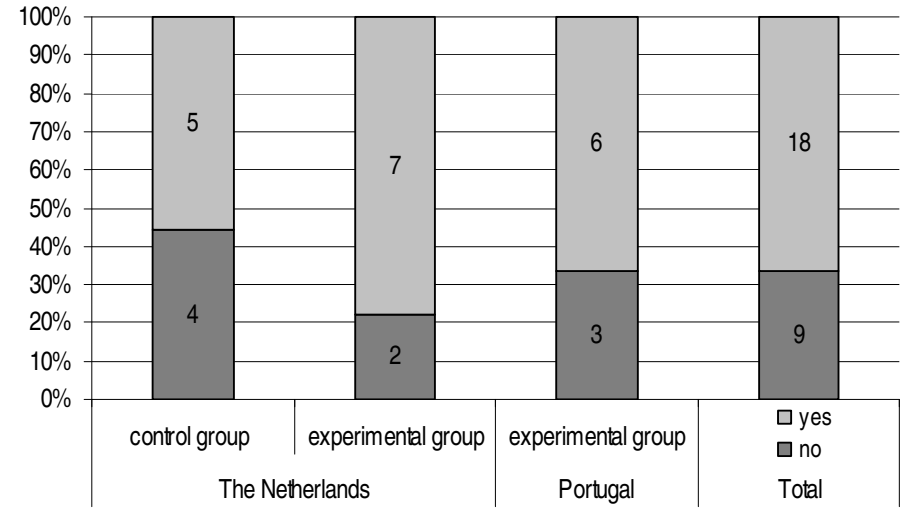


Figure 91 – The acknowledgement, of the students, for successful rehabilitation designs

Students from the Netherlands identified as successful the *Witte Dame* (1994-1998) and *Vertigo* (1998-2002), both developed by Diederen, Dirrix & van Wylick. The particularity of the last reference is that these students are also its users. *Vertigo* hosts now the Faculty of Architecture, Building and Planning (*vide* Figure 93), but formerly hosted the Faculty of Chemistry (*vide* Figure 92).

Tate Modern was their only international example. Among other references from the Netherlands, the control group referenced the *Van Abbe Museum* and the experimental group referenced the *Granida,* both located in Eindhoven. From Portugal, most students referenced the rehabilitation design developed by the architects Eduardo Souto Moura e Humberto Vieira, for the Convent of Santa Maria do Bouro (*vide* Figure 94) be converted into a hotel (*vide* Figure 95). EXPO 98, in Lisbon (urban rehabilitation); the Wall, in Lagos (restoration) and the Youth Centre, in Portalegre were the other three referenced rehabilitation designs.

At the experimental groups, students from the Netherlands mentioned the importance to design new respecting the old building + architect and others pointed out the importance of relating / reaching the needs of the place. Instead, students from Portugal mentioned the importance of accomplishing environmental / ecological concerns, detailing well the connections between old and new materials, a harmoniously relation between the building's past, present and future, the use of current materials and technologies for the additions and the ability to accomplish controlled costs.

During the semester, students at the experimental groups did not often bring examples of rehabilitation designs which they would consider examples of successfulness. Even if they would, the motive for such choice was unclear. Curiously, it seemed to the researcher that a rehabilitation could be considered automatically as successful, just because it had been published in an Architecture magazine.

Tendentiously, the points of success students would present, when describing a good-practice or even their own design, would also frequently focus on the additions introduced by the design; rather than accurately determine what exactly happened to the pre-existence and why, to better judge if such rehabilitation intervention could in fact be considered successful or not. Such of critical judgement was lacking at both groups.

Figure 92 – Faculty of Chemistry, in Eindhoven (1960-63)[13]

Figure 93 – Faculty of Architecture, Building and Planning (Vertigo), in Eindhoven (2002)[14]

Figure 94 – The Convent of Santa Maria do Bouro, in Amares (DGEMN, s.d.)[15]

Figure 95 – The Hotel of Santa Maria do Bouro, in Amares (Pereira, 2004)

When answering Questionnaire A3, more students confirmed their awareness successful rehabilitation (*vide* Figure 96). Again no argument was found together with the negative answers.

From the Netherlands, students maintained their reference on the *Witte Dame* (1994-1998) and Vertigo (1998-2002). At the control group, students referenced the rehabilitation of a Water Tower (*vide* Figure 97) converted into a residential facility (*vide* Figure 98), undertaken by the architectural office *Zecc Architecten* (2002-2004).

[13] Coppens, M. & Hetjes, D. (1960-63) *T-Hoog: Faculteit Scheikunde,* Eindhoven: TUE. Stafgroep Repro-Fotografie & KLM Aerocarto, available at: http://library.tue.nl/catalog/FullBB.csp?WebAction=ShowFullBB&RequestId=383356_18&Profile=RFA&OpacLanguage=dut&NumberToRetrieve=50&StartValue=9&WebPageNr=1&SearchTerm1=1960.21.4666&SearchT1=&Index1=Index2108&SearchMethod=Find_2&ItemNr=9 (accessed on 30-05-2007)

[14] Bagen, A. (2002) *Faculteit Bouwkunde (Vertigo)*, Eindhoven: Bagen, available at: http://www.diederendirrix.nl/project_utiliteitsbouw.php?category=19&project=66 (accessed on 30-05-2007)

[15] DGMEN (s.d.) *IPA PT010301190006: The Convent of Santa Maria do Bouro,* Lisboa: Direcção Geral dos Edifícios e Monumentos Nacionais (DGMEN), available at: http://www.monumentos.pt/Monumentos/forms/002_B1.aspx (accessed on 30-06-2007)

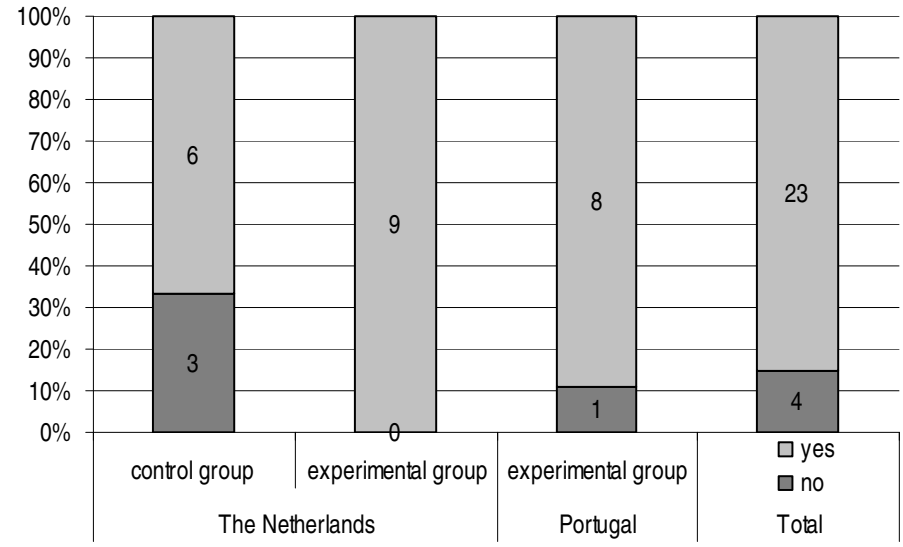


Figure 96 – The acknowledgement, of the students, for successful rehabilitation designs

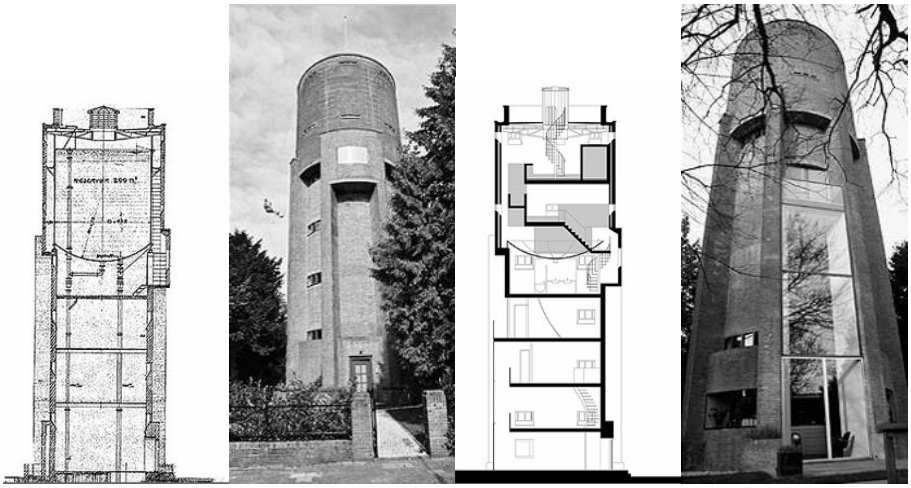


Figure 97 – The Water Tower, in Soest (2001)[16]

Figure 98 – The House Tower, in Soest (2004)[17]

This building is a *Rijksmonument* and the rehabilitation design was awarded with the *Nederlandse Watertorenprijs 2004* (Dutch prize for water towers 2004).

[16] Zecc Architecten (2007) *Herbestemming en restauratie Watertoren Soest*, Utrecht: Zecc Architecten, available at: http://www.zecc.nl/ZeccP001.html (accessed in 15-07-2007)
[17] *Ibidem*

The rehabilitation designed by Herzog and De Meuron, in London, converting the Bankside Power Station designed by the architect G. G. Scott and built between 1947 and 1963, into the Tate Modern Gallery, between 1995 and 2000 gained more references among the experimental group, than at Questionnaire A2. Further, the rehabilitations of St. Annakerk, in Breda; of the Train Station, Amsterdam Central; and of the *Schouwburg*, in Utrecht were also found referenced.

From Portugal, four students referenced again the rehabilitation of the Convent of Santa Maria do Bouro, together with the Museum of Transports and Communication, in Porto, designed by the same architect. Moreover, there were three rehabilitation designs referenced by the students, undertaken by Portuguese architects. Those were, the Medieval Tower, in Braga, designed by the architect Francisco Perry Azevedo; the Public Library, in Tavira, designed by architect João Luis Carrilho da Graça; and the Castle Museum, in Silves, designed by the architects Mário Varela Gomes and Pedro Correia da Costa.

Figure 99 – The Museum of Chiado, in Lisbon[18]

Students from Portugal referenced to two international architects and respective rehabilitation designs. The fist reference was the rehabilitation of the Museum of Chiado, offered by the government of France to contribute to the rehabilitation of the historic area of Chiado (*vide* Figure 99).The rehabilitation was designed by the architect Jean-Michel Wilmotte (1988-1994). The second reference was the rehabilitation of several buildings along the river Seine in Paris, undertaken by the architect Jean Nouvel.

All groups referenced as arguments to consider rehabilitation designs successful, the ability to integrate new functions / requirements; second was the successful management of the relationship between old and new construction; third was the ability to use suitably the existing qualities of the remainings; and fourth and last common argument was the ability to respect the old building and respective architect.

There were two common arguments identified at the control group and among students from Portugal. Those were the ability to preserve the original charisma of the remainings of the pre-existence, and to reach with the additions higher and/or suitable levels of habitability; reaching in such way the needs of the people. There were also common arguments identified among the two experimental groups.

[18] Wilmotte, J. - M. (2007) *Musée National du Chiado, Restructuration complète avec aménagement intérieur et muséographie,* Paris: Wilmotte et Associés SA, available at: http://www.wilmotte.fr/pge/realisations/detail.php?project=39&type=&keywords=chiado&continent= (accessed in 15-07-2007)

First reference was the ability to reach higher values than the one assessed at the pre-existence, regarding both significance and condition factors, to use contemporary materials, technologies and identity and relate and/or reach the needs of the place with the new additions.

From the Netherlands, both groups have referenced the aesthetical values. Students at the control group referenced the ability to preserve them as aspect of success; while students at the experimental group referenced the ability to improve them. The control group has also mentioned the ability to accomplish controlled costs. Instead, from Portugal, two students argued the ability to raise ecological values, e.g. reduce usage of energy resources, connections between old and new materials; reuse existing resources, etc. Curiously, one student emphasised the importance to consider harmoniously the building's past, present and future.

Purposely to crosscheck arguments, Questionnaire A3 asked students if they would classify their own rehabilitation design as successful. Most students did and all groups appointed the ability to integrate new functions and/or requirements into the pre-existence an aspect of success.

From the Netherlands, students commonly considered the ability to preserve the building's pre-existent construction and the ability to use the existing qualities of the pre-existence suitably at the new existence. Instead, both experimental groups argued the ability to reach habitability levels and to answer successfully the needs of the people. Particularly, students at the control group have presented the ability to successfully preserve the architectural qualities and manage the relationship between remainings and additions.

At the experimental groups, students from the Netherlands have presented the ability to respect both building and architect, when determining the relationship between remainings and additions. While students from Portugal have presented the ability to solve environmental / ecological concerns, to raise condition and significance values with the new existence; to achieve the needs of the place; and to accomplish controlled costs. Once referenced was also the ability to preserve several of the theorised cultural values e.g. historic, aesthetical, social and ecologic values; to promote a new identity, through the additions created for the new existence with contemporary materials and technologies.

Instead, the arguments used to justify their own rehabilitation designs as unsuccessful were only provided by the experimental groups. From the Netherlands, the arguments were incompleteness; the destruction of the best architectural qualities of the building and the disharmony of the additions. From Portugal, the arguments were lack of time and the low priority on the addition of renewable energies.

- **The interest in the theorised design process**

  Due to its apparent rationality, students have first confronted the theorized design process and progressively verified its usefulness.

Some students at both experimental groups, had initial difficulties on accepting the theorised design process, introduced and explained by the researcher, as valuable. Somehow they felt that their freedom was being reclaimed and that their creativity would vanish when following such design process. Inversely, others were pleased with the tasks and sequential process; because they could focus further on more relevant aspects.

Particularly more from the Netherlands, this initial rejection and constant questioning was difficult for the researcher, but simultaneously challenging, as these particular students were most often against than in favour of what was being purposed. Consequently, the researcher would have to explain everything very clearly and that extra knowledge required to support her arguments was later used to complement the guidelines theorised for sustaining the design process.

Despite the initial difficulties, at the end of the semester, all except one student from the Netherlands became positive about the theorised design process (*vide* Figure 100). This was the same student that earlier has argued that the design process was too rigid when asked about the interest in developing rehabilitation designs.

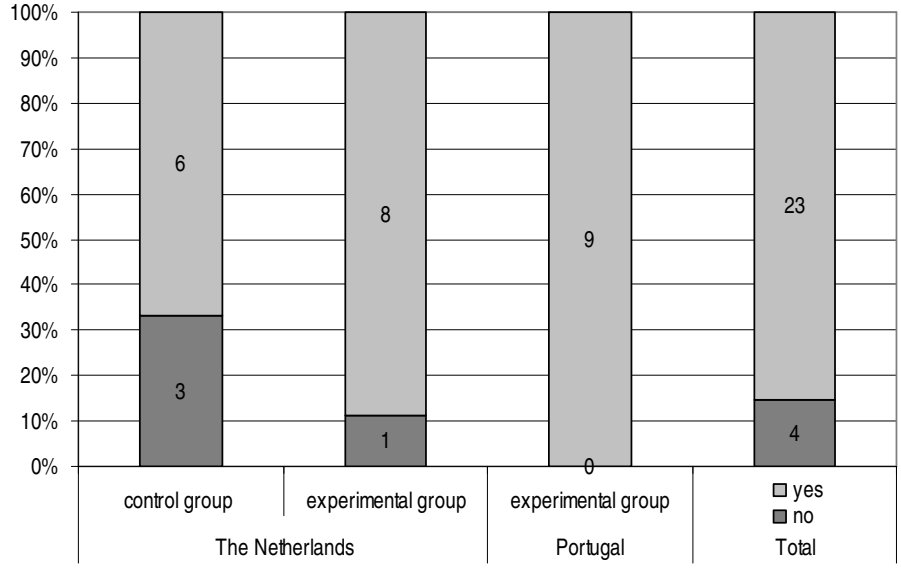


Figure 100 – Their interest towards theoretical support, during rehabilitation designs

Even at the control group, that did not follow the theorised design process; more students confirmed than denied that more theoretical support could have helped them becoming more conscious of the building lifespan and its environment, raising the quality of the rehabilitation design. They argued that extra help is always welcome, especially pointing to technical details and to better time management. Others argued the current lack of education activities on such matters, e.g. rehabilitation, lifespan, etc.

Still at the control group, the students who declined the idea of obtaining theoretical support along their design process presented curious arguments that clearly reflect a common reaction from who rejects without knowing what it is; a behaviour that is recognised more among designers than initially expected. Those students argued that there is already enough information at the library and/or at lectures to support them and that "it is not really possible to fit design in a fixed method".

From the Netherlands, the positive arguments were respectively, that students got more aware of the different aspects that can be considered when researching the pre-existence, and the feedback that such research can correspond to the rehabilitation design;

that they are more conscious about the building's lifespan that it supports in how to develop rehabilitation designs and to appreciate existing buildings more.

All students from the experimental group from Portugal agreed that the theoretical support helped them becoming more conscious of the building lifespan and its environment, raising the quality of the rehabilitation design. While, from the Netherlands, one student was negative to the theorised design process due to its rigidity; from Portugal few students considered this same rigidity a benefit for both work and time management. Accordingly, "the severity of the presented theoretical model allowed a more integrated and conscientious approach to the problematic involving built heritage".

Similar to the students at the other experimental group, students from Portugal got more aware of the different aspects that can be considered when researching the pre-existence, and the feedback that such research can correspond to the rehabilitation design; it sustains becoming more conscious about the building's lifespan and how to develop rehabilitation designs, dealing with pre-existent and added materials more consciously. One student also mentioned the contribution of the theorised design process to the raise of values and usability in a building, which would initially be perceived as valueless.

6.3 Testing the design product

6.3.1 THE LIFESPAN REHABILITATION DESIGN PROCESS

With the design product developed and produced, it was time to test the implementation of the theorised design process for a lifespan conscious rehabilitation into a design process support system, RE-ARCHITECTURE®, and verify its effective contribution to the raise of lifespan consciousness of designers involved in rehabilitation design developments. For the purpose, two groups of MSc. students were again supervised, from the Netherlands and Portugal, while developing a rehabilitation design development.

The **Experimental Group** from the Netherlands, was formed by MSc. students (fourth year) attending an International Design Studio (M1/M2), at Eindhoven University of Technology (TU/e), during February – June 2007. This time, there were no parallel groups; so, it was not possible to ask the cooperation of other tutors and create a **Control Group**.

The **Experimental Group** from Portugal were the MSc. students attending the "Rehabilitation of Buildings and Places" course (fourth year), at *Instituto Superior Manuel Teixeira Gomes* (ISMAT), Portugal, during March – June 2007. Such international experience was again possible due to a Socrates / Erasmus Protocol (European Commission Program).

Arch. Walraven (TU/e) and Arch. Valverde (ISMAT) accepted the challenge to cooperate with this research and test the design process theorized in this research with their students, through the sustenance of RE-ARCHITECTURE®. As earlier referenced (*vide* book I - *basis*), trainee Eliziário has also assisted the tutoring of both groups.

Under the academic – research + education – theme *Design for Lifespan,* coordinated by Prof. Arch. Jouke Post; researchers, tutors and MSc. students, graduating on Architecture and/or Building Technology were challenged to focus on Industrial Heritage, during the academic year of 2006/2007. Four buildings were pre-selected for the purpose; *Het Veem* and *NDSM werf*, in Amsterdam and the *Schiecentrale* and the *Graansilo*, in Rotterdam. The trainee Bonsignori undertook a preliminary research on the four buildings, to better sustain the researcher on the selection of the building that was requiring rehabilitation.

Even if all four buildings had recently been rehabilitated or were being rehabilitated at the time; the Graansilo was the only one that had been partially rehabilitated. In 2003, the ground floor of the Graansilo was converted into the discothèque NOW & WOW, designed by a challenging architectural office, Gevonden Ontwerpen. Arch. Huib De Jong, from the architectural office Art Constructions, designed the master plan (*vide* Figure 101). In Portugal, the Silos in Santa Catarina da Fonte do Bispo – Tavira, Algarve were the most comparable silos, of which contacts with the owners revealed successful (*vide* Figure 102).

Different in scale and proximity a the river; this building was also an obsolete landmark, claiming for a rehabilitation intervention. Despite the larger scale of the buildings and proportional complexity, one of the biggest novelties in this test period compared to the previous one, was the involvement of architects in the verification of RE-ARCHITECTURE®, the implementation of the design process into a support system.

Figure 101 – The Graansilo, in Rotterdam (Bonsignori, 2007)[19]

Figure 102 – The *Silos*, in Santa Catarina da Fonte do Bispo – Tavira (Pereira Roders, 2006)

Architects, mostly practicing in Portugal and the Netherlands, were invited to register, access, and make use of RE-ARCHITECTURE® to support their daily design activities, when involved in rehabilitation design developments.

To attract the architect's attention and interest; first, the researcher wrote a "public invitation" in form of an article (in both Portuguese and Dutch language) to be published in technical magazines, nationally recognized. In Portugal, the magazine "*Arquitectura & Vida*" published the "public invitation" in January 2007 (*vide* Appendix 6). Despite all attempts and contacts, no magazine was found in the Netherlands, interested in publishing the article, but few did offer to publish smaller notices, e.g. "*Renovatie*" in February (*vide* Appendix 6) and "*BouwIQ*" in March 2007 (*vide* Appendix 6).

As not many registrations were being noticed in RE-ARCHITECTURE®, the researcher contacted both Order of Architects (O.A., Portugal) and Royal Association of Dutch Architects (BNA, the Netherlands) and they showed interest to cooperate with this research. A small article, in both website and newsletter (*vide* Appendix 6). Afterwards, a considerable progress occurred, especially regarding the Portuguese architects.

As a last attempt to diffuse RE-ARCHITECTURE® under both Dutch and Portuguese architects, the researcher contacted via e-mail few field experts (mainly architects) already aware of this research, to invite them personally to use RE-ARCHITECTURE®. Besides, they were also asked to forward it to other potentially interested experts. As a snowball, the "personal invitation" aimed to reach the architects more directly and efficiently.

As the researcher did not have many contacts of Dutch architects, the researcher decided to make use of the contact information available at the website of BNA and send to all architects (with e-mail address) the "personal invitation" e-mail, with the article attached (*vide* Appendix 6). There were also few spontaneous notices at several field-related websites from Portugal. Probably, this was a consequence of the actions undertaken by O.A and/or of the "personal invitation" snowball (*vide* Appendix 6: Notices on RE-ARCHITECTURE®).

[19] Bonsignori, C. (2007) *RE-ARCHITECTURE of Industrial Heritage*, Haupt, T. (eds.) Proceedings of the CIB World Building Conference 2007: Construction for development; Cape Town: South African Institution of Civil Engineering

6.3.1.1 METHOD

THE MEANS TO VERIFY THE HYPOTHESES THROUGH PRACTICES

The method used to test the design product, slightly differed from the method for testing the design theory. For example, when testing the design theory, architecture students participated in the experience and filled in both pre- and post-survey (Questionnaires A2 and A3). These Questionnaires were printed and delivered personally. When testing the design product, both pre- and post-survey (Questionnaires B1 and B2) were placed accessible directly through the prototype, RE-ARCHITECTURE®.

Most questions were maintained from Questionnaire A3. The purpose was to provide parallel data on similar questions and to establish coherent correlations between both test periods, occurring during the academic years 2005/2006 and 2006/2007. However, few more questions were introduced, focusing on the design process support system RE-ARCHITECTURE®. But these answers can be compared the current experimental groups.

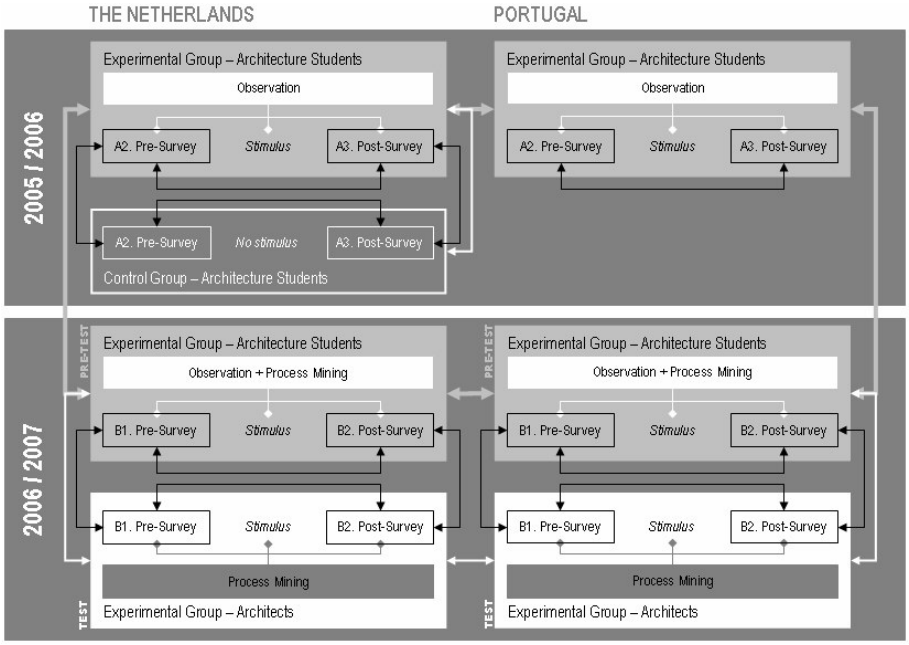


Figure 103 – The test method (2005/2007)

One other difference between both test periods is the inexistence of a Control Group (*vide* Figure 103). Such action was not possible to maintain due to the lack of a second group and tutors following the same program. At the MSc. level the groups of students are reduced and follow specific educational strategies, which could not be changed for the purpose of one single experience.

Nonetheless, both architects and architecture students were challenged to access and follow the theorised design process (stimulus), now implemented and accessible through internet, in the newly completed prototype RE-ARCHITECTURE®, during their rehabilitation design developments and to a limited period of four months.

Similar to the test period of the design theory, the researcher would control the evolution of the students and architects through their answers to Questionnaire B1 (Pre-Survey) before being acquainted with the design process (stimulus) and to Questionnaire B2 (Post-Survey) after the stimulus. The differences between the answers would determine how useful RE-ARCHITECTURE® could be for designers involved in rehabilitation design developments.

The fact that no change would be made to RE-ARCHITECTURE® during the test period was also another important difference. During the test period of the design theory the researcher was constantly developing and revising the theorised design process. Inversely, during the test period of the design product no change would be made to RE-ARCHITECTURE®, even if the researcher would identify them. Those would be respectively mentioned in the respective conclusions of this doctoral research.

The theorised design process available at RE-ARCHITECTURE® was the same used with the experimental group from Portugal, during the test period of the design theory (*vide* Figure 104). The main difference was, that at the test period of the design product all guidelines would not be tutored, but provided at RE-ARCHITECTURE®. Tools were also implemented to facilitate the adoption of such theorised design process into their frequent design process activities.

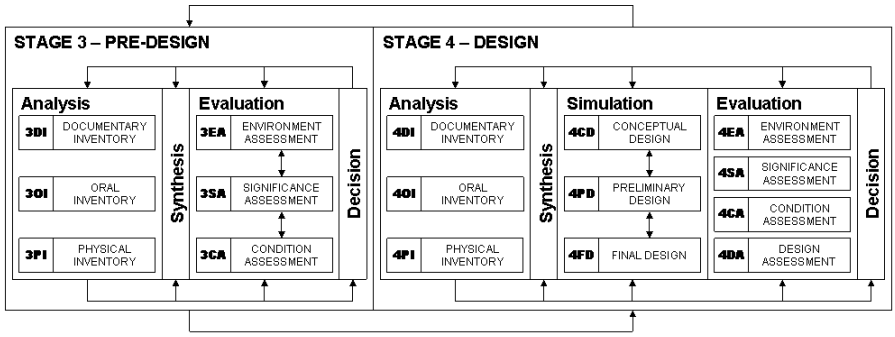


Figure 104 – The lifespan rehabilitation design process (last version)

This time, both experimental groups of students followed a similar schedule of sixteen weeks, meeting the tutors three hours per week; and with no theoretical lectures to introduce, nor support them during the whole process. They would have to be more independent and search themselves for sustenance. Besides RE-ARCHITECTURE®, students could acquire RE-ARCHITECTURE *scapus*; especially published to support the students, while developing their rehabilitation designs.

Similarly to what developed for the experimental groups, during the test period of the design theory (*vide* Chapter 6.2.2.1); students followed the team work method, organised in groups, so that they could all contribute and information would not get lost (*vide* Appendix 7). Moreover, besides Questionnaire B1 and B2, two other methods were chosen to control the evolution of the architects and architecture students from Portugal and the Netherlands (*vide* Figure 103).

The first method was observation, previously used during the test period of the design theory; mainly to provide support to the other data collection methods, rather than being individually sufficient to reach very accurate conclusions. During the entire semester, the researcher encountered few remarks during and after the lectures, summarising the general impressions and sensed by the researcher, during the developments of the students participating in the two experimental groups.

The second method was process mining (Alves de Medeiros, 2006)[20], being the fourth and last method introduced at the test period of the design product. It is undeniably much more accurate than the observation method. Process mining techniques allowed the researcher to verify how the RE-ARCHITECTURE® website has actually been used.

> "Process mining techniques allow for extracting information from event logs. For example, the audit trails of a workflow management system or the transaction logs of an enterprise resource planning system can be used to discover models describing processes, organizations, and products. Moreover, it is possible to use process mining to monitor deviations (e.g., comparing the observed events with predefined models)."[21]

In this situation, the event logs were generated by the RE-ARCHITECTURE® website. Every time a user visited a tool/help page, created a new design etc., events have been registered in the table **accesslog** in the database.

Thus, all required was to convert the data in this table to the input format (MXML) accepted by the process mining tool ProM 5.0. Once the log was in the MXML format, one could run a process mining algorithm (Fuzzy Miner), to get a model that portrays the usage of the RE-ARCHITECTURE® website. This technique was selected, because:

> "(…) the Fuzzy Miner is able to clean up a large amount of confusing behavior, and to infer and extract structure from what is chaotic. We have successfully used the Fuzzy Miner on various machinery test and usage logs, development process logs (...), among others. These are notoriously flexible and unstructured environments, and our approach has proven to be the most useful tool for analyzing them so far."[22]

As explained before, RE-ARCHITECTURE® does not enforce the design process theorised in this doctoral research (*vide* book II - scapus). So, with the mined model, this research was willing to prove that an unstructured behaviour is possible, independent from the structured design process. That would reflect the freedom of navigational user patterns on RE-ARCHITECTURE®.

The mining of the models was assisted by Dr. Alves de Medeiros. Similar to the previous and following surveys; the researcher considered both global and group perspectives, filtered according to the variable **country** (values: The Netherlands and Portugal) and **occupation** (values: architects and architecture students). In the following, the researcher elaborates the results.

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[20] Alves de Medeiros, A. K. (2006) *Genetic Process Mining*, Eindhoven: Eindhoven University of Technology

[21] PMG (2007) *About Process Mining Research*, Eindhoven: Technische Universiteit Eindhoven, TM.IS Department, Process Mining Group (PMG), available at: http://is.tm.tue.nl/staff/wvdaalst/BPMcenter/process%20mining.htm (accessed in 23-07-2007)

[22] Günther, C. W. & Aalst, W. M. P. van der (2007) *Fuzzy Mining – Adaptive Process Simplification based on Multi-Perspective Metrics,* Eindhoven: Eindhoven University of Technology, *5th International Conference on Business Process Management (BPM 2007) (to appear) Australia 2007.*

6.3.1.2 MOTIVATION AND ASSUMPTIONS

THE REASONING BEHIND THE HYPOTHESES

Complementary to the motivations of the theorised design process, its implementation into a design process support system aimed to provide easy accessible guidelines and tools that would sustain any designer interested in developing lifespan conscious rehabilitation designs of obsolete built heritage.

These two test periods, had exactly that motivation; to evaluate the effective need for sustaining designers of lifespan consciousness and to determine the effective contribution of the theorised design process, respective guidelines and tools. Faults to improve and virtues to maintain shall be identified to better sustain conclusions and further recommendations.

After the first period of test, the researcher believed that a design process support system available at the internet would intrigue both groups and challenge them to experiment it and likewise contribute to its improvement. Novelty would probably intrigue them, rather then previous acquaintances on lifespan and sustainable ideologies.

The Pre-Survey (Questionnaire B1) provided the researcher with information enough to survey the initial level of lifespan consciousness presented by the students and by the architects. As a first milestone, the moment before getting acquainted with the theorised design process (stimulus) is fundamental to understand their real aims and principles.

The Survey (Observation) of the students shall bring extra information to sustain the researcher reaching conclusions that cannot be reached exclusively with the information provided by the answers to the questions at both Pre-Survey and Pos-Survey. The method of observation remained the same from the previous test period (vide Chapter 6.2.2.2).

Accurate information on the use of RE-ARCHITECTURE® shall be brought by the process mining. Especially with users that did not have previous formation on its use; it is fundamental for the researcher to understand the logical method of use and how that complies with the assumed use, hypothesised when simulating and developing all functionalities with much attention and detail.

The Post-Survey (Questionnaire B2) shall provide the researcher with information enough to survey the final level of lifespan consciousness presented by the students, as well as the architects. As a second milestone, the moment after getting acquainted with the theorised design process (stimulus) is fundamental to understand the contribution and compatibility of the theorised design process with their real aims and principles.

The motivations and assumptions involving the method to collect data at a Pre-Survey (Questionnaire B1), Survey (Observation), Process Mining and Post-Survey (Questionnaire B2) were subdivided into the *following* nine main themes. To enable a global understanding, these themes shall reappear at the results (*vide* Chapter 6.2.1.3).

1. the experience in developing rehabilitation designs,
2. the experience in using RE-ARCHITECTURE®,
3. the perspective on developing rehabilitation designs,
4. the interest in developing rehabilitation designs,
5. the design process followed at rehabilitation designs
6. the universe of subtractions, remainings and additions,
7. the importance of rehabilitation interventions,
8. the appointed successes in rehabilitation designs, and
9. the interest in RE-ARCHITECTURE®.

■ **The experience in developing rehabilitation designs**

Students with experience in developing rehabilitation designs shall answer more lifespan consciously, than the inexperienced ones.

Architects with experience in developing rehabilitation designs shall answer more lifespan consciously, than the inexperienced ones.

Similar to the previous test period, the researcher planned to identify the experience in developing designs rehabilitation, and to verify if such experience would influence the quality of the answers provided by the sampled students. Hence, question **B1.01** enabled the researcher to survey all data and information retrieved through the variable **experience**, which had only two possible values: **yes** or **no**.

Such variable could become relevant or not, depending on the similarities and differences identified in the answers of the designers, from the same group and/or different groups, when surveying and correlating them. In addition, it would also provide an indication on how frequent designers from these groups developed rehabilitation designs.

The assumption that designers, both students and architects, with experience in developing rehabilitation designs shall answer more lifespan consciously to the questions while performing the rehabilitation design developments, was based on the fact that they already had to deal with pre-existences of buildings that require rehabilitation and are familiar with the problems the researcher is trying to diminish.

■ **The experience in using RE-ARCHITECTURE®**

Students shall make use of RE-ARCHITECTURE®, according to the program; but shall draw a balance between theory and their individual approaches.

Architects, in both countries, especially concerned with lifespan consciousness at rehabilitation interventions shall accept the challenge and test RE-ARCHITECTURE®.

The experience in using RE-ARCHITECTURE® was controlled directly and indirectly. **Question B2.00** and respective sub-questions were the direct control, where the researcher asked if the designers used it to support their rehabilitation design developments, and respective motivation. Instead, both statistical and process mining surveys were the indirect control, where the researcher monitored their workflow behaviour.

Through their global behaviours, the researcher could identify the most and least used areas of RE-ARCHITECTURE®. Based on these results, the researcher would be able to verify if, in fact, the developed design process support system, RE-ARCHITECTURE® was used as initially assumed and if both guidelines and tools provided to sustain designers, involved in rehabilitation design developments, could actually be considered of use to them.

Even if such results might apparently seem to bring distress to the researcher, in fact, it provides her harmony and confidence. RE-ARCHITECTURE® is a prototype and not a miracle. Therefore, the more it is discovered through its users, when revealing all factors of success, failure, and open for improvement, the better it can become on for further research developments.

- **The perspective on developing rehabilitation designs**

  Students with different perspectives than the pure architecture-oriented ones shall react differently to the theorized design process.

  Architects with different perspectives than the pure architecture-oriented ones shall react differently to the theorized design process.

Similarly to question **A2.01** and **A3.01**, question **B2.01** enabled the researcher to survey all data and information retrieved through a variable. However, this time the variable was **perspective** and had a total number of eight values: **architect**, **building process manager**, **urban planner**, **researcher / professor**, **building technology engineer**, **building physics engineer**, **structural engineer**, and **other**.

This variable could become particularly important for the students from the Netherlands, as at the MSc. level, there are students aiming for a graduation on Architecture, Building Technology or both, attending the same studio. Instead, this would not be relevant for the students from Portugal, as they were MSc. architecture students at their last year of graduation. Such information could justify perspective-related deviations at the answers.

Once again, such variable was mostly oriented towards the students and to understand their arguments, when deviant from the group arguments. Nevertheless, it might be interesting to understand the diversity of architects and their interests, beyond the architecture. Especially in Portugal, where there is no graduation in Building technology such field could be undertaken by architects and or civil engineers.

- **The interest in developing rehabilitation designs**

  Students shall show interest in developing rehabilitation designs; however, they shall mostly prioritize the novelties and required additions.

  Architects shall show interest in developing rehabilitation designs; however, they shall mostly prioritize the remainings together with the required additions.

Question **B1.02**, similarly to question **A2.02** aimed to discover if the designers found their previous design interesting, and most important of all, aimed to identify the designers' considerations about their rehabilitation perception and motives to consider it interesting. For purposes of synthesis their considerations were filtered according to the relationship between the pre-existence and the new existence (subtractions, remainings and additions).

When surveying it again at question **B2.02**, similarly to question **A3.02,** the researcher would get feedback on the influence of RE-ARCHITECTURE® and retrieve enough data and information to accurately compare the arguments and identify respective similarities and differences. Already in the arguments used to sustain the answer to this question, potential raises of lifespan consciousness can be traceable, whenever present.

Due to the similarity of questions, the researcher would be enabled to identify potential evolutions in the answers, and relate them to the fact that the students answering question **A3.02** had access to the design process model (theory) and the ones answering question **B2.02** had access to RE-ARCHITECTURE®. In what regards the architects, it could be verified if, in fact, they consider more the remainings than the students, in their arguments.

- **The design processes followed at rehabilitation designs**

  Students shall have followed similar design processes and dealt with similar problems, already before following the theorised design process.

  Architects shall have more variety, but still have followed similar design processes and dealt with similar problems, already before following the theorised design process.

Similar to questions **A2.03** / **A3.03**, questions **B1.03** / **B2.03** would enable the researcher to reach better conclusions regarding the design processes followed in rehabilitation designs, by the sampled designers and verify if they are as varied as preached by the designers, or if instead design processes are similar. For that purpose, three questions were placed in Questionnaire B1 and repeated in Questionnaire B2.

Question **B1.03** / **B2.03** would identify if the design process followed was theory-based, individual-based or a mixture of both; its stages, approximate time (hours) and usefulness (yes/no). Question **B1.04** / **B2.04** would identify if there were particular aspects designers were aware of which was less successful in their design process to conclude potential problematic stages that require more/less time, theoretical support, etc.

Last, Question **B1.05** / **B2.05** shall allow the researcher to identify particular stages with more need to theoretical support; common sources of knowledge and the potential for a theoretical support through the internet. Again, the comparison between the answers at **B2.05** and the answers given at question **A3.03** would allow the researcher to identify the evolution facing the different theoretical supports, design process model versus implementation.

- **The universe of subtractions, remainings and additions**

  The correlation between subtractions, remainings and additions shall not be considered by the students; but shall grow while using RE-ARCHITECTURE®.

  The correlation between subtractions, remainings and additions shall not be considered by the architects; but shall grow after using RE-ARCHITECTURE®.

To better control the perception of the students regarding the universe of the subtractions, remainings and additions; the researcher introduced at Questionnaire B1 seven main questions. Question **B1.06,** similar to question **A3.10,** aimed to supply the researcher with the importance given by the designers to these three realities; as well as, the importance given to the connections between remainings and additions, at the new existence.

Instead, questions **B1.07** till **B1.10**, similar to questions **A3.11** till **A3.14,** aimed to inventory more information about their design decisions related to these four realities, as well as, few illustrative examples from their own rehabilitation designs. By the examples provided before and after using RE-ARCHITECTURE®, the researcher would be able to identify evolution on their concern for the subtractions, together with the remainings and additions.

Last, questions **B1.11** and **B1.12**, similar to questions **A3.15** and **A3.16** would supply the researcher with the approximate percentual relation between subtractions and remainings and between additions and remainings. By comparing it with the results before and after using RE-ARCHITECTURE®, the researcher would again be able to identify evolution on the relationship between subtractions, remainings and additions.

- **The importance of rehabilitation interventions**

  The importance of rehabilitation interventions shall achieve much more sustenance on ecological arguments by the students, rather than on the building's classification.

  The importance of rehabilitation interventions shall achieve more sustenance on ecological arguments by the architects, rather than on the building's classification.

At this level, designers were not only asked about the importance to rehabilitate existing buildings. They were asked about the arguments that support such judgement. Question **B1.13/B2.13**, similar to question **A2.06**/**A3.07,** allowed the researcher to filter the answers of all designers and depict the most inherent cultural values. However, this time only the students and designers with experience in rehabilitation designs answered it.

In Questionnaire **B1/B2**, an extra sub-question was added to question **B1.13/B2.13** similar to question **A3.07**, with the purpose to make the students express clearly their judgement on which existing buildings should be rehabilitated and which should be demolished. The answers of both questions would allow the researcher to verify if the ecological and or the general cultural values would raise consideration.

Moreover, when comparing the answers given at questions **A3.07** with the ones given at questions **B2.13**, the researcher would be able to identify if there have been differences on the raise of consideration with reference to the ecological and or the general cultural values, from the test period of the design theory to the test period of the design product. There should be expected some differences, even if not considerably high.

- **The appointed successes in rehabilitation designs**

  Students shall easily identify successful rehabilitation designs; however, their definitions and appointed successes shall seldom match.

  Architects shall easily identify successful rehabilitation designs; and their definitions and appointed successes shall often match.

Questions **B1.14/B2.14**, similar to questions **A2.07**/**A3.08** aimed to identify if the students would be able to reference rehabilitation designs and respective architects, which they would consider as successful. Further, they would be asked to define a successful rehabilitation design; providing the required arguments necessary to understand their choices of reference, as well as, compare them to the rehabilitation theorised as lifespan conscious.

To support advanced conclusions, question **B1.15/B2.15** focused on their self-evaluation, regarding the success of the developed rehabilitation designs, described at Questionnaire B1/B2. Intentionally, these questions were placed just after questions **B1.14/B2.14**, so that both the researcher and the student could formulate logic correlations.

On balance, what was once defined as successful should also rule at the self-evaluation. However, this correlation between what designers define as successful when produced by others and themselves is often deviant, especially among students; who are still learning what successful means and are too often eluded by immediacies. Instead, architects are expected to go beyond the appearances and be more coherent in their arguments.

- **The interest in RE-ARCHITECTURE®**

  Due to its apparent rationality, students shall first confront RE-ARCHITECTURE® and progressively verify its usefulness, stage by stage.

  Due to its apparent rationality, architects shall first confront RE-ARCHITECTURE® and after verify its usefulness, on particular stages.

Exclusive from Questionnaire A3, question **A3.04** asked the students about getting theoretical support, concerning the different stages and/ or activities of the design process (methodology). While at the control group, the question was 'would it have helped', at the experimental groups, the question was 'did it help', becoming more conscious of the building lifespan and its environment, raising the quality of the rehabilitation design.

The aim of such question was to identify how students would react or how they did react to the support through a theorised design process, with pre-established stages and/ or activities. Particularly, the answers from the students at the experimental groups, would reveal the advantages and disadvantages of such approach, its contribution to the raise of lifespan consciousness and respective raise of quality at the rehabilitation designs proposed.

Such variable could become relevant or not, dependent on the similarities and differences identified in the answers of students from the same group and/or different groups, by the researcher when surveying and correlating them. In addition, it would also provide an indication to the researcher on how frequent students from these groups develop rehabilitation designs at their own Faculties.

6.3.1.3 RESULTS

THE HYPOTHESES VERSUS PRACTICES

The presented results were synthesised after analysing all information provided by the different methods to survey architecture students and architects from the Netherlands and Portugal, as users of RE-ARCHITECTURE®. Questionnaire B1 had a total number of nineteen main questions and twenty-six sub-questions; while Questionnaire B2 had a total number of twenty-one main questions and twenty-eight sub-questions.

As illustrated in Figure 105, the weeks between the end of January 2007 (week 5) and March (week 13) were determining for the registration of designers from Portugal; while the weeks between half February (week 8) and beginning of March (week 10) were determining for the registration of designers from the Netherlands.

For the students from the Netherlands most registrations occurred with the beginning of the semester in the first week of February (week 6); while the registration of students from Portugal already started with the publication of the "public invitations" and notices and got even higher at the beginning of the semester in the first week of March (week 10).

The **registrations** at RE-ARCHITECTURE® reached in the last week of July (week 30) the total number of **450** users; **108** from the Netherlands and **342** from Portugal. Both countries had approximately the same number of students. However, the considerable difference was the number of architects from Portugal; approximately four times above the number of architects from the Netherlands (*vide* Table 4).

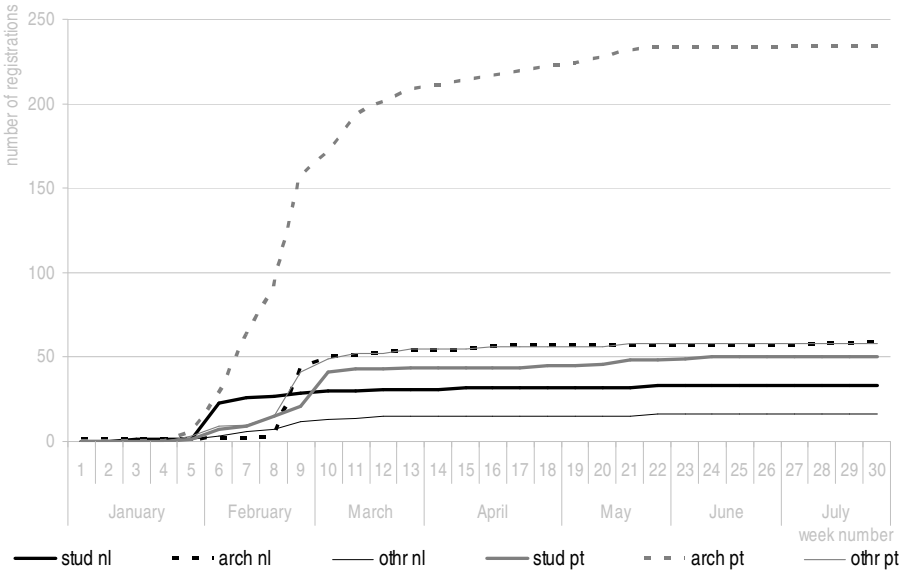


Figure 105 – The evolution of the number of registrations at RE-ARCHITECTURE®

From the total registrations, a considerable percentage of users stopped using RE-ARCHITECTURE® along the process. Almost half (48%) by the moment they discovered that the **Pre-Survey** (Questionnaire B1) was mandatory to gain access to its full content. Even if many from the other half have created a design process and used RE-ARCHITECTURE® for a while, the ones filling in the **Post-Survey** were even more reduced (12%).

	The Netherlands				Portugal				Total
target	nl/s	nl/a	nl/o	nl	pt/s	pt/a	pt/o	pt	nl+pt
Registrations	33	59	16	108	50	234	58	342	450
Pre-Survey valid	28	23	8	59	27	84	14	125	184
Pre-Survey invalid	3	3	4	10	4	18	20	42	52
Pre-Survey total	31	26	12	69	31	102	34	167	236
Design Process	40	21	9	70	32	71	27	130	200
Post-Survey	21	**9**	1	31	12	**9**	1	22	53
Logins	494	94	28	616	294	351	81	726	1342
Clicks	10445	2351	890	13686	6279	8614	2089	16982	30668

*nl = the Netherlands; pt = Portugal; s = student; a = architect; o = other occupations

Table 4 – Summary of all fundamental values

Consequently, the nine architects filling in the Post-Survey have defined the limit of the users and respective answers to be surveyed. A sample had to be retrieved from the groups of students. The criteria were the moment of registration and insufficient valid answers. Complementary, the researcher has decided to survey both **logins** and **clicks** to identify respectively how often and how long RE-ARCHITECTURE® would be used.

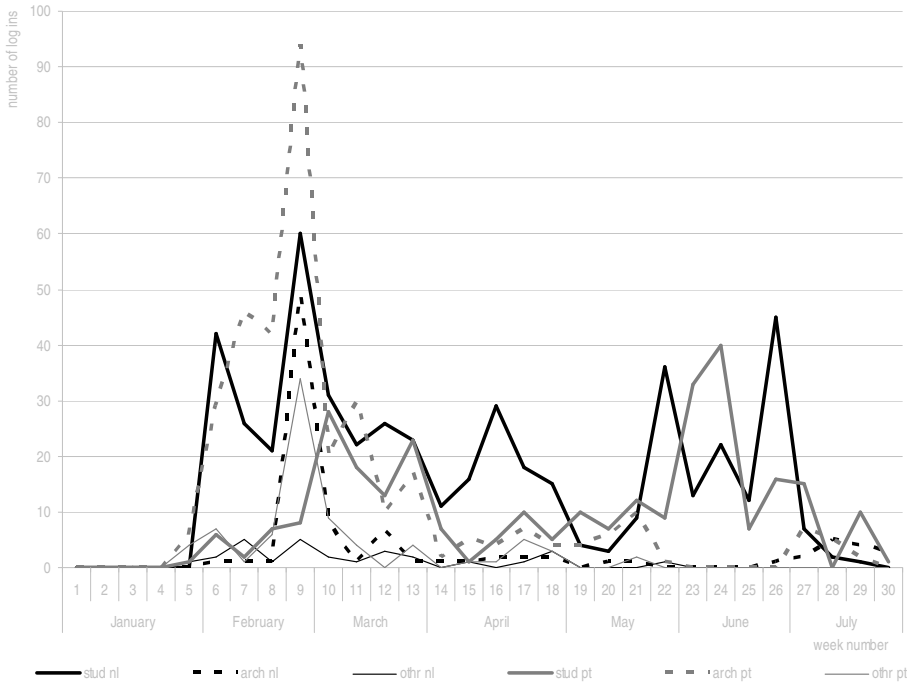


Figure 106 – The evolution of the number of logins at RE-ARCHITECTURE®

Figure 106 describes the evolution of the total number of logins, through the test period. The amount of logins at the first month of diffusion in the internet is clearly visible. But the most interesting aspect is that somehow the peaks of logins undertaken by both groups of students are correlated to the stages of the design process.

For example, it is clearly visible at the logins by the students from Portugal that they used RE-ARCHITECTURE® at the period of the simulation stage, during the first weeks of June. Probably, that has also to do with the fact that both researcher and Prof. Post visited the group of students in that period of time and the personal contact might have stimulated their contribution to this doctoral research.

The researcher has also illustrated the number of logins per group user to better understand their behaviour. Inversely to the number of registrations, the range of logins undertaken by the students was found approximately five times higher than by the architects. Portugal still used it approximately twice as more as the Netherlands (*vide* Figure 107).

There are exceptions e.g. the two user accounts created by the two groups from the Netherlands (user 195) and from Portugal (user 428) to store all collectively retrieved data from the Pre-Design stage, which reached from the Netherlands a value above the sixty logins and from Portugal a value above the seventy logins.

Moreover, from the Netherlands there was one MSc student, Marijn Roos (335), doing an independent research Master related to RE-ARCHITECTURE® . He has reached a value of over fifty logins. From Portugal, one of the students from the experimental group, John Wilson (391), reached a value above the twenty logins. Architect Wim Kristel (234) from the Netherlands was also the only reaching the value of six logins; while Architect Miguel Bronze (166) and Architect Sonia Vieira (352) were the only ones reaching the value of seven logins.

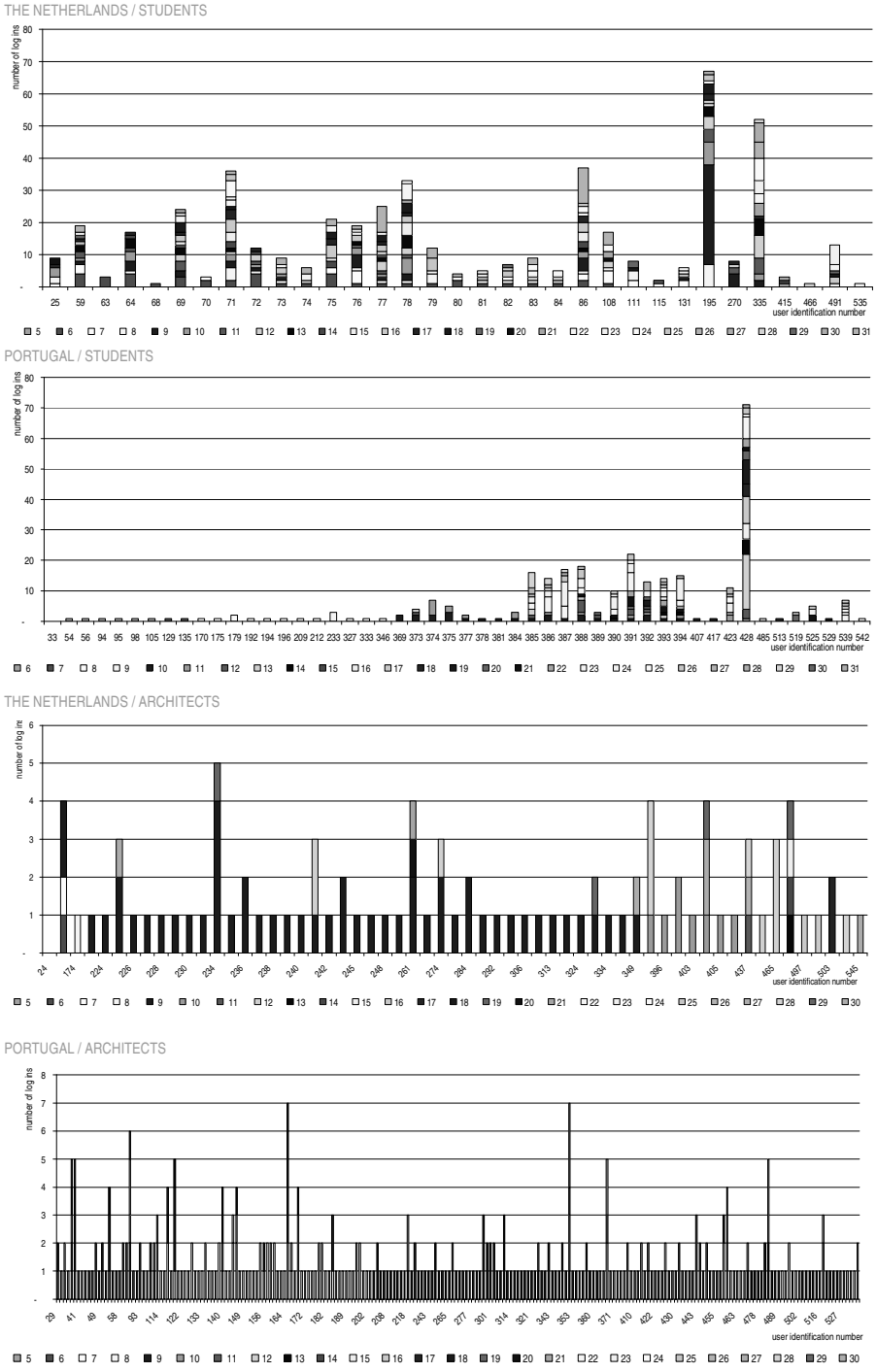


Figure 107 – The number of logins, per group user of RE-ARCHITECTURE®

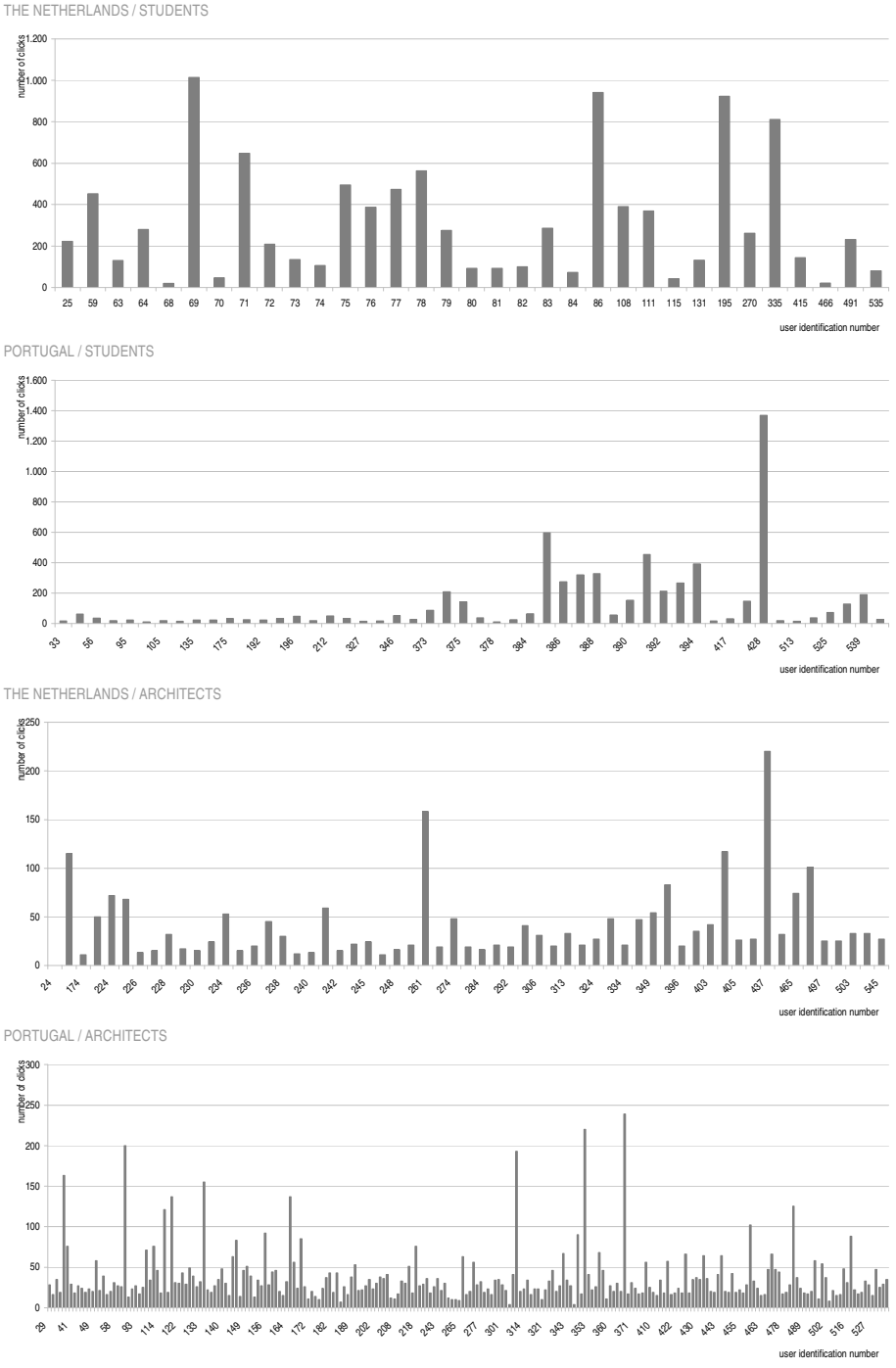


Figure 108 – The number of clicks, per user of RE-ARCHITECTURE®

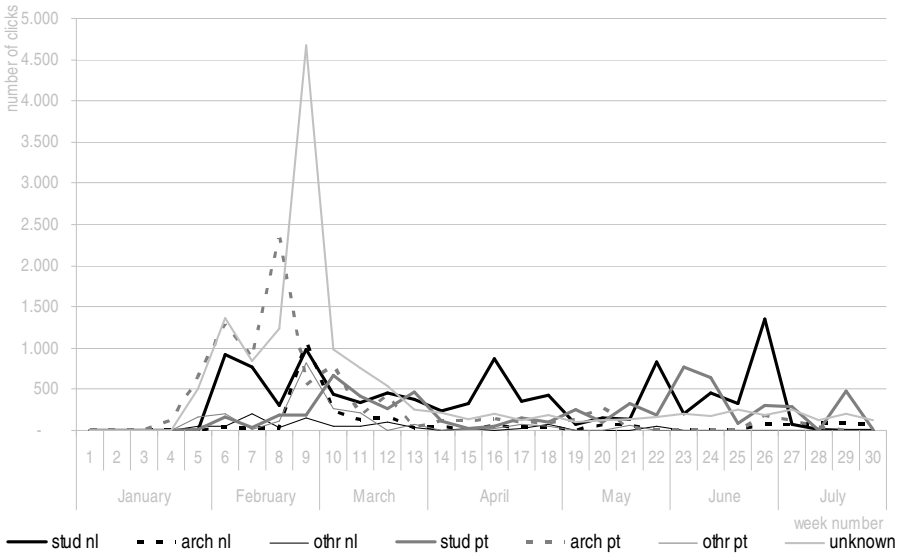


Figure 109 – The evolution of the number of clicks at RE-ARCHITECTURE®

Curiously, the range of **clicks** (movements between pages of RE-ARCHITECTURE®) revealed similar patterns to the range of logins, with few differences. First and last positions remained respectively with the students and architects from the Netherlands, while in-between; architects from Portugal reached higher ranges of clicks than the students from Portugal; probably correlated with the number of registrations (*vide* Table 4).

Figure 109 illustrates the evolution of the number of clicks, throughout the test period. For example, the month of February and first week of March; together with the last week of June, were particularly significant for the group of students from the Netherlands, who have clicked more than ever; probably to prepare the final design report.

The researcher has also illustrated the number of clicks per group user to better verify the relation between clicks and logins (vide Figure 108). Again the ranges followed the order revealed with the number of logins; first the students and last the architects. The Netherlands reached twice the values of Portugal in the students, but one-two-thirds in the architects.

Just as at the total results of the logins, there were few exceptions on each group that fall out of this indicative range. Joining the two previous mentioned users (at the logins); two other students from the Netherlands emerge above eight-hundred clicks. Those were respectively the students Daniel Tulp (69) and Anja Zajkowska (86). Similarly, another student from Portugal, Lionel Estriga (385), emerges together with the previous users, as well above the four-hundred clicks.

At the group of architects from the Netherlands, there were also four users that executed more than one-hundred clicks. One Architect, Tom Veeger (403), clicked more than one-hundred fifty and Architect Bart de Kreij (437) clicked even two-hundred times. From Portugal, there were three architects who have executed more than two-hundred clicks. Those were respectively the previously mentioned Architect Sonia Vieira (352); plus, the Architect Maria Alexandra Cardoso (368) and the Architect Sérgio Miguel Magalhães (86).

■ **The experience in developing rehabilitation designs**

Students with experience in developing rehabilitation designs did not answer more lifespan consciously, than the inexperienced ones.

Architects with experience in developing rehabilitation designs did not answer more lifespan consciously, than the inexperienced ones.

Like when testing the design theory, most designers have confirmed their experience in developing rehabilitation designs (*vide* Figure 110). Yet, there have been still designers who have stated to have never developed rehabilitation designs, slightly more in the Netherlands than in Portugal. Without further information on their rehabilitation experiences, those designers were automatically redirected to the last questions of Questionnaire B1, mostly referring to RE-ARCHITECTURE® and their respective expectations.

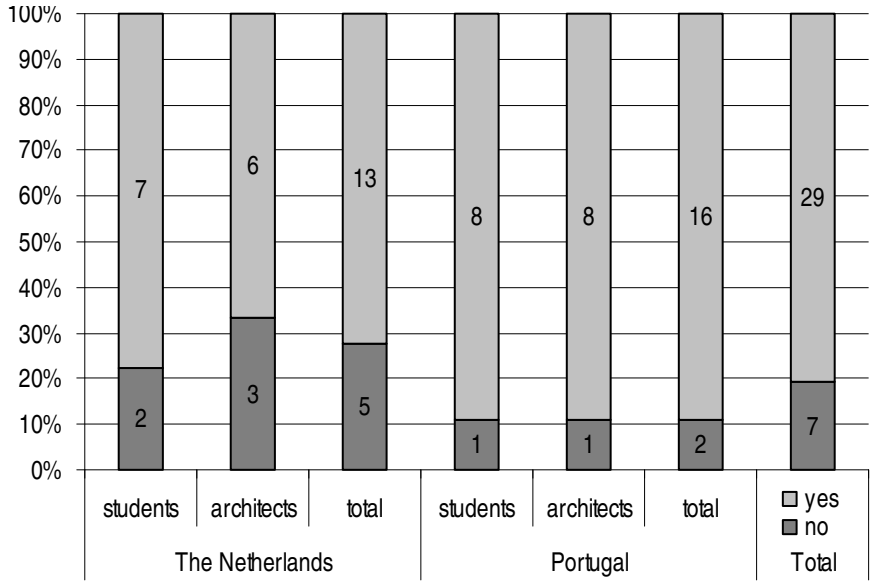


Figure 110 - The experience in developing rehabilitation designs

With such results it is possible to verify that there are architects from both countries, practicing in the built environment, who stated to have no previous experience in rehabilitation interventions. One could wonder if they exclusively considered the rehabilitation practice or if they also considered the rehabilitation design developments during their graduations in architecture.

After all, independent from having practiced it or not, architects should have gained proficiency in all interventions on the built environment during their graduation in architecture and not just only on developing new buildings. Not enough explored, during this doctoral research, this could be the starting point of many other interesting research programs.

Moreover, this question would help distinguishing the experienced from the inexperienced designers in both countries, and sustain the verification of their answers, as well as behaviours; which would be considered more or less lifespan conscious.

Particularly for the architects, their answer regarding RE-ARCHITECTURE® and their respective expectations did not differ sufficiently to state that there was a correlation between the experience of undertaking rehabilitation interventions and the level of lifespan consciousness.

During the semester, students at both experimental groups did neither denounce their experience or inexperience in developing rehabilitation designs, through their behaviour at the lectures; nor in their answers on both Questionnaires B1 and B2. Similar to the previous period to test the design theory, most students were very confident about their own principles; even if often such principles did not have strong sustenance, nor be clearly understandable and showing lifespan consciousness.

There were, however, clear differences of behaviour between the students from the Netherlands and Portugal. This time, students from the Netherlands were more motivated and brought periodical progress after comments and critics. Instead, the students from Portugal would hardly show periodical progress. The first students would challenge the researcher with questions, while the second students would only listen and hardly react.

- **The experience in using RE-ARCHITECTURE®**

  Students made use of RE-ARCHITECTURE®, according to the program; but drew a balance between theory and their individual approaches.

  Architects, in both countries, especially concerned with lifespan consciousness at rehabilitation interventions accepted the challenge and tested RE-ARCHITECTURE®.

Inversely to the architects, all students stated to have used RE-ARCHITECTURE® to support their rehabilitation design developments (*vide* Figure 111). Nonetheless, as this research follows qualitative methods, the researcher has chosen to still include the survey of their answers in the following themes, even if well aware of them being not representative.

Other option would have been to exclusively focus on the students. However, in this case the expertise would not be able to learn from their experiences and opinion. Moreover, while the techniques of observation have given enough support to be more certain about specific behaviours of the students, the process mining techniques have done the same for both architects and students.

The researcher was interested to understand their motivations for not having used RE-ARCHITECTURE®. Their comments and answers to Questionnaire B2 would be of much value for further recommendations and improvements on future RE-ARCHITECTURE® versions. That was exactly the reason to introduce this question, while realising their low adoption, controlling the logged workflow.

Most designers from both countries, who have not used RE-ARCHITECTURE® have either stated not to be involved with any rehabilitation design, but still curious to see what RE-ARCHITECTURE® had to offer; or to be involved but in such a late stage that everything was already defined and decided; or with a schedule that did not allow extra or unplanned activities.

Particularly from the Netherlands, few architects considered the use of RE-ARCHITECTURE time-consuming and unprofitable. Others found the English language a very difficult barrier. One architect from Portugal, found too difficult to start using RE-ARCHITECTURE, without a previous demonstration or formation.

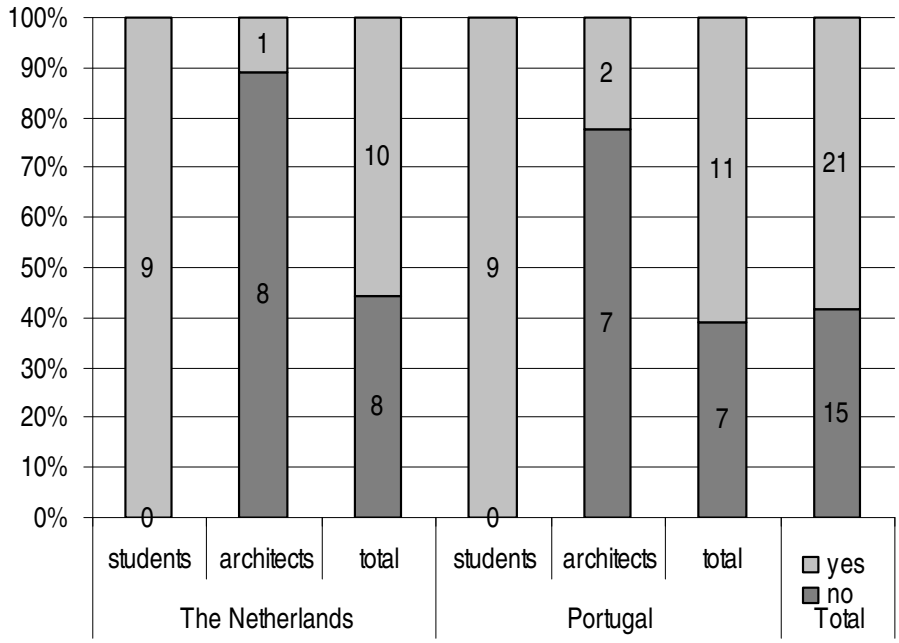


Figure 111 – The experience in using RE-ARCHITECTURE®

The students did not denounce any particular rejection behaviour for using RE-ARCHITECTURE®. Few of them preferred the book RE-ARCHITECTURE *scapus*, over searching and reading the guidelines online. Basically, they declared to be using RE-ARCHITECTURE® mostly for the tools.

Most students from the Netherlands were curious and motivated by the program to undertake a rehabilitation design of an industrial heritage building, and with the particularity of participating in a doctoral research, by testing RE-ARCHITECTURE®. Even if some initially seemed concerned with the impact of this experience on their own assumptions and methods, most students were open to the new experience and tried different methods.

Generally, students presented few critics even if strongly encouraged. From the Netherlands, students mostly commented e.g. it would be better if designers were enabled to share the same design process, export data, etc. Instead, students from Portugal mostly argued issues related to aesthetics of the interface, e.g. colour, letter size, etc.

Moreover, process mining techniques revealed that the ways designers would use RE-ARCHITECTURE® were varied (*vide* Appendix 8). Here, the researcher found enough evidence to support the hypothesis that such support system would not constrain the process of designers willing to develop lifespan conscious rehabilitation designs, nor their creativity.

Probably, designers who consider that the theorised design process and respective RE-ARCHITECTURE® constrains their design process, without really trying; are in fact, designers who consider themselves entitled to their creative freedom; allowed to vanish the built environment in their rehabilitation design developments, without any sorrow for the wasted resources; which might have been significant and in good condition. And for them, RE-ARCHITECTURE® has, indeed, no use.

■ The perspective on developing rehabilitation designs

Students with different perspectives than the pure architecture-oriented ones reacted similarly to the theorized design process.

Architects with different perspectives than the pure architecture-oriented ones reacted similarly to the theorized design process.

Most students from the Netherlands (78%) and all students (100%) from Portugal answered that becoming an architect was their first professional expectation. So, did the architect from the Netherlands and one architect from Portugal. The other students (22%) from the Netherlands chose for building technology engineer (*vide* Figure 112).

From the Netherlands, students referenced as other professional expectations building technology engineer, while the architect chose for building process manager. Instead, from Portugal, students referenced urban planner, building process manager, researcher and/or professor. For the architects those were respectively, building process manager, urban planner and researcher and/or professor (*vide* Figure 113).

Despite the differences in professional expectations, evidences that would confirm the hypothesis could not be identified by the researcher in the behaviour of the students, nor in the answers of both students and architects. Most students have revealed tendency for architectural developments and only few students from the Netherlands, targeting building technology; were less conceptual, but their design processes were not less interesting. In fact, this opened prospects for providing RE-ARCHITECTURE® to other actors involved in rehabilitation design developments.

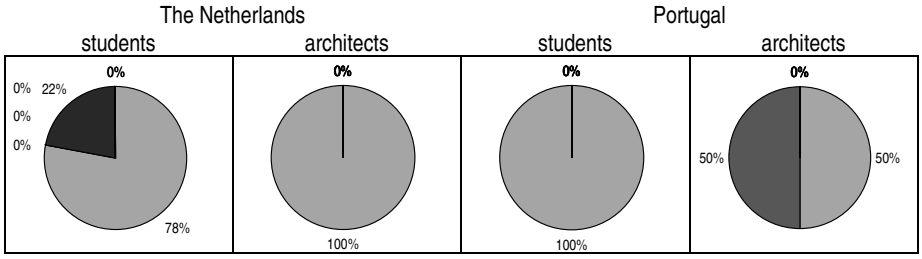
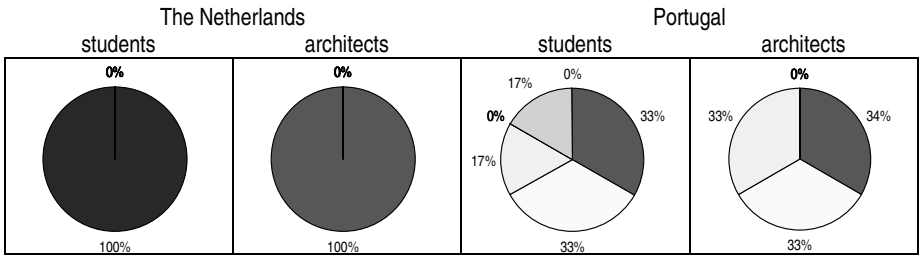


Figure 112 – The first choice at the professional expectations of the designers, after graduation



Architect; Building Technology Engineer; Urban Planner; Researcher/ Professor; Building process manager; Other

Figure 113 – Other choices at the professional expectations of the designers, after graduation

Again, in these matters there were clear differences between the students from the Netherlands and from Portugal. The students from the Netherlands were much more acquainted with the surveys to be undertaken during the Pre-Design stage than the students from Portugal. Therefore, even if most of them have had previous rehabilitation interventions, their acquaintance with surveys involving interventions in the built environment was very limited. Probably, such difference was either lack of knowledge and/or language barriers. Nonetheless, a curious point of attention was the mutual interest for dealing with the building and respective environment on a social-oriented perspective.

- **The interest in developing rehabilitation designs**

  Students have shown interest in developing rehabilitation designs; however, they have mostly prioritized the present and respective novelties.

  Architects have shown interest in developing rehabilitation designs; however, they have mostly prioritized the present and respective novelties.

All designers from both countries have considered their preceding rehabilitation designs interesting, when answering Questionnaire B1. Most arguments regarded the building. However, there have been few interesting ones, which were more oriented towards the designer and his aims. From the Netherlands, one student particularly argued its inherent process of irrationality and sensitivity; while from Portugal, one architect argued the ability to apply his principles. The only common argument among the four groups of designers was the ability to integrate past (old) and present (new) in the new existence. Also much referenced were: integrating new functions and services in the new existence and the management of the building restrictions and/or problems of the pre-existence.

From the Netherlands, one student argued to reduce demolitions and built heritage losses; while two architects argued to treat existing components / materials and to deal with existing buildings as interesting. From Portugal, equally referenced were the challenge to integrate new components and materials into a pre-existence, to manage a conscious / minimal design and to preserve valuable buildings.

In most arguments the focus on the present achievements and respective additions in the new existence is visible; either referenced individually (37%) or directly related to the remainings from the pre-existence (37%). Less referenced were the remainings (23%); followed by the subtractions.

When asked specifically for the advantages that could be clearly identified in their rehabilitation designs, like when testing the design theory, the only common aim was to **replace** the building areas, functions and/or services. To **improve** the building condition and physics (e.g. light, acoustics etc.) till the modern requirements was also argument referenced by all groups, except for the students from Portugal.

In fact, the aim to **improve** the building and respective environment was the most referenced (44%), followed by the aim to **replace** (33%). Instead, to **restore** was referenced by designers from Portugal(8%). The aim to **maintain** was exclusively referenced by the architects (6%). Equally referenced was the aim to **decrease** (6%); however, this was an aim exclusively referenced by the architects from the Netherlands.

Students from the Netherlands and architects from Portugal aimed to **improve** the "building areas, functions and/or services". Inversely, one architect from the Netherlands and one student from Portugal referenced the interest to **improve** "environments which are or can

become socially valuable for their people". Students and architects from Portugal have referenced the aim to **restore** the "building's lifespan and consequent sustainability".

From the Netherlands, students aimed to **improve** the "environment through the building rehabilitation". Instead, one architect mentioned the interest to **decrease** the building "usage of economic, energy and natural resources"; to **improve** the "ecological values of the pre-existence". While one architect from the Netherlands aimed to **maintain**; students from Portugal aimed to **improve** what "architecturally valuable in a building as well as its identity, image and/or status". Moreover, one architect referenced the interest to **maintain** "built heritage and/or culturally valuable buildings".

At the four groups, four common factors were presented as influential to their design developments. Most referenced were the "essence and/or original qualities" of the **pre-existence**; second were the "user demands", for the **new existence**; third and fourth were respectively the "construction" of the **pre-existence** and of the **new existence**, considering the nature of "what to add into the building and its relation with the remainings".

All groups except for the students from Portugal have referenced the "concept" of the **new existence** and the "economic resources available for the development" of the **new existence**. Moreover, except for the group of architects from the Netherlands, all others referenced the "functions" in the **new existence**. The choices involving the "construction" of the **new existence** and its respective "level of sustainability" was also a fundamental factor to all groups except from the group of students from the Netherlands.

At both groups from the Netherlands, the building physics in the **new existence** was considered an important factor to their rehabilitation designs. The historic values of the **pre-existence** and the time available for the rehabilitation intervention were two factors mentioned at the groups of architects. Instead, the "forms and/or geometries" of the **pre-existence** were an important factor referenced by students from the Netherlands and architects from Portugal.

Particularly, at the group of students from both countries which the researcher was able to observe, it was confirmed their favouritism for the present achievements and their visions for the new existence.

The pre-existence would be hardly mentioned when revealing their interest in developing rehabilitation interventions and even more rare to find were designers who set their interest in establishing the harmony between past, present and future of the building and respective environment. Curiously, past would only be referenced when the building would be found culturally valuable, e.g. historic, social, scientific, aesthetical, etc.

Generally, the students from the Netherlands would be much more motivated, but also much more intrusive. Along the process, they would be constantly asked about their aims and guiding principles. Only by the end of the semester, most students have understood the aim of such experience and importance to become more lifespan conscious.

Students from Portugal, instead, planned their interventions much more carefully. They had inherited not only the motto of WASTE ZERO from the previous year, as they had a new motto. They would see this intervention as a tenant. Therefore, the more reversible they would develop their rehabilitation designs the better. Consequently, such mottos have brought very minimal interventions.

With the end of the semester for the students and the four months of RE-ARCHITECTURE® trial for the architects, designers were asked again about their interest in developing rehabilitation design and their arguments. Almost all designers (95%) have considered it interesting. Only one student (5%) from Portugal has argued the complexity of RE-ARCHITECTURE® to consider it uninteresting. Instead, at all groups, designers have

argued the interest in developing their rehabilitation design related to the interest in the theorised design process which they were challenged to follow.

Students from the Netherlands mentioned that the method followed offered more structure in the design process, enabling them to "speak with the building"; taught them a "great deal about rehabilitation"; made them "more conscious" about lifespan rehabilitations; pointed out a different approach; and provided a methodological approach to deal with the complexity of rehabilitation interventions. Moreover, students from Portugal mentioned that the method allowed them to try a scientific method and to verify its results, as well as that the method was innovative and a "very important experience for the conscience" of what rehabilitation is, together with the process before construction.

The architect from the Netherlands, who was already in the middle of a rehabilitation design process when started using RE-ARCHITECTURE®, argued that if the earlier choices would have been properly documented, as fully guidelined in RE-ARCHITECTURE®, that probably his design process would have been much easier. One architect from Portugal, mentioned the interest of RE-ARCHITECTURE® for being able to support her mental process and another architect mentioned the ability to not let a designer forget about anything.

More oriented towards the building, three were the arguments found common at both groups of students. The first was the challenge to deal with existing buildings while defining a new existence; the second was the ability to design respecting the old building and the architect; and the third was the ability to integrate new components and/or materials.

At the group of students from the Netherlands, references were found on the challenge to manage the building restrictions / problems, on the ability to preserve valuable buildings, and on the ability to integrate harmoniously old and new, at the new existence. From Portugal, one student mentioned the ability to integrate new functions / services and other mentioned the ability to use current materials and technologies.

Again, the importance endorsed to the additions by the designers is clear; either referenced individually (36%) or directly related to the remainings (45%). This last one has grown considerably since the Pre-survey (37%). Less referenced were the remainings (18%). This time, subtractions are not mentioned at all, nor the combination between subtractions and remainings and between subtractions and additions.

When asked specifically for the advantages that could be clearly identified at their rehabilitation designs, only one common aim was found among all four groups of designers. That aim was to **restore** the building's identity, image and/or status. There was another common aim among all groups, to **improve** the building's areas, functions and/or services, except for the group of architects from the Netherlands.

The aim referenced at all groups was to **restore** (26%). Instead, to **improve** the building and respective environment was the most referenced aim (50%), by all groups except the architect from the Netherlands. To **maintain** was the following most referenced aim (12%) referenced at the groups from Portugal. Instead, the aim to **decrease** was exclusively referenced at the group of students, from Portugal. Last aim, to **replace** was only mentioned at the group of students (3%), from the Netherlands.

Both groups of students aimed to **improve** what socially valuable; at the level of the building and at the level of the environment, as well as, to **improve** the building's identity, image and/or status. Moreover, designers from Portugal have also commonly referenced the aim to **maintain** the building's identity, image and/or status.

Students from the Netherlands aimed to **restore** the social values within the building; to **improve** the building generally and to **replace** the building areas, functions and/or services. Instead, students from Portugal aimed to **decrease** the usage of economic

resources, to **decrease** the demolition / waste of resources and the usage of natural resources; to **maintain** what considered historically and socially valuable; in the building; and to **improve** the building's lifespan and respective sustainability.

When asked to describe the most important factors which have influenced their design developments, all groups except for the architects from Portugal, have mentioned the historic values inherent in the **pre-existence**. Inversely, all groups except the group of architects from the Netherlands described the aesthetical values inherent in the **pre-existence** and the "functions" in the **new existence**.

Students have presented the "forms and/or geometry" and the "essence and original qualities" of the **pre-existence**; the user demands reached at the **new existence**; the relation with the environment; and sustainable and/or ecological construction. This last one enclosed references to ecology and/or to e.g. "reuse of materials", "plan what to do with the things you take out of the building". Last common fundamental factor, the minimal damage to the **pre-existence** was as a fundamental factor referenced at both groups from Portugal.

From the Netherlands, students pointed respectively the verticality and/or the height of the **pre-existence**, and the building physics of the **new existence**, e.g. daylight, comfort. From Portugal, students mentioned the social values and the importance of the building's condition. Both architects from Portugal mentioned the "construction" of the pre-existence, however, only one referred its "level of sustainability", e.g. solar conditions.

The main difference between the arguments presented in questionnaire B1 and B2 is the theorised design process and reasons to consider it interesting. That has also occurred in the previous period to test the design theory. Respectively, students where asked if they considered the rehabilitation design interesting and most of them would argue about either the theorised design process and/or RE-ARCHITECTURE®.

Moreover, they still tend to generally focus in the additions and novelties, just as hypothesised. That is clearly revealed by the strength of the aims to improve on both Questionnaire B1 and B2. Nonetheless, a raise of lifespan consciousness was found among the arguments of the students, with the minor interventive aim being more considered than earlier e.g. restore, maintain, etc. gaining more presence in their arguments.

Being the pre-existence the motive of the rehabilitation intervention, this design process helped designers to observe, rather than just to look; before idealising the new existence. Most students have realised such difference and treasured the level of knowledge retrieved to sustain their rehabilitation design developments; not only from documents, but from the involved actors, as well as from the building and respective environment.

- **The design processes followed in rehabilitation designs**

  Students have followed similar design processes and dealt with similar problems, already before following the theorised design process.

  Architects have more variety, but still have followed similar design processes and dealt with similar problems, already before following the theorised design process.

When asked in Questionnaire B1 about the design process (methodology) followed in their preceding rehabilitation design development, designers could choose between three options of answer: theory-based, individual-based or both. These options are different than at Questionnaire A2 and A3; but actually they mean exactly the same: teacher, own or both. It was only a matter to universalise the same question for both students and architects.

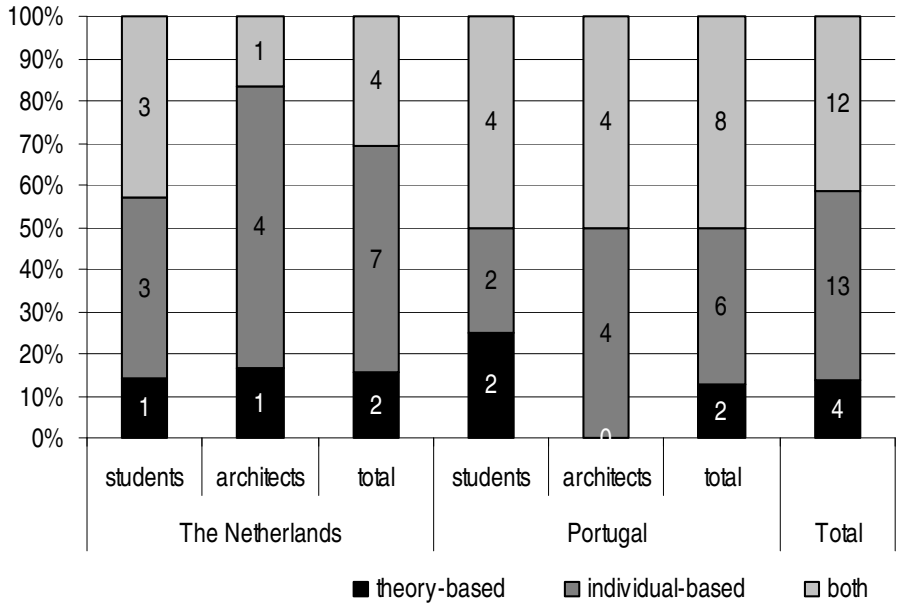


Figure 114 - The design process followed by the designers

Together with the individual-based, a compromise between the individual-based and the theory-based was considerably found chosen at all groups; leaving the theory-based, only found unselected by the architects, from Portugal. In fact, it was curious to find designers from the Netherlands being more individual-based than from Portugal. Such results meant that at least half of them could be, in advance, already more receptive for reaching a compromise with the theorised design process (*vide* Figure 110).

As clearly illustrated in Figure 115, designers performed more than the double of activities stages/activities from the Design stage (67%), than from the Pre-Design stage (33%). Within the Pre-Design stage, analysis (3AN) was mentioned at all groups and synthesis (3SY) was only not found mentioned at the group of architects from the Netherlands. However, no reference was found on activities of evaluation (3EV) and decision (3DE), exclusively focus at the pre-existence of the building.

Within the Design stage, related to the building's new existence, activities of analysis (4AN) were found by students from the Netherlands and architects from Portugal; while activities of synthesis (4SY) were only not found referenced by students from Portugal. Again, simulation (4SI) was the sub-stage with more activities referenced, comprising more than the half (56%) of the total number of activities. Activities of evaluation (4EV) were only referenced by designers from the Netherlands; while the activities of decision (4DE) were found referenced by one architect from the Netherlands and one student from Portugal.

Except for the students from the Netherlands and the architects from Portugal that have spent **>40** hours on activities of analysis (3AN), most designers focused most of their time, also **>40** hours**,** on activities related to simulation, more than on all other theorised sub-stages. Moreover, most designers proclaimed the usefulness of their stages/activities.

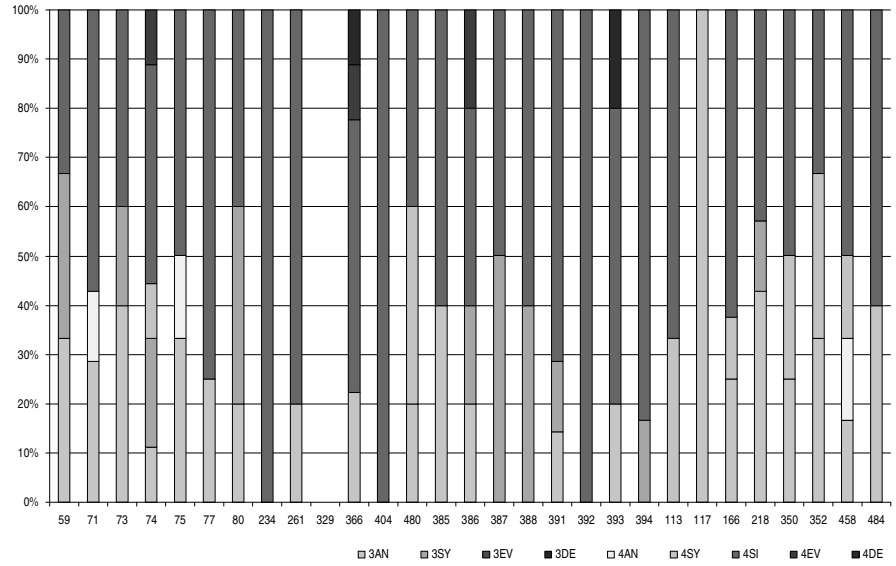


Figure 115 – The activities identified by the designers, ordered per design process sub-stage

Except for the group of students from Portugal; all groups were quite pleased with the preceding design process. In fact, generally the groups of designers stating “yes” (45%) or “no” (55%), to change and/or improve particular activities, were very comparable. Probably due to their level of experience and confidence with their own design processes, architects were much less open to follow different design processes than students.

Most changes regarded time management problems; most often too little time to produce the specific activities and take the design further, with the aimed quality. Few other changes regarded the involvement of other actors in the design process. Most activities identified were from the sub-stage simulation (4SI), followed by activities of synthesis (3SY) and by activities of analysis (3AN) and synthesis (4SY).

From the Netherlands, students required more time for developing the “architectural aspects”, which one considered “difficult in rehabilitations”; and architects for surveying the building and defining the “visualisation of strategy; opportunity to set the starting point” and less “design meetings; not focussed enough”. From Portugal, architects required more time for surveying the “history of the building”, meeting with the “involved engineers during the design process and not just at the end”.

There was one particular reference from an architect from Portugal that exactly sustains the main aims of this doctoral research. She also mentioned changes regarded time management problems, but on too much time spent researching rehabilitation theories and/or practices. Accordingly, such support is normally not easily accessible and such research is very time-consuming.

From the Netherlands, students suggested the participation of the neighbours since the beginning of the design process; to develop further the historic survey of the building, a common structure to harmonise the differences between all designers involved in the same rehabilitation design; and better conceptual developments.

From Portugal, both students and architects presented interest to improve considerations during their design developments, e.g. application of more renewable energies and better developed concepts. Students also mentioned a better research on the characteristics of the components and materials, planned for the new-existence – remainings and additions – and a better research on the required services for such functions.

When asked about extra-support along their preceding design process, most students stated to have needed extra-support, found in the **library** (41%), **internet** (38%), **teacher** (38%) and **experts** (31%). Curiously, the extra-support coming from colleagues, either at the academic or at the professional level was seldom referenced by the groups from the Netherlands; but quite much referenced by the groups from Portugal.

While observing the students along the semesters, the researcher has denoted the same time management problems. Particularly, with the schedule of approximately one week per sub-stage, students would often have to go forward with their design processes, without having finished the activities, from the previous sub-stage.

That naturally brought considerable inconsistency to the evaluation sub-stages; and taking as point of priority the earlier identified stages of analysis and simulation students tend to neglect the sub-stages which they were less acquainted with. For example, the evaluation stage was quite neglected. Consequently, they presented evaluation rates based on their opinion; instead of presenting evaluation rates based on the surveys, respectively undertaken on base of the inventoried information. Such passive and sustain role was still difficult to accept among the students in both groups, as they are used to not have to sustain their arguments on the real pre-existence, but at an ideal new existence.

Moreover, due to the particularity and novelty of specific taxonomy, the researcher would often have to explain what was already explained in RE-ARCHITECTURE®. More evident in Portugal than in the Netherlands, there were few students that were not accessing RE-ARCHITECTURE® or reading RE-ARCHITECTURE *scapus.* Consequently, they were not acquainted with the guidelines or tools.

A new taxonomy was synthesis. Most students confuse its meaning with analysis. Actually, most students only recognise two different stages, analysis and simulation; the first to search for related information without any defined method or guiding parameters and tendentiously end up transforming such information immediately into design developments, through simulation activities.

Nonetheless, the difficulty on surveying it technically remained perceptible as with the groups from the previous period when testing the design theory, but more in Portugal than in the Netherlands. Students from Portugal, while inventorying information were tendentiously taking their conclusions, as they have always done and presenting already evaluations without those being sustained by the pre-existence.

With RE-ARCHITECTURE® to sustain them, students showed fewer difficulties surveying all inventoried information. Again, they have showed preference to RE-ARCHITECTURE *scapus*, which they could “take everywhere and would not have to be dependent on the internet connection”. Moreover, they had also access to parameters, which they could either consider or not.

In Questionnaire B2 designers were asked again about the design process (methodology) as well their respective time and degree of usefulness. Most designers (67%) chose for the combined individual-based and the theory-based method (*vide* Figure 116).

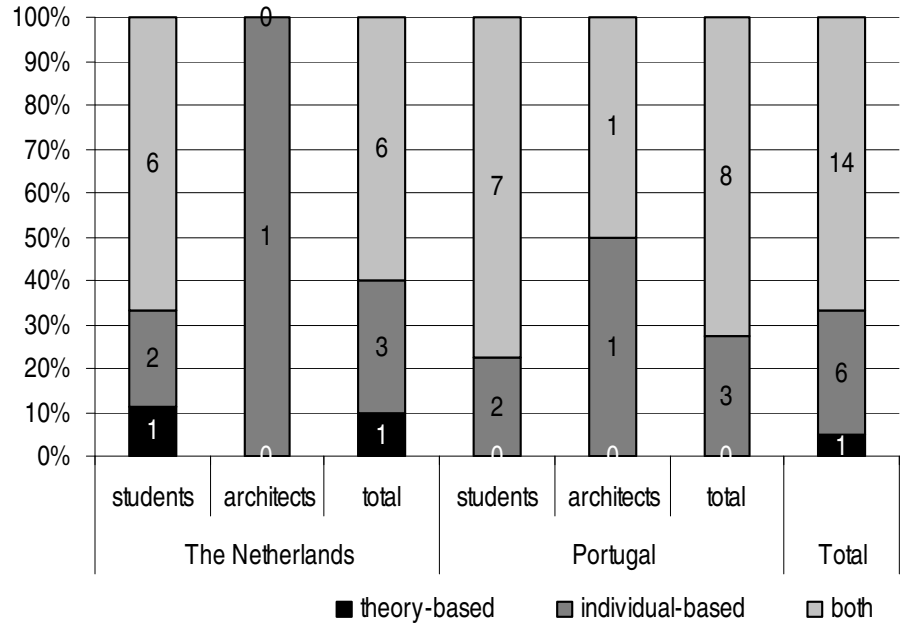


Figure 116 - The design process followed by the designers

Again, designers have performed more activities from the design stage (77%), rather than from the pre-design stage (23%). Particularly regarding the students, the researcher was aware that they have performed all sub-stages, even if unreferenced. Nonetheless, it was important to verify which sub-stages and/or respective activities students would consider important to mention.

There was, however, a curious tendency in the Post-Survey to not mention the activities undertaken at the Pre-Design stage (*vide* Figure 117). The researcher perceives two arguments to justify such behaviour. First argument is that, as the question asked for the individual design process; few students deduced that the researcher was asking for the activities they performed alone, during the Design stage.

Second argument is a deduction sustained on base of their general behaviours, but that can be misinterpreting the reality. The researchers believes that few students do not consider the research undertaken exclusively to evaluate both building and environment significance and condition; as part of the design process. Some behaviour evidenced that only when dealing with activities of the Design stage, they would feel developing a rehabilitation design.

Nevertheless, both groups of students have identified all sub-stages, within the Pre-design stage; except for the students from the Netherlands, who did not identify activities of decision (3DE). The architects from Portugal have only mentioned activities of analysis (3AN).

Within the Design stage, all sub-stages were mentioned by both groups of students. Activities of analysis (4AN) and simulation (4SI) were mentioned by every student. Last, one architect from Portugal mentioned activities of synthesis (4SY).

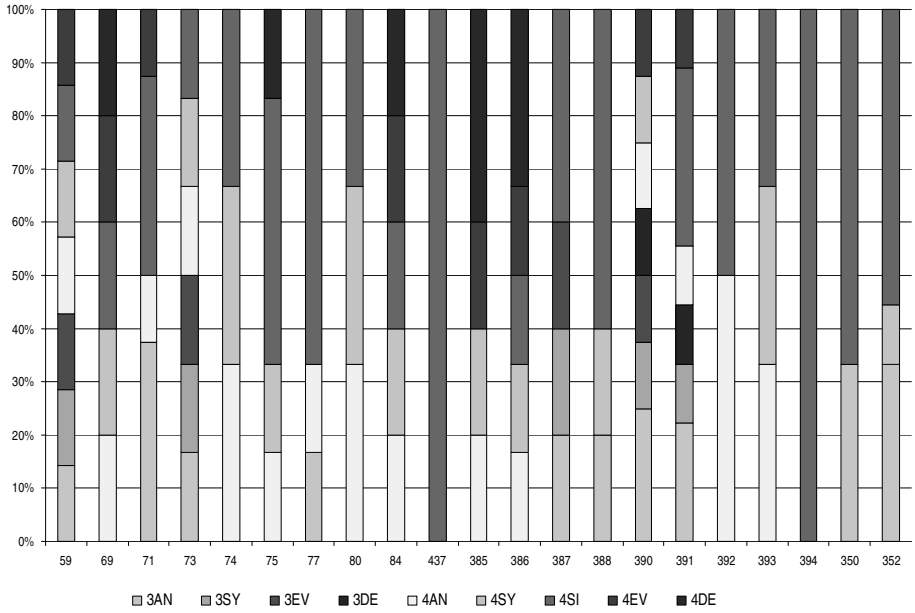


Figure 117 – The activities identified by the designers, ordered per design process sub-stage

Almost all designers spent **>40** hours in activities of simulation. Only some students from the Netherlands have also spent a considerable amount of time (**>20** hours) in activities of analysis (4AN) and synthesis (4SY) worthwhile of reference. Moreover, most designers proclaimed the usefulness of the undertaken stages/activities. In fact, only students from the Netherlands considered few activities developed useless, e.g. activities of evaluation, decision and synthesis (condition survey).

In fact, most students (72%) from the Netherlands and Portugal stated not to have followed another design process. Inversely, architects from the Netherlands and Portugal stated "yes" to the question if they would follow a different design process; together with few students from the Netherlands and Portugal. Again, as at Questionnaire B1, most arguments concerned time management problems in the sub-stages of simulation and analysis.

At the level of the activities of analysis, both groups of students identified the need to develop more detailed oral and physical inventories that can provide them with better information to sustain the respective surveys and assessments of the respective building condition and significance. One student from the Netherlands stated "every part I demolished could be an inspiration for what to do with it so it could increase the quality of my design", but other students from Portugal also mentioned the need to better sustain "what to remove and what to add", leading to a better "exploitation of the existing resources in the building".

The architect from the Netherlands mentioned activities of synthesis, to "look further into history to find out why decisions were made". One architect from Portugal mentioned activities of analysis e.g. visiting more the building; and the other architect mentioned the simulation stage, where the designer should have considered "more alternatives" to materialise her concepts of intervention.

Regarding what stages/activities to do less, students pointed towards pre-design stages. Students from the Netherlands pointed towards the evaluation sub-stage; while from

Portugal towards the analysis sub-stage. Nonetheless, these were minorities, as most designers did not mention specific stages and/or activities to do less in the design process. Accordingly, all had specific purposes and influence in the design developments.

All designers stated to have needed extra-support at varied stages of the design process. When asked to state in which stage/activity and where they found the extra-support; most designers chose **teachers/consultants** (24%); followed by the **library** (22%) and **colleagues** (22%), the **internet** (14%) and the **experts** (11%). There is a particular and unique reference, of one student from the Netherlands, to the **Pre-Design report** – they developed during the Pre-Design stage – as extra-support to his design developments, together with further references related to the library.

The stages where designers needed extra-support were within the design stage; e.g. analysis, synthesis and simulation. While students from the Netherlands referenced more analysis and synthesis, e.g. "to find aims and requirements of the dive centre and find out the installation concept"; students from Portugal referenced simulation, e.g. "while designing, I needed more extra information about the subtractions and how could I turn it profitable again. I had some doubts especially on the transformation of the concrete."

Therefore, by comparing their preceding design processes, and later their design processes making use of RE-ARCHITECTURE® the researcher was able to conclude that there are evident patterns of activities, as well as of the problems raised while describing what to do more or less. The design process is, after all, no more than a succession of stages, more or less structured, more or less linear. Even the most creative and irrational designer follows a design process, an irrational process, but that is also a process.

When he repeats such method, or part of it, even if it was only once, he has created a pattern. And, in this case of the students, a clear pattern was identified. So clear, that it even remains above the structure of the theorised design process, which is already considered a strong pattern. The priority of developing activities of **analysis** and **simulation** is undeniable, in more than one from the previous questions. For them they loose most time and for them they search for more information beyond referencing them together with few others.

The process mining survey was considerable useful to confirm such pattern, joining the evidences from the written arguments of the students with their user behaviours (*vide* Appendix 8). Moreover, even if from the architects there are hardly written arguments; the same pattern is found in their user behaviours (*vide* Appendix 8).

Students from both experimental groups became already more aware of other sub-stages within the theorised design process and how they could benefit from them to improve the quality of their design results. Hopefully, in time, this pattern shall change and enclose more and more the sub-stages theorised in the design process implemented in RE-ARCHITECTURE®. That would certainly help designers getting more lifespan conscious results, with decisions sustained in a compromise between the pre-existence and the new existence, rather than exclusively sustained in the new existence.

- **The universe of subtractions, remainings and additions**

  The correlation between subtractions, remainings and additions was not considered by the students; but grew while using RE-ARCHITECTURE®.

  The correlation between subtractions, remainings and additions was not considered by the architects; but shall grow after using RE-ARCHITECTURE®.

In Questionnaire B1, just as in the period to test the design theory, most designers (82%) have attributed positive values (reasonable, high and very high) to the importance given in their design decisions to the building subtractions, remainings, additions and connections (*vide* Figure 118).

Both groups from the Netherlands and the architects from Portugal considered the **remainings** of very high importance. From the Netherlands, most students and architects considered the **subtractions, additions** and **connections** of high importance.

From Portugal, students considered all **four realities** of reasonable importance; only the subtractions were equally considered of very low and very high importance (25%). Instead, the architects considered the **subtractions** of reasonable importance, the **additions** were considered simultaneously of low, reasonable, high and very high importance, and the **connections** were considered of very high importance.

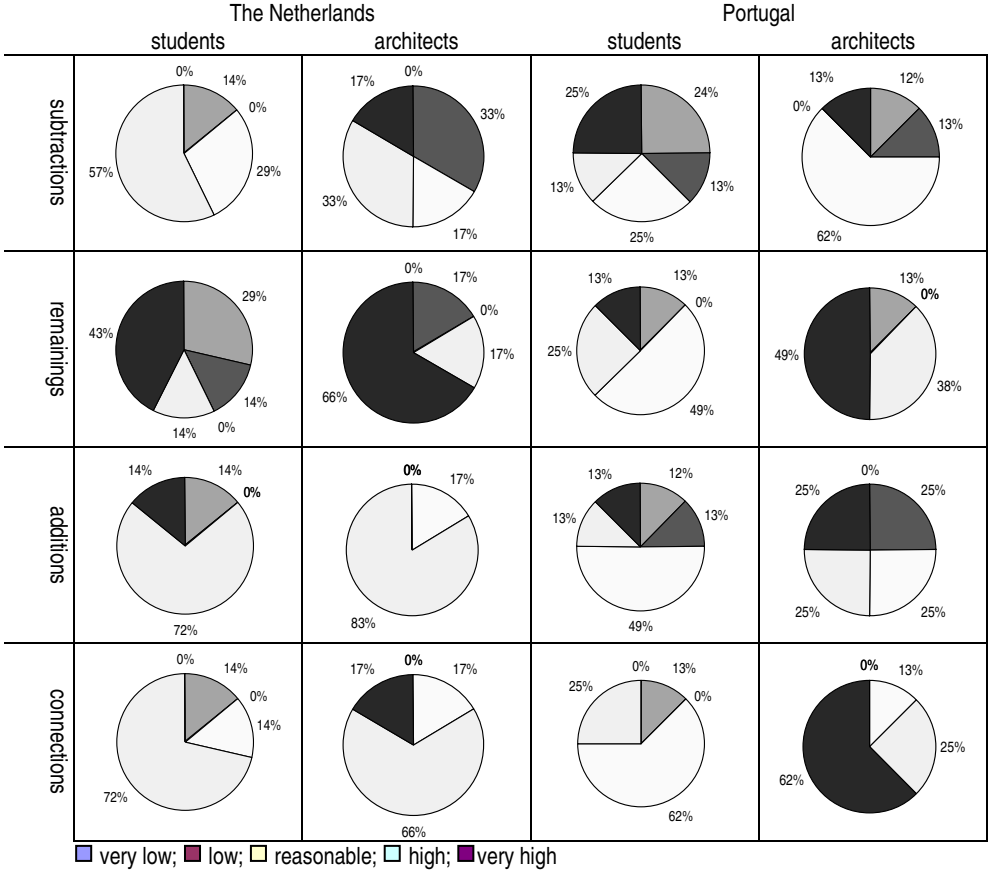


Figure 118 – The importance given to the subtractions, remainings, additions and connections

When asked if they planned something for the building subtractions, the group of designers got divided, stating “yes” (48%) and “no” (52%). Particularly, students from the Netherlands argued that subtractions were not a factor at their assessment and that there was too little time. Students from Portugal argued that there were hardly subtractions planned

and that they have never considered them before. The main aims of the designers towards the subtracted elements are illustrated in Figure 119. Most designers chose for the aim to **reuse.**

The architects from the Netherlands presented examples where structural elements, staircases, light boxes, transport belts, etc. were reused; while carpentry-work and masonry were relocated. Instead, the architects from Portugal illustrated the reuse of components from the floors and stairs, e.g. ceramics and wood elements; as well as, of roof tiles and stones. The relocation was illustrated with the subtraction and relocation of forms such as stairs and stones, either from stairs or from window frames, etc.

In the cases of reuse and/or relocation, most examples presented required the action of reprocess / demount, where forms are converted into components or components end up converted into material. A pure relocation without reprocess can only be considered as valid, when the form or component in question does not require an extra effort to be demounted and assembled at the same position without considerable alterations to its previous state.

Alike the subtractions, the remainings were much more (76%) considered by the designers. Most designers have chosen the main aim to **repair.** The least interventive, to **arrest decay** was the less selected (*vide* Figure 120).

From the Netherlands, students have chosen to first to **reinforce** and second to **repair**; while each architect has chosen to **arrest decay**, to **repair** and to **reinforce**.

From Portugal, architects have chosen together with the students to **repair**; and to **consolidate**, and alone chosen to **reinforce**. To **consolidate** was not chosen by designers from the Netherlands; and to **arrest decay** was not chosen by designers from Portugal. Therefore, while the designers from the Netherlands prioritised to **reinforce**, the designers from Portugal have prioritised to **repair**. Equally valued was to **repair** for the designers from the Netherlands and to **consolidate** for the designers from Portugal.

Most examples regarded main aims to repair, e.g. “physical aspects”; “windows”, etc. From the Netherlands, students repaired the “building’s functional layout” and the architects the “building’s construction”. From Portugal, students repaired the “façade and doors” and the architects the “decorative elements and roof”. There were, however, examples to reinforce the “building’s façade and construction”, “windows, stairs and the building’s functional layout”; and to consolidate .e.g. “finishings”, “roof and the building’s construction”, etc.

Similar to the test period of the design theory, all designers stated to have planned where to locate the additions. Most designers chose to locate the additions **inside (connected)**, followed by **outside (apart)**, and **inside (demountable)**. Least chosen was the main aim to locate the additions **inside (connected)** (*vide* Figure 121).

From the Netherlands, students and architects have chosen as main aim to locate the additions **inside (connected)** and **outside (apart)**. Individually, students chose to locate the additions **inside (loose)**; and one architect chose to locate the additions **inside (demountable)**. From Portugal, students and architects choose to locate the additions **inside (connected)** and **inside (demountable)**. Instead, one architect chose to locate his additions **outside (apart)**.

In case of both the additions and the connections between additions and remainings, the examples provided by the designers have not been considered clear and relevant enough to be presented together with the remaining results.

Most students (86%) confirmed their concern for the connections between the remainings and the additions, at the building pre-existence. When asked about how they have planned the connections, most students chose for the option **totally fixed**; followed by **punctually fixed**, **demountable** and **loose** (*vide* Figure 122)

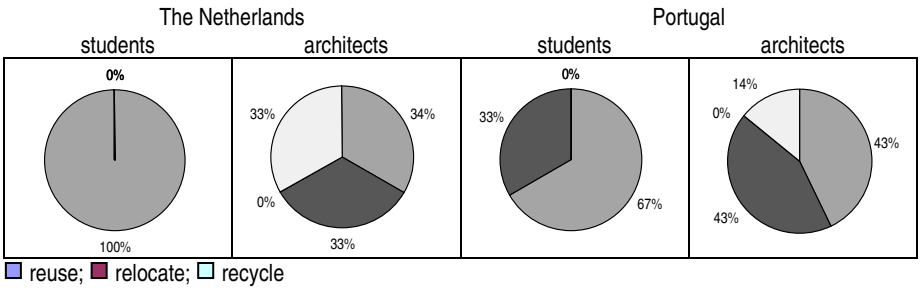


Figure 119 – The main aims towards the subtractions

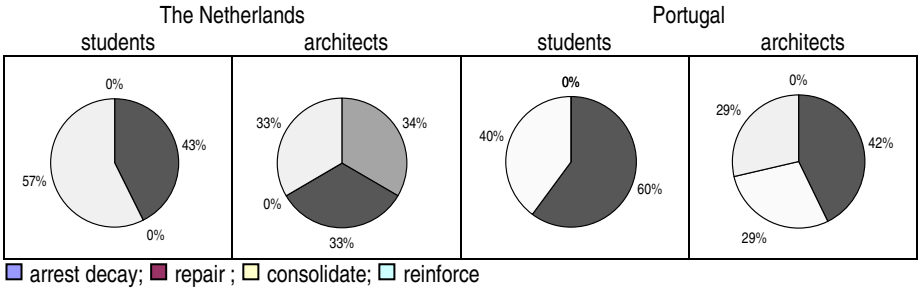


Figure 120 – The main aims towards the remainings

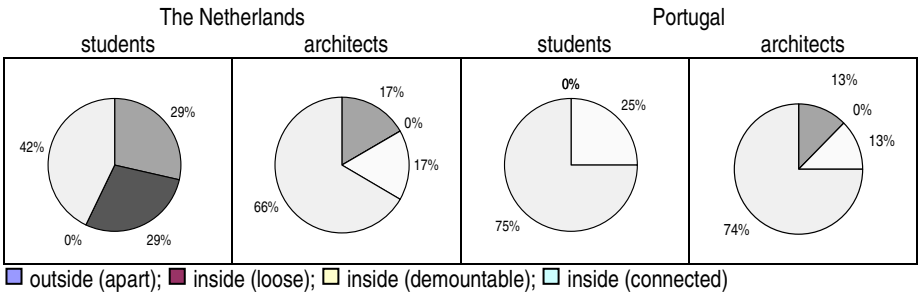


Figure 121 – The main aims towards the location of the additions

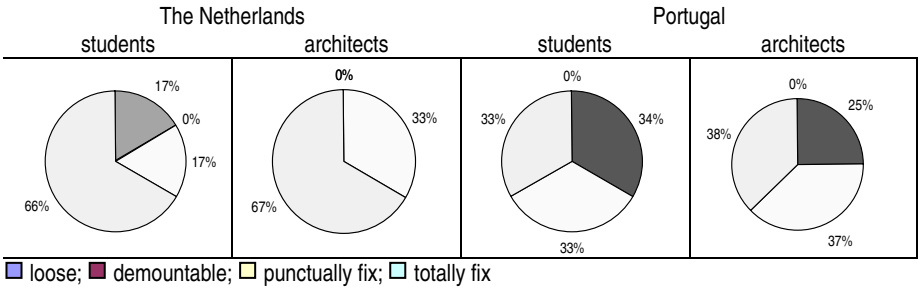


Figure 122 – The main aims towards the connections

Particularly, the first two connections were selected by all groups. From the Netherlands, students and architects have chosen for **totally fixed** and for **partially fixed** connections. Only one student chose for **loose** connections. The **demountable** connections were selected by students and architects from Portugal. No student or architect from the Netherlands has selected **demountable** connections; and, no student or architect from Portugal has selected the **loose** connections.

When asked about the relation between subtractions (S) and remainings (R), more designers (31%) selected the scale **S>25 v R<75** than the scale **S>05 v R<95**, being equally selected as the scale **S>50 v R<50** (*vide* Figure 123). From the Netherlands, students have selected to describe their rehabilitation designs from the least interventive scale **S>05 v R<95** till the scale **S>75 v R<25**. Instead, the highest value at both groups of architects was the scale **S>50 v R<50**. From Portugal, students referenced all scales.

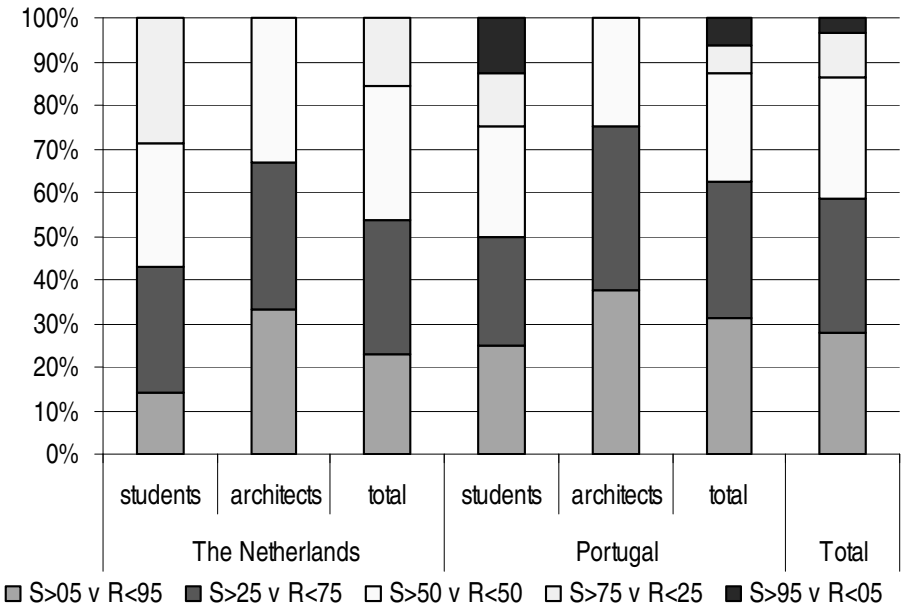


Figure 123 – The subtractions, within the relation between subtractions and remainings

Designers were also challenged to estimate the relationship between the additions (A) and the remainings (R) in the new existence. Both scales, **A>25 v R<75** and **A>50 v R<50**, were the most chosen scales, referenced by eleven designers (38%), from both the Netherlands and Portugal (*vide* Figure 124).

From the Netherlands, the most referenced scale was **A>50 v R<50**. The highest range selected was the scale **A>75 v R<25** by the students and the scale **A>50 v R<50** for the architects. Instead, from Portugal, the most referenced scale was **A>25 v R<75**. The highest range selected was the scale **A>95 v R<75** by the students and the scale **A>50 v R<50** for the architects.

Particularly, in some answers of students from the Netherlands it was possible to identify the interest for the challenge of dealing with these four realities. They were naturally more interested in the additions, just as most others; but they felt the curiosity of dealing with the building on a different way. Even if a smaller percentage of the whole group, some

students have proposed very interesting solutions of reuse, relocation and reprocess in their design developments.

When the researcher and Arch. Walraven would ask for their arguments and direct correlations to the pre-design stage, most frequently they would bring few arguments reached at the pre-design stage. Nonetheless, not so often sustain by ecological values. Their arguments would be always more related to historic, aesthetical, scientific and social values.

Instead, the students from Portugal had a more conservative approach with almost no subtractions. Similarly to the previous year, the pre-established aim was: WASTE ZERO. They were challenged to rehabilitate the building with the least construction & demolition waste possible. Not all were willing to consider its importance, but few students ended simulating interesting solutions to add the subtracted substances into the new existence.

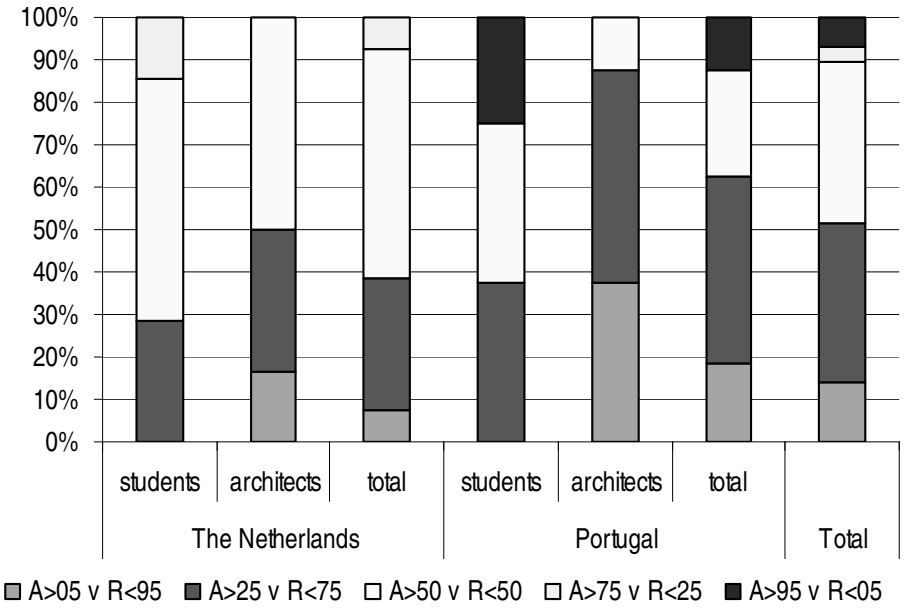


Figure 124 – The additions, within the relation between additions and remainings

When answering Questionnaire B2, most designers (82%) have attributed positive values (reasonable, high and very high) to the building **subtractions**, **remainings**, **additions** and **connections**, rather than negative values (low, very low).

At both groups of students, **subtractions** were mostly considered of high importance. From the Netherlands, most students considered the **remainings** and **additions** equally of high and/or very high importance and the **connections** of very high importance. Instead, from Portugal, most students considered **remainings** and **additions** of reasonable importance and the **connections** of reasonable and high importance (*vide* Figure 125).

At both groups of architects, **additions** were considered of reasonable importance. The architect from the Netherlands has considered the **subtractions** and the **remainings** of low importance and the **connections** of high importance. Instead, the two architects from Portugal have considered the **subtractions** of reasonable and very high importance, the **remainings** of very high importance and the **connections** of very high importance.

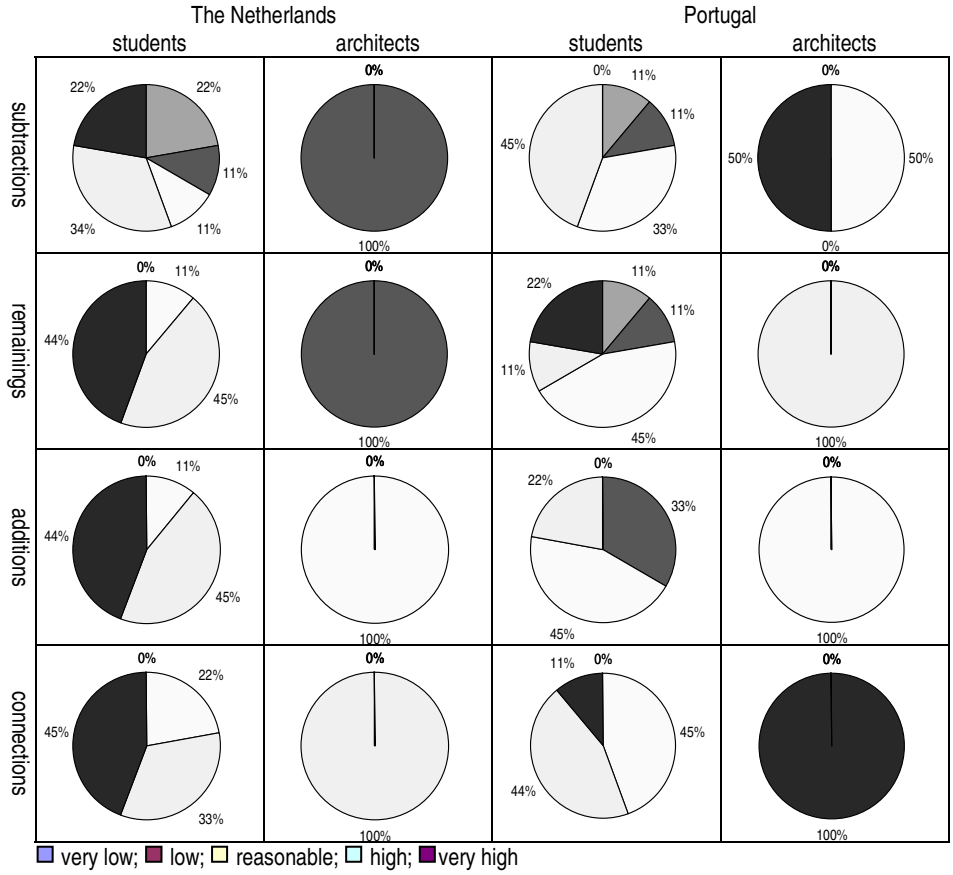


Figure 125 – The importance given to the subtractions, remainings, additions and connections

Except for one student from Portugal, all other designers have stated to have planned what to do with the subtracted elements. His argument to sustain such choice was that in his rehabilitation design developments there were no subtractions planned at the new existence; so, consequently it was not necessary to plan their destiny (*vide* Figure 126).

Most designers (71%) have chosen to **recycle + reuse**, when describing their main aims towards the subtractions to the pre-existence. Much less chosen were to **relocate** (18%) and to **reuse** (12%). No designer chose as main aim to **reprocess** the subtracted elements.

From the Netherlands, students and the architect choose as main aim to **recycle**; while only other students also chose to **reuse**, to **relocate** and last, to **reprocess** the subtracted elements. Students from Portugal have chosen as main aim to **recycle**; to **reuse** and to **relocate**. Similarly, the two architects from Portugal have also provided examples of **relocation** at their rehabilitation design developments.

Students illustrated their main aim to recycle e.g. steel, glass, wood, concrete forms; either at the façade, silos, etc. The recycled concrete was also planned to be reused again by some students at e.g. floor levelling and slabs. From Portugal, students also presented one example of relocation, where doors would be subtracted and relocated on other positions of

interest. The two architects from Portugal have given also interesting examples, regarding the relocation of stairs and window frames, made of stone.

All designers (95%) except for one student, this time from the Netherlands, stated to have planned what to do with the building remainings. Accordingly, it was "quite obvious that parts needed to be restored, so I did not waste any of my time to design on that." When asked about their main aim towards the remaining substances, most designers have chosen the main aim to **repair,** followed by to **consolidate**, and then to **reinforce**. The least interventive, to **arrest decay**, was not selected by any designer. (*vide* Figure 127).

From the Netherlands, students chose evenly to **repair** and to **reinforce**, and few less to **consolidate**. Even if one student stated "yes" to the question if he planned what to do with the remainings, he did not provide a proper aim.

From Portugal, students chose more to **consolidate** than to **repair**. Moreover, the architect from the Netherlands chose to **repair,** as one of the two architects from Portugal, while the second chose to **reinforce**.

The examples provided by the students from the Netherlands regarded to repair e.g. "façades and/or other inner walls", reinforce e.g. "existing stairs" and consolidate e.g. "construction". The construction was also mentioned by one of the two architects; however, her main aim was to reinforce it instead, together with the "windows, and tiles". The students from Portugal illustrated to repair materials, e.g. finishings; components, e.g. doors, windows and services; and forms, e.g. roofs.

All designers stated to have planned where to locate the additions. Most designers (52%) chose to locate the additions **inside (demountable),** followed by **inside (connected)**, and **outside (apart).** The aim to locate the additions **inside (loose)** was not chosen by any designer (*vide* Figure 128). Both students from the Netherlands and Portugal chose more to locate the additions **inside (demountable)** than **inside (connected)**. Difference was that the ones from Portugal did not choose for **outside (apart).** Both groups of architects chose to locate the additions **inside (connected)**.

Students from the Netherlands illustrated the additions located **inside (demountable)** with e.g. "new primary elements", "new work apartments hanging in the silos" and "floors added into the silos". The examples of the additions **inside (connected)** were mostly facilities and new secondary elements. Last, the example of the additions **outside (apart)** was "the new entrance of the community centre".

The students from Portugal provided examples of additions **inside (demountable)** e.g. "demountable partition walls at the sanitary facilities" and "stairs at the silos", "new entrance through a slope" and of additions **inside (connected)** e.g. "new slabs".

The architect from the Netherlands did not provide a direct example; however he emphasised the importance to "connect old and new, with different details; so that the new additions are clearly identifiable". The two architects from Portugal provided examples of additions located **inside (connected)** e.g. new floors, primary elements, etc.

Most students (86%) confirmed their concern for the connections between the remainings and the additions. Most designers chose for the option **demountable**; followed by **punctually fixed**, and **totally fixed**. As no designer has chosen for the option **loose**, no student from the Netherlands choose **totally fixed** (*vide* Figure 129).

Most students at both groups have chosen for **demountable** connections and only few for **punctually fixed**. From Portugal, only one student has chosen **totally fixed**. Moreover, the architect from the Netherlands only chose for **totally fixed** connections and the two architects from Portugal have respectively chosen for **punctually** and **totally fixed** connections.

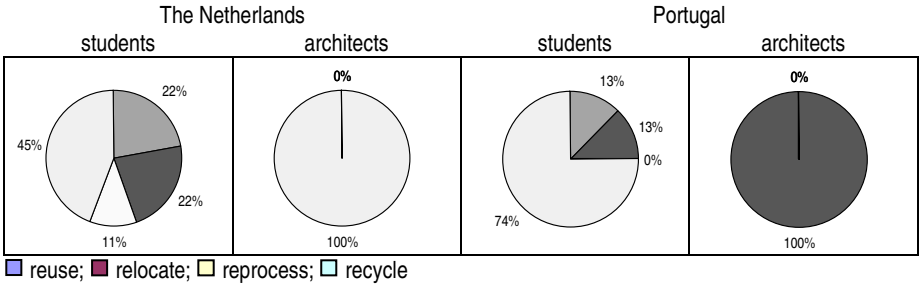


Figure 126 – The main aims towards the subtractions

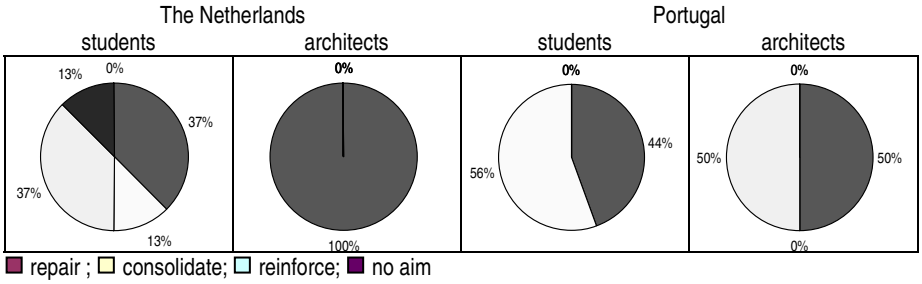


Figure 127 – The main aims towards the remainings

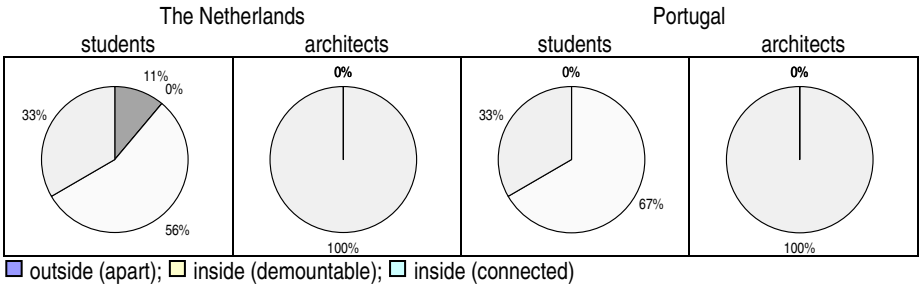


Figure 128 – The main aims towards the location of the additions

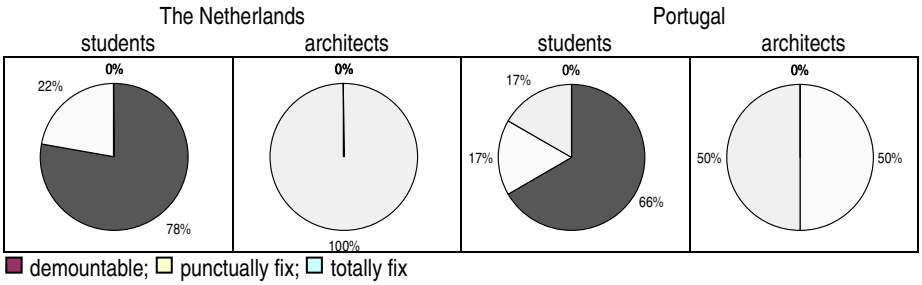


Figure 129 – The main aims towards the connections

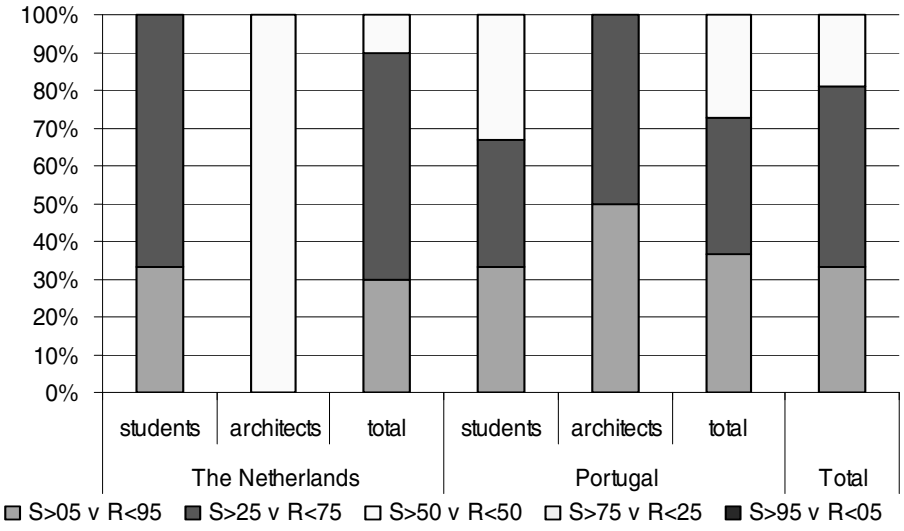


Figure 130 – The relation between subtractions and remainings

When asked about the percentual relation between subtractions (S) and remainings (R), the results remain similar to the ones presented at Questionnaire B1. More designers have chosen (48%) the scale **S>25 v R<75**, followed by the scale **S>05 v R<95** and last, by the scale **S>50 v R<50**. The difference between the answers, before and after getting acquainted with RE-ARCHITECTURE® is, that this time the other two higher values were not chosen by any of the designers (*vide* Figure 130).

From the Netherlands, most students have chosen for the scale **S>25 v R<75**; while the rest of the students has chosen for the lowest scale **S>05 v R<95**. Instead, from Portugal, each scale **S>05 v R<95**, **S>25 v R<75** and **S>50 v R<50** has been chosen by three students (33%). The architect from the Netherlands preferred to choose the scale **S>50 v R<50**. The architects from Portugal referenced the scale **S>05 v R<95** and **S>25 v R<75**.

Designers were also challenged to estimate the relationship between the additions and the remainings in the new existence. Most have chosen the scale **A>25 v R<50**. Together with the most referenced one, also the scale **A>05 v R<25** was equally referenced by students from both groups. Instead, the scale **A>50 v R<50** was chosen by the architect from the Netherlands and few students from Portugal. Last, one student and architect from Portugal chose the scale **A>75 v R<25** (*vide* Figure 131).

In what regards the limited number of architects who got acquainted with RE-ARCHITECTURE®, there can be no comparison between a pattern before and after using the prototype, but with the students it is possible.

On their arguments presented in both Questionnaires, it was possible to verify that students reduced their level of subtractions and additions. Most of them developed much further the additions with new materials, but there have been also students who have developed additions with subtracted elements. Moreover, few of them have taken time to better develop the connections between the remainings and additions, allowing additions to be reversible, in future interventions. Inversely to the period to test the design theory, the raise of lifespan consciousness was higher in the Netherlands than in Portugal.

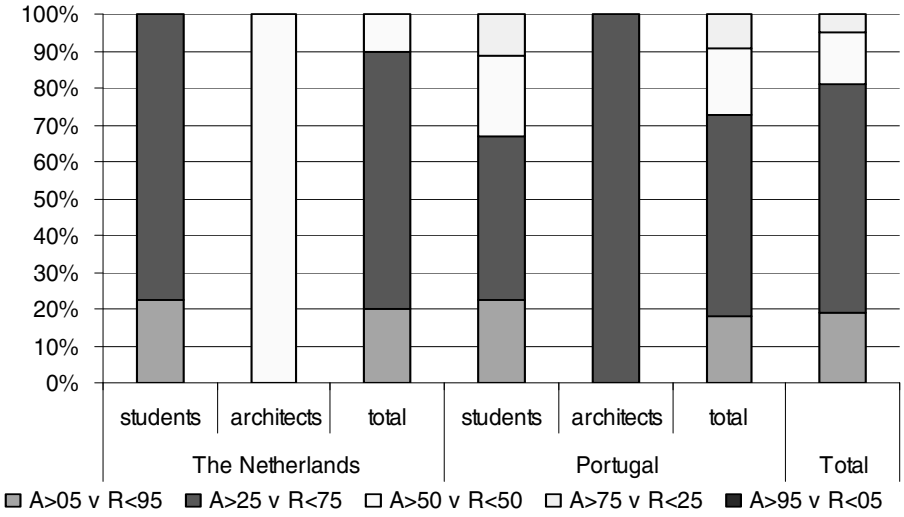


Figure 131 – The relation between additions and remainings

- **The importance of rehabilitation interventions**

  The importance of rehabilitation interventions has achieved more sustenance on ecological arguments by the students, rather than on the building's classification.

  The importance of rehabilitation interventions has not achieved more sustenance on ecological arguments by the architects, rather than on the building's classification.

In Questionnaire B1, all designers from the four groups considered important to rehabilitate existing buildings. However, when asked to justify their answers, two architects from the Netherlands and one student from Portugal did not provide proper considerations.

Comparable to the answers in the period to test the design theory, the aim to **maintain** was most referenced among the students (55%), followed by to **decrease** (26%), **improve** (11%) and **replace** (6%). The aim to **restore** was found among the arguments of one student (2%).

There was one argument that all four groups shared to sustain the importance of rehabilitation, which was also shared by all surveyed groups in the design theory test. This was the aim to **maintain** buildings which are "historically valuable".

There were two aims commonly referenced by the two groups from the Netherlands; to **decrease** the impact of "demolition and/or waste of resources", referenced also by one architect from Portugal; and to **maintain** "built heritage and/or culturally valuable buildings"; also mentioned by one student from Portugal. The two groups from Portugal had also a common aim; which was to **decrease** the usage of "economic resources". The last common aim was between one architect from the Netherlands and few students from Portugal, to **maintain** "what considered socially valuable", at the level of the environment.

Architects from the Netherlands referenced the importance to **maintain** e.g. buildings which are considered "socially valuable", "which inhere particular features and characteristics"; as well as, the building's "identity, image and/or status". This last argument

was also mentioned by the students from Portugal, but of the environment. Last, architects from Portugal argued the need to **decrease** the "usage of energy and natural resources", as well as, to **restore** the building's "lifespan and sustainability" and to **maintain** the building's "forms and construction", through interventions of rehabilitation.

To complement the previous survey with more results, the researcher ordered the arguments raised by the designers, according to the **cultural values** (*vide* book II - *scapus*) theorised in this doctoral research (*vide* Table 5).

		pv 1	pv 2	pv 3	pv 4	pv 5	pv 6	pv 7	pv 8	pv 1:9	total
The Netherlands	nl/s	2	3	-	2	-	1	-	3	1	12
	nl/a	3	-	-	1	1	-	-	1	1	7
	nl	5	3	-	3	1	1	-	4	2	19
Portugal	pt/s	4	1	-	2	-	-	-	-	2	9
	pt/a	2	2	-	8	-	1	1	5	-	19
	pt	6	3	-	10	-	1	1	5	2	28
total		11	6	-	13	1	2	1	9	4	47

Table 5 – The cultural values beneath the preceding importance of rehabilitation interventions

The **historic** values (PV4) were the cultural values most reflected at their arguments. Second came the **social** values (PV1) and third the **ecological** values (PV8). The general reference to the **cultural** values was found among the arguments of four designers, just after the **economic** values (PV2). All these designers considered the maintenance of built heritage and inherent cultural values meaningful through rehabilitation interventions.

Curiously, the **aesthetical** values (PV5) were much less referenced, together with the **scientific** (PV6) and the **age** values (PV7). Instead, the **political** values (PV3) were not mentioned at all.

Therefore, to further complement the inventory of arguments to consider the rehabilitation of existing buildings of importance, they were asked which buildings should be rehabilitated and which should be demolished. There were already few designers who stated that such decision should depend on the situation of both building and respective environment. Accordingly, "there should be no rule for all buildings".

Nonetheless, the majority argued particular classifications. And this time, designers excluded not only the **political** values, but also the **scientific** and the **age** values. However, they did not forget the **historic** values, even if it was not the most referenced. Instead, the **ecological** values were raised among the arguments, sustained by the fact that when in good condition, buildings should be rehabilitated and not demolished.

Another curious factor that would determine the demolition of the building was the "impact at its own environment", referenced by few designers, from both countries. Also referenced in both countries were the **social**, **economic** and **aesthetical** values. And again, there were few designers which referenced the cultural values generally.

Along the semester the researcher could observe the progress of the students realising that there were more values to consider than the more traditional ones e.g. historic values. In fact, even if they would realise the importance to rehabilitate instead of demolishing for ecological reasons; whenever deciding within their design developments the historic, social and aesthetical values would always come above.

Many students related again the importance to rehabilitate existing buildings to the importance of the respective building. In both experimental groups, the buildings selected for the rehabilitation were purposely unlisted, but generally considered of very high significance as industrial heritage; with inherent social, historic, aesthetical, scientific, etc. values.

However, not often the same principle would prevail at the building + environment scale. Students from both groups started determining the new existence without a clear relation to the inherent cultural values and condition of such forms, components and materials. Nonetheless, along the process they have understood the need to initiate a dialog with the building and environment. Mostly, the priority would be placed at broader scales, e.g. raising social values of the building; without clearly realising that such priority could bring its consequences, depending on the design solutions proposed. Such broad aim does not need to mean interventive rehabilitation. Instead, it could mean to reach the social needs of the environment and still preserve the building as much as possible.

In Questionnaire B2, again all designers from the four groups favoured to rehabilitate existing buildings, with the argument to **maintain** again as main aim, presented by most of the respondents (65%). **Decrease** was the next argument referenced (23%); followed by **improve** (10%) and **restore** (3%). The argument to **replace** was not referenced.

Similar to the period for testing the design theory, a slight raise of lifespan consciousness can be noticed among designers in their sensibility towards rehabilitating existing buildings. The less intrusive arguments (maintain and decrease) gained more references, while the importance of the more intrusive (improve, restore, replace) diminished.

All groups referenced the aim to **decrease** the "need for new construction". Together, they also referenced the importance of rehabilitation directly related with the aim to **maintain** "built heritage / culturally valuable buildings". No common arguments were identified between the two groups of designers from the Netherlands. Instead, both groups from Portugal have mentioned the importance to **maintain** "architecturally valuable" buildings.

The researcher has also identified five common arguments between the two groups of students; the aim to **decrease** the "usage of natural resources and its consequent impact at the environment"; the aims to **maintain** the "building's age and/or temporal values", the "ecological values", as well as, its "identity, image and/or status"; and, inversely to the preceding answers, the least referenced aim was to **maintain** the "building's historic values".

To **improve** the "building's condition till the current requirements", as well as, the "ecological values" of specific buildings were aims, shared by both groups of students.

One student from the Netherlands exclusively mentioned the main aim to **decrease** "demolition and/or waste of resources through rehabilitation of existing buildings"; while other mentioned the ability to **restore** the "building's lifespan and respective degree of sustainability". Nonetheless, there were few others who mentioned to **maintain** environments "which would be considered historically or socially valuable".

Instead, the architect from the Netherlands mentioned the importance to improve the "economic values" of the building, together with one student from Portugal, who mentioned the importance to "decrease the usage of economic resources". Other students from Portugal mentioned the importance to rehabilitate buildings considered important at the **social**, **economic** and **political** level. Last, one of the two architects from Portugal also mentioned the importance to maintain the "building's areas, functions and/or services".

While at the preceding answers the **historic** values were found the most inherent cultural values to consider rehabilitation important, at Questionnaire B2, the **ecological** values (PV8) were the most referenced. Second came the **social** values (PV1), exclusively referenced by the students. Third came the **economic** values (PV2), together with the

general conception of cultural values, without any specification to particular cultural values, mentioned at all groups, except for the architects from Portugal (*vide* Table 6).

Almost as much referenced as the social values, the **historic** values (PV4) were referenced by both groups of students; who also referenced the **age** values (PV7). The **political** values (PV3) were exclusively referenced by one student from Portugal. Also, exclusively referenced by designers at the two groups from Portugal were the **aesthetical** values (PV5). Instead, no designer mentioned the importance to preserve buildings with inherent **scientific** values (PV6).

		pv 1	pv 2	pv 3	pv 4	pv 5	pv 6	pv 7	pv 8	pv 1:9	total
The Netherlands	nl/s	3	1	-	2	-	-	2	4	2	14
	nl/a	-	1	-	-	-	-	-	1	1	3
	nl	3	2	-	2	-	-	2	5	3	17
Portugal	pt/s	4	2	1	2	2	-	1	5	2	19
	pt/a	-	1	-	-	1	-	-	1	-	3
	pt	4	3	1	2	3	-	1	6	2	22
total		7	5	1	4	3	-	3	11	5	39

Table 6 – The cultural values beneath the subsequent importance of rehabilitation interventions

A raise of lifespan consciousness was identified, when cross checking the precedent answers to sustain which buildings should be rehabilitated and which should be demolished. This time, much more arguments (47%) evidenced that a decision to rehabilitate or to demolish a specific building should depend on the situation (significance and condition) of both building and respective environment. Accordingly, "if there should a rule; such rule should be that all buildings could be rehabilitated, as all building inhere cultural values".

Certainly, first, a "detailed research" should be undertaken, to determine if such building should be rehabilitated or not on base of evidences and not subjectively. One student from Portugal even recommended "interviews to survey with the population what they would consider about such building(s)". A curious factor that would determine the demolition of the building, besides its "bad quality and/or condition"; was the "impact at its own environment", referenced by few students, from the Netherlands.

This time, designers excluded not only the **political** values, but also surprisingly the **aesthetical** and **scientific** values. One student from Portugal mentioned the **historic** values and two other, one from each group, mentioned the **socia**l values. All groups of designers, even if not considerably high have mentioned arguments with a clear background on **economic** values; followed by the **age** values, also mentioned by all groups except for the architects from the Netherlands.

Instead, **ecological** values were raised among the arguments, sustained again by the fact that when in good condition buildings should be rehabilitated and not demolished. Even if these arguments do not state clearly its ecological consciousness; the researcher decided to consider it as arguments with intrinsic ecological values. Nonetheless, there were some students from the Netherlands, who have directly used the term ecological values.

■ The appointed successes in rehabilitation designs

Students identified successful rehabilitation designs; however, their definitions and appointed successes seldom matched.

Architects identified successful rehabilitation designs; and their definitions and appointed successes often matched.

Only few students from Portugal affirmed not to be aware of any rehabilitation design they would consider successful. For the rest, most designers affirmed positively and provided an example as well. Most examples provided by the different groups were buildings and architects from the Netherlands and Portugal. Only one student from the Netherlands referenced Tate Modern; previously referenced at the test period of the design theory.

The most referenced rehabilitation design was the *Van Nelle fabriek (vide* Figure 132 and Figure 133), designed by the architects Claessens Erdmanns Architect & Designers en Wessel de Jonge Architecten (2002-2004); followed by the *St. Annakerk*, in Breda, converted into an office building by the architectural office *Oomen Architecten*, in 2003.

Students from the Netherlands have mentioned again *Vertigo* (*vide* Figure 92 and Figure 93), followed by the *Urban Campus*, by Jo Coenen; *Het Wallisblok*, by Hulshof Architecten; the *Loydpier,* in Rotterdam; and the *Glaspaleis*, by Jo Coenen (1949) and Wiel Arets (1955). Architects have mentioned the *Zonnestraal*, in Hilversum; designed by Wessel de Jonge Architecten, Henket & Partners Architecten and Vught. The *Theater Gooiland*, by Koen van Velsen; the *Havenspoor*, by Trudy Hooykaas and the *WORM* in a *VOC warehouse*, by 2012 architects were three other references provided by the architects.

Figure 132 – The Van Nelle Fabriek, in Rotterdam[23]

Figure 133 – The Van Nelle Fabriek, in Rotterdam (Pereira Roders, 2005)

From Portugal, students referenced several rehabilitation designs from the region of Algarve. Those were the Castle Museum, in Silves, designed by the architects Mário Varela Gomes and Pedro Correia da Costa; the Market, in Loulé, designed by the architectural office SIMAL in cooperation with the local authorities of Loulé; the Castle, in Ferragudo; the Market, in Silves designed by the architect Manuel Alegria. Only the House in Brejos de Azeitão

[23] Unknown Author (s.d.) *Van Nelle Fabriek*, Rotterdam: Van Nelle Ontwerp Fabriek, available at: http://www.vannelleontwerpfabriek.nl/imgvn/foto/historische_foto_Van_Nelle_zwart-wit.jpg (accessed in 27-07-2007)

(2001-2003) was located in Setubal, designed by the architects Manuel and Francisco Aires Mateus (*vide* Figure 134 and Figure 135).

Architects from Portugal have mentioned again the Convent of Santa Maria do Bouro (*vide* Figure 94 and Figure 95), together with the Museum of Transports and Communication, in Porto. Moreover, there were also found references to the rehabilitation designs of the Castle in Portalegre, designed by the architect Cândido Chuva Gomes; of the *Palácio do Freixo*, in Porto, designed by the architect Fernando Távora; of the *Armazéns do Chiado*, designed by the architect Siza Vieira and a of a *Palacete* in Sintra, designed by the architects Victor Mestre e Sofia Aleixo.

Most arguments to consider rehabilitation designs successful reflected as target the new existence, considering more remainings and additions together, than individually. However, no appointed successes referred to the subtractions from the pre-existence. All groups mentioned the ability to **maintain** "the original charisma of the pre-existence" and respect "the old building and respective architect".

Both groups from Portugal have mentioned the ability to **improve** the aesthetical values, together with one student from the Netherlands. A second factor of success, also mentioned by few architects from the Netherlands, was the ability to **improve** the building till it reaches "habitability levels and/or the needs of the people".

The two groups from the Netherlands mentioned the ability to **maintain** "the architectural qualities". Inversely, the ability to manage successfully the relationship between "old and new construction" was commonly mentioned by both groups from Portugal. At both groups of architects the reference was found to "contribute with the new existence to the current environmental and/or ecological concerns".

Figure 134 – House in Brejos de Azeitão – Setúbal (2000)[24]

Figure 135 – House in Brejos de Azeitão – Setúbal (2003)[25]

The ability to "integrate the new functions and respective requirements successfully" was mentioned at both groups of students. Last common argument was the importance to

[24] Aires Mateus, M. & Aires Mateus, F. (2003) *Casa em Brejos do Azeitão*, Lisboa: Aires Mateus, available at: http://www.airesmateus.com/index.php?lop=conteudo&op=aab3238922bcc25a6f606eb525ffdc56&id=d3d9446802a44259755d38e6d163e820#

[25] *Ibidem*

"use current materials, technologies and identity", shared between one student from the Netherlands and one architect from Portugal.

From the Netherlands, students argued the ability to **mantain** the "pre-existent construction" and the "historic evidences". From Portugal, students argued the importance to "preserve the exterior aesthetics", "to consider the social circumstances" and "to accomplish good results with controlled costs". Architects have instead argued that the new existence should reach higher values, e.g. significance, condition, etc. than the pre-existence; and one architect mentioned the importance to "reuse the existing resources as much as possible; so that new natural resources can be spared", at least for that rehabilitation design.

To cross check the definition of successfulness, designers were asked about their own rehabilitation design and if they would consider it successful. Most designers (76%) answered positively. There were however, few students together with one architect from Portugal that considered their rehabilitation design developments unsuccessful.

The arguments presented by the students from the Netherlands were the "lack of historical importance and interest" to be rehabilitated and the "differences between group members" that contributed to the shortage of quality at the final results. Instead, the arguments presented by the students from Portugal were quite curious. They stated that they "are not the ones to assess their own work – users certainly are" and that they "would require much more knowledge and information to develop more successful results". Last, one architect argued the "lack of resources to consider the introduction of renewable energies and to develop solutions that actually the traditional (pre-existent) technologies into practice".

Regarding the arguments to consider their rehabilitation design as successful, both groups from the Netherlands mentioned the achievement of "higher values", e.g. significance, condition, etc. and the "managing the relationship old - new construction"; together with the group of architects from Portugal.

Again, both groups from the Netherlands mentioned their success on reaching the "habitability levels and/or the needs of the people"; together with the group of students from Portugal. This last group has also argued their success on "preserving the pre-existent construction"; and another student together with an architect motivated their judgement with the fact that the new existence developed as final result reached "higher aesthetical values".

Students from the Netherlands presented "the exterior aesthetics" and "the social circumstances". Still from the Netherlands, architects were proud on their achievements in what regards respectively, the "environmental and/or ecological concerns at the new existence"; and the "reached needs of the place". From Portugal, students stated their achievements respecting the "old building and architect" and "controlling the costs". Last, architects from Portugal mentioned as factor of success to have preserved the "architectural qualities" of the pre-existence.

The students from the Netherlands, more than the students from Portugal, brought to the lectures few examples of rehabilitation designs, which they would consider as row models of success. Despite this noble action, not always the motive for such choices would be clear. Curiously, again, it seemed that just by being published at an architecture magazine the rehabilitation could be considered as successful; without any critical judgement.

Tendentiously, the points of success the students would present, when describing a good-practice or even their own design, would also frequently focus at the additions introduced by the design; rather than accurately first determine what exactly happened to the pre-existence and why, to better judge if such rehabilitation intervention could in fact be considered successful or not. Such critical judgement was lacking in both groups.

When the semester was finished, still four students from Portugal were not acquainted with successful rehabilitation design developments, when filling in Questionnaire B2. That clearly reveals the difference of interest in searching for references, between the students from the Netherlands and Portugal. All other designers provided examples, mostly buildings and architects, from the Netherlands and Portugal. Only the same student from the Netherlands referenced the Tate Modern again; and one student from Portugal referenced the *Reichstag*, designed by Norman Foster.

The most referenced rehabilitation design by the students from the Netherlands was the *Van Nelle fabriek (vide* Figure 132 and Figure 133), which most students visited during the semester. *St. Annakerk*, in Breda; the *Urban Campus*, by Jo Coenen; and the *Glaspaleis*, by Jo Coenen (1949) and Wiel Arets (1955) have already been mentioned at Questionnaire B1 and again were again mentioned in Questionnaire B2. Nonetheless, few new references emerged as well; e.g. *Watertoren*, designed by Rothuizen Architecten; *Las Palmas* (*vide* Figure 136 and Figure 137), designed by Benthem Crouwel Architecten (2003-2007).

Vertigo (vide Figure 92 and Figure 93) was again mentioned; but this time only by the architect from the Netherlands, together with the mentioned rehabilitation design of the *Zonnestraal*, in Hilversum.

Figure 136 – Las Palmas, in Rotterdam[26]

Figure 137 – Las Palmas, in Rotterdam [27]

From Portugal, the students have referenced the convent of S. Francisco, in Faro; the Cultural Centre of S. Lourenço, in Almancil and the Museum of Portimão. The House in Brejos de Azeitão (2001-2003), in Setubal, designed by the architects Manuel and Francisco Aires Mateus was also mentioned again (*vide* Figure 134 and Figure 135). The architects instead have mentioned the Museum of Transports and Communication, in Porto and the Museo Amadeo de Sousa Cardoso, in Amarante, designed by the architect Alcino Soutinho.

Again, the motivations argued by the designers to consider rehabilitation designs successful have mostly reflected as target the new-existence, considering both remainings and additions (44%); followed respectively by the additions (30%) and the remainings (26%). Only the ability to "reach the habitability levels" was commonly argued at the groups of students and of architects from Portugal.

[26] Unknown Author (1945) *Las Palmas*, Rotterdam: Kop van Zuid Rotterdam, available at: http://www.kopvanzuid.info/?id=38 (accessed in 02-08-2007)
[27] *Ibidem*

Students and architects from the Netherlands mentioned the ability to manage successfully the relationship between the "old and new construction". According to both groups of students, a successful rehabilitation had to "preserve the original charisma of the pre-existence", to apply "environmental and/or ecological concerns", to "respect the old building and architect", and to "integrate successfully the new functions and/or requirements".

Exclusively from the Netherlands, two students mentioned the ability to "preserve the functions of the pre-existence" and one student mentioned the ability to "reach higher values". Instead, students from Portugal mentioned the ability to "preserve the exterior aesthetics", the "construction of the pre-existence"; and to "accomplish controlled costs".

One architect from Portugal curiously mentioned the motto of lifespan consciousness; with a personal interpretation; defining for a successful rehabilitation, the ability to consider the "Past and Present, while designing the Future".

When asked about the successfulness of the rehabilitation design they developed, most designers (90%) answered positively. An important notice is that this time they have been sustained by RE-ARCHITECTURE®. There were however, students from Portugal that considered their rehabilitation design developments unsuccessful. The arguments of these students were respectively the lack of consideration for some significant stages of the design; and the excessive percentage of additions and subtractions towards the pre-existence. Accordingly, despite so much destruction, the final result was "sufficiently functional", and the new existence was "very differentiated and sustainable". The architects from both countries did not provide arguments to sustain the evaluation of their rehabilitation design developments as successful.

To cross check the definition of successfulness, designers were asked what they would consider successful in their designs. Both groups of students valued the ability to "preserve the original charisma" of the pre-existence, followed by "to respect the old building and architect and to consider the social circumstances". Last common argument is the ability to integrate new functions and/or requirements, with more references from the Netherlands than from Portugal.

Students from the Netherlands mentioned the importance to preserve the "historic values" of the pre-existence; to manage successfully the "relationship between old and new construction" and to reach "habitability levels", "the needs of the people" and "the needs of the place". From Portugal, students mentioned respectively the ability to preserve "the construction" of the pre-existence; to integrate "environmental and/or ecological concerns" at the new existence; and to accomplish "controlled costs".

- **The interest in RE-ARCHITECTURE®**

  Due to its apparent rationality, students have first confronted RE-ARCHITECTURE® and progressively verified its usefulness, stage by stage.

  Due to various motives, architects did not take time for RE-ARCHITECTURE® and could not verify its usefulness.

When asked in Questionnaire B1 about design process support systems and the importance of their availability to support rehabilitation design developments, all designers answered positively, except for one student from the Netherlands.

An important point of attention to this and the following questions; is the fact that also the designers, who initially stated not to have any experience in developing rehabilitation designs, have contributed with their answers. Therefore, at this and following questions the sample reaches the nine designers per group.

There was a clear the preference at all groups (56%) to motivate the importance of such design process support systems on its **(p)rocess** and potential qualities to support designers structuring their own design processes, stages and activities (*vide* Table 7).

country	occupation	p	k	q	s	r	n	total
The Netherlands	students	4	3	1	-	-	2	10
	architects	6	1	4	-	-	1	12
	total	10	4	5	-	-	3	22
Portugal	students	9	-	-	-	-	-	9
	architects	4	1	4	1	-	-	10
	total	13	1	4	1	-	-	19
total		23	5	9	1	-	3	41

Table 7 – The motivations for sustaining the interest in design process support systems

The process is followed by the potential raise of (**q)uality** (22%); the (**k)nowledge** sustaining their design developments (12%); and by the potential raise of (**s)ustainability** reached with their design results (7%). Support on **(r)ehabilitation** in general was not referenced. There were some designers, who confirmed that a support system was important to them, but did not provide a proper reason: **(n)o reason**.

Particularly, one architect from the Netherlands considered important such design process support systems in detriment of other design support systems; because they would not substitute the designer and "make decisions when you add some parameters"; but would support the designer with field-related knowledge to sustain his decisions.

Other architect from the Netherlands, stated that even if he agrees that until a certain extent such design process support systems can help designers developing rehabilitation designs, "helpful as a checklist"; one needs to be aware that "every existing situation is different by building type, history and development strategy", considering that no global design process can be defined.

From Portugal, one architect considered design process support systems useful to sustain designers on the problems that emerge at rehabilitation design developments and that cannot be dealt empirically. Another architect mentioned that "in Portugal is very difficult to aim certain results, because there is a great absence of critical discussion on this mater".

Both **knowledge** and **quality** were mentioned by all groups except for the group of students from Portugal. However, while the students from the Netherlands prioritised the knowledge available; the architects from both countries aimed for the raise of quality.

Generally, most designers considered that knowledge (extra-support) which is field oriented is always welcome. Particularly, students from the Netherlands believed that such design process support system could influence their decisions regarding the "use of materials". Moreover, one architect from Portugal mentioned the importance to be "constantly updated on new technologies and know-how".

Regarding the raise of quality on the rehabilitation design developments, one architect from the Netherlands argued that such support could challenge the designer with specific targets and items, contributing to the "quality and completeness of a design project".

Moreover, one architect from Portugal mentioned that "with the proper means rehabilitation designers can achieve better practical results, such as constructive quality, allied to aesthetical achievement".

Last, one architect from Portugal mentioned the contribution of such design process support system to "the raise of **sustainability** and/or **ecological consciousness** of his rehabilitation design results". This designer considered that "a database which would provide easy accessible lifespan data and respective reference to building components would certainly help designers sustaining their choices".

When asked about what they would consider fundamental in such design process support systems, all designers answered clear stages and different activities to help systematising the work method; rehabilitation-oriented guidance; flexibility; user friendliness; as well as, the availability of details, materials, etc.

Students from the Netherlands aimed for a "good method to analyse buildings target of rehabilitation prior to the design stage developments"; "good-practice reference designs"; and the "freedom of interpretation", where the designer could "take his own decisions". Instead, students from Portugal aimed for the possibility to "contribute for the compatibility between the additions and the remainings"; "clear keywords that everyone understands"; and "share of information and knowledge".

Architects from the Netherlands presented the "financial aspects", "broadness of parameters", "to not decide in advance which parameters should be considered", "aspects of history, details, materials, (pre)design, permits, construction, time, money, etc." should be handled, "guidance into building laws and design rules concerning traditional patrimony related to modern living standards and sustainability", and to "provide support for establishing priorities among the variables and consequently provide evaluative results".

Particularly, one architect from the Netherlands considered fundamental making choices acquainted of the related theory, "especially when the decisions are based on shared information", instead of choosing "only for financial or nostalgic reasons" and one architect from Portugal favoured the action to bring knowledge "out of the academic circles" and make it accessible to all interested designers.

When asked about what they would consider redundant in such design process support systems, most designers (64%) answered not to know the answer to this particular question. The remaining designers mainly answered the redundancy to interfere with the process and results (25%), followed by to "supply too much and redundant theory, especially if without practical evidences" (6%) and to supply "financial data" (3%).

The students from the Netherlands mentioned the redundancy of having a support system deciding and producing the design results, instead of the designer. Accordingly, it could be useful supporting the designer; but, it should never take his freedom to decide what and how to do. The interference with the process and results was presented by students from the Netherlands, and two students and three architects from Portugal. However, it regarded different levels that are interesting to survey.

Similarly, one architect from Portugal referenced that "a support system should 'support' the creative process and not influence it. It can dissuade, but never forbid." Other mentioned the redundancy to present "unnecessary restrictions, contradictions, disrespect for the creative free space, etc." and the last mentioned the redundancy of "proposing standard elements that fix you to a certain architectural language".

Most designers (91%) stated their belief, that RE-ARCHITECTURE® would support them raising the lifespan consciousness in their rehabilitation design developments (*vide* Figure 138). Only from the Netherlands, one student considered himself already "very conscious regarding the lifespan of buildings" and two architects stated "not to have an opinion yet" and that "lifespan is not an issue for rehabilitation design developments". Accordingly, most decisions are taken, either based on "financial value or heritage value".

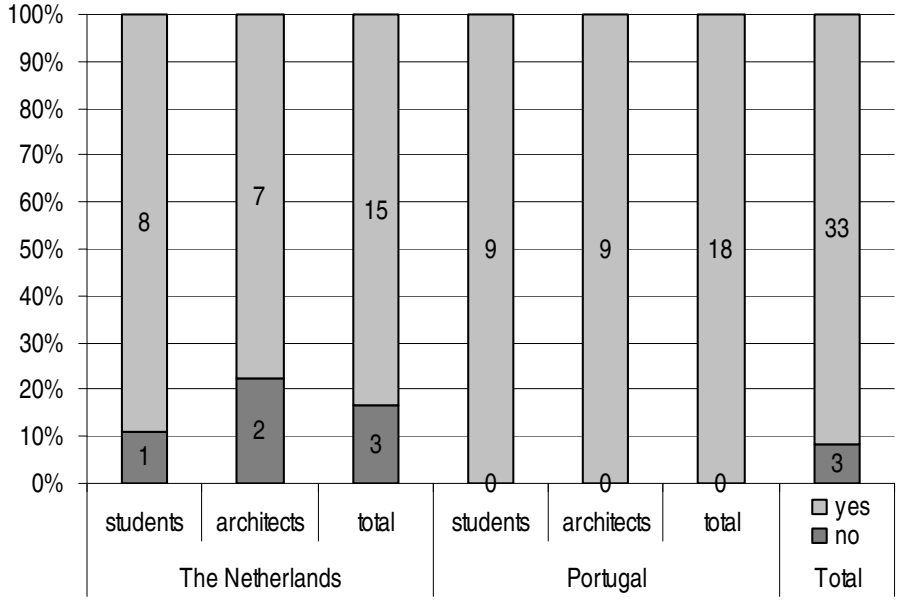


Figure 138 – The believe that RE-ARCHITECTURE® shall support raise of lifespan consciousness

Both groups of students hoped that RE-ARCHITECTURE® could help them "structure their work"; "provide new points of view" and "learn more about rehabilitation".

Moreover, students from the Netherlands hoped for sustenance to "structure the knowledge required to support the design developments"; "achieve a good insight on the building"; "develop good concepts and decisions"; "bring ecology into attention"; and to "develop themselves further as designers". Instead, students from Portugal argued "better design results", "better Analysis and the hope that such support system would help".

Architects from Portugal also answered with the hope that RE-ARCHITECTURE® would support them raising the lifespan consciousness of their rehabilitation design developments. Generally, they all considered important "the access to field-related knowledge", "to find solutions and advises for specific cases", "serve as a model to address to when defining a rehabilitation design as lifespan conscious or not, in both process and result".

Instead, architects from the Netherlands stated that "it could be a good design manual in order to fulfil a demanding project" and that had "some interesting insights". Particularly, one architect stated that he believed on it because it was, at least as far as we knew, "the first support system of such kind".

Few students, from the Netherlands and Portugal, showed initial difficulties in dealing with RE-ARCHITECTURE®; probably because they were not previously acquainted with it and had to start learning and using something unknown immediately. Particularly, the English language and the constant access to internet was a stronger barrier in Portugal than in the Netherlands.

A constant pattern of both groups was their will to accomplish in too little time, everything that was guidelined; which was not possible, nor the purpose. Instead, the purpose was to sustain what they would decide to do. They would achieve more lifespan conscious results if they would have only assessed the parameters which they have had information for and took time to develop a qualitative survey.

From the moment, they understood that they were allowed to develop further only what they would consider noteworthy; keeping always in mind the pre-design results and the consequences their designs would bring to the building; somehow their relationship with RE-ARCHITECTURE® changed. They generally understood the aims of such support system and were quite proud of their design results; and of particular design solutions where they knew they have been more lifespan conscious than others.

Particularly for RE-ARCHITECTURE® as support system, there have been stages which designers have used it more than in others. Particularly, at the regent sub-stages, analysis and simulation, a stronger adoption is visible in the process mining (*vide* Appendix 8) than at other stages such as synthesis and evaluation.

The lack of previous formation might have been the cause for such difference between the adoption in the different stages and sub-stages. But, before accessing RE-ARCHITECTURE®, designers have had described their design processes and at that time they have already decreed the analysis and simulation, as the stages where they have spent more time and undertook more activities.

In Questionnaire B2, after getting acquainted with RE-ARCHITECTURE®, most designers (92%) answered to consider important the availability of design process support systems to support designers in their rehabilitation design processes; except for few architects (8%) from the Netherlands.

None of the architects except one from the Netherlands and two from Portugal used RE-ARCHITECTURE®. Nonetheless, the researcher considered their answers; so that one could learn from their arguments. Even the student from the Netherlands who was initially negative about RE-ARCHITECTURE®, here agreed that such support systems can support design processes, even if design processes are unstructured and with a considerable number of decisions taken on “emotional bases”.

Their arguments regarding the importance of design process support systems such as RE-ARCHITECTURE® revealed a clear the preference (84%) to its **(p)rocess** and ability to support designers structuring their own design processes, stages and activities. Besides the process; the research has only identified few arguments (14%), related to the field of **(r)ehabilitation** (*vide* Table 8).

Both groups of students and architects from Portugal mentioned such design process support systems a good companion for the whole design process, “reminding us of all the steps to a conscientious work”. “Especially useful if designers do not have much experience in rehabilitation designs”, was stated by both students and architects from the Netherlands.

Students from the Netherlands considered it a “powerful aid” to sustain designers with “complex design developments” and with “considerable amount of information to deal”; which should not be overlooked. They also considered that “one should not feel constrained about

such support systems, because designers can use it as they would like"; "use the whole system", or only the "guidelines and tools of interest".

Students from Portugal considered it an "eye opener", to "help considering what is important and what not", "an alternative to their preceding design processes where decisions would be taken mostly empirically", "very pedagogic" and a "good reference for the development of rehabilitation designs". One even mentioned that "when one learns to work with such support systems, it looses the apparent complexity and becomes an advantage".

country	occupation	p	k	q	s	r	n	total
The Netherlands	students	8	-	-	-	-	1	9
	architects	5	-	-	-	1	-	6
	total	13	-	-	-	1	1	15
Portugal	students	9	-	-	-	3	-	12
	architects	9	-	-	-	1	-	10
	total	18	-	-	-	4	-	22
total		31	-	-	-	5	1	37

Table 8 – The motivations for sustaining the interest in design process support systems

Architects from the Netherlands mentioned that such design process support systems would enhance "awareness for the values involved", "not just his own perception, but in a broader view". Last, the architects from Portugal mentioned its ability to work as a "mental support", contributing to a better "process and time management", "a tool that considers many subjects, important to a project, but with flexibility allowing different approaches". Moreover, it allows the designer to "analyse the building globally and evaluate the quality of the design decisions, in terms of lifespan consciousness".

When asked to particularly specify the fundamental aspects in RE-ARCHITECTURE® students from the Netherlands presented the "structured method with clear steps", the "scientific analysis", its "completeness", the pre-design that "is very strong and could be very useful", the "rating system", and the "awareness of ecology". One student mentioned that a "lesson to extract from all this support system was to consider more the building while designing its rehabilitation and to consider the subtractions, based on its qualities"; contributing with "awareness of sustainable design".

Again, the students from Portugal mentioned as fundamental the "whole theoretical base sincerely organised", covering "many aspects for support rehabilitation developments on all categories of buildings, most effectively possible" and the "possibility to access it everywhere, through internet". Similarly to the students from the Netherlands in the earlier question, one student from Portugal mentioned that it "can help in many directions; it is up to the designer to decide how".

Similarly, the architects from the Netherlands also considered as fundamental the division of the method into "phases" – as a "systematic approach", the "guidelines", the "information" available, the emphasis of the Pre-Design and at "environmental, lifespan and cultural aspects". One architect valued the effort to make the reuse and/or recycle of architecture more scientific. Accordingly, "it creates awareness in a deeply rooted practice of *tabula rasa*".

The architects from Portugal presented as fundamental the breath of “science” into the design process, the “objective analysis”, the database of components, the “preoccupation with recycling”, the “mental process stages”, and the provision of a method to an expertise field that is requiring it urgently, stage by stage.

When asked about what they would consider redundant in RE-ARCHITECTURE®, few aspects enter in contradiction with considerations on the previous question. Probably, that has to do with the fact that what one can consider as advantage, others may consider as disadvantage. More related to the doctoral research, both students and architects from Portugal complained with the length of the “Questionnaires”.

Few students from the Netherlands pointed redundant the “extreme detail of few guidelines and the extensiveness of the Pre-Design stage”. Accordingly, the designer has to “make sure he does not get lost in the theory”. Simultaneously, another student pointed out that “there is no redundancy” because the designer is free to “use the steps you think that are important for your design.” There were references to the redundancy of the analysis sub-stage, from the Design stage. Accordingly, “rules and regulations should be excluded”.

Students from Portugal considered redundant the “aesthetics of the interface” and one the “interactivity” of RE-ARCHITECTURE®. Accordingly, it is “boring and difficult to find the right information”. Other student commented that the Analysis and Synthesis sub-stages, from the Pre-Design stage that could be different. However, he did provide any suggestion. Curiously, one student considered redundant the “access through internet”; earlier presented as part of the fundamentals.

Last, the architects from the Netherlands considered RE-ARCHITECTURE® complex and extensive. Accordingly, a “new design tool which you have to learn” costs time and “time = money”. Instead, most architects from Portugal did not have redundancies to present.

When asked about the RE-ARCHITECTURE® contribution to the raise of lifespan consciousness on their rehabilitation design developments, most designers (75%) stated ‘yes’. However, there is a clear difference between the students, who were periodical users and the architects who hardly used RE-ARCHITECTURE®.

While, among students, only one student from the Netherlands argued that RE-ARCHITECTURE® did not help him raising the lifespan consciousness of his design developments; almost half of the architects answered no to the contribution of RE-ARCHITECTURE® (*vide* Figure 139).

Students from the Netherlands argued to now consider more the “building and the reuse of materials”, the “re-usage of the subtractions”, the “consequences of their actions towards the building” and the “raise of awareness for “ecology and sustainability”.

One particularly student illustrated that in the beginning of his rehabilitation design developments he has planned to demolish a considerable part of the building; and in the end, he was much more satisfied with the result, “leading to a more exploratory approach towards the building and environment”. Other student stated that without RE-ARCHITECTURE® he probably “would be tempted to demolish the entire building”.

From Portugal, the students argued the components database as a source of lifespan data that sustained their raise of awareness for such thematic. Most of them mentioned the “understanding of the intervention of rehabilitation and the power [of the designer] to usufruct the space without destroying it.” Accordingly, RE-ARCHITECTURE® and the contact with the tutors truly helped them “looking further”, when e.g. “finding explanations to support theoretically [their] aims”.

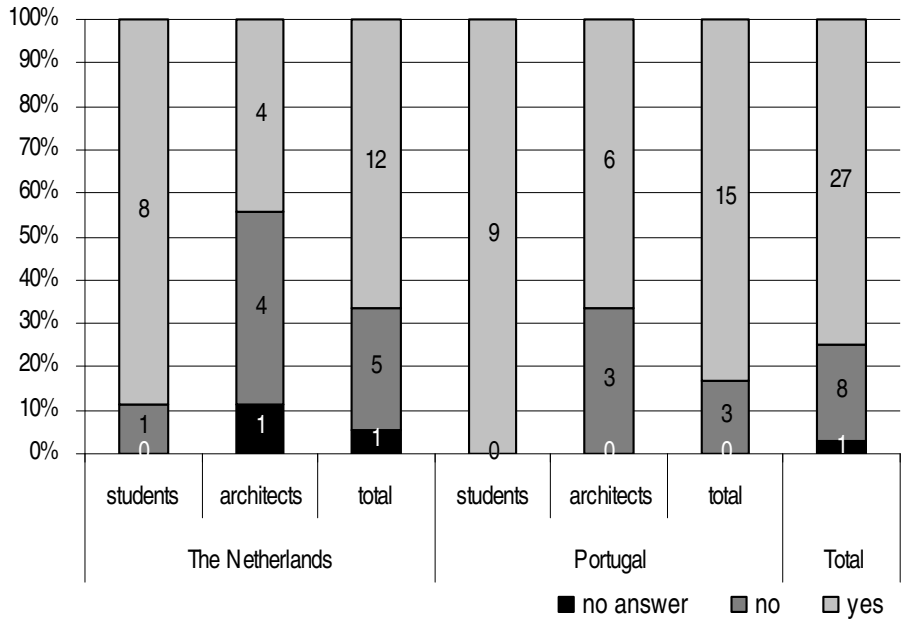


Figure 139 – The verification that RE-ARCHITECTURE® supported the raise of lifespan consciousness

The architects from the Netherlands who have previously answered negative, argued that they did not experience RE-ARCHITECTURE® enough to be able to verify if their lifespan consciousness increased or not. Instead, the architects that answered yes; considered that it helped them, even in the "little time of use", "think clearly and make good choices"; and making them "aware of a new way of looking at the subject".

Instead, the three architects from Portugal who have also answered negative considered themselves "already lifespan conscious enough" and one stated that, by the time the designer got acquainted with RE-ARCHITECTURE®, all "decisions had been taken already at his rehabilitation designs". The positive arguments were mostly related to the "systematic method to undertake rehabilitation design developments", "thinking step by step", "helping to remember what to remember and not to forget lifespan consciousness".

At the last question, regarding the possibility of becoming a frequent user of RE-ARCHITECTURE®, when released again after being revised and upgraded, most designers (86%) answered positively. Only four designers answered no (11%); three architects from the Netherlands, and one student from Portugal (*vide* Figure 140).

The arguments presented to sustain the negative answer by the architects from the Netherlands were again the inexperience with RE-ARCHITECTURE®. Instead, the student from Portugal argued that its inherent complexity would make him loose much more time than expected for a rehabilitation design development.

The arguments regarding why would they become a frequent user of RE-ARCHITECTURE® were not much different than the ones they presented when asked about what they would consider as fundamental and redundant at RE-ARCHITECTURE®. Few argued that they certainly would, if the redundancies would improve. Others, instead, valued the fundamental factors and stated to be interested to use a revised and upgraded version.

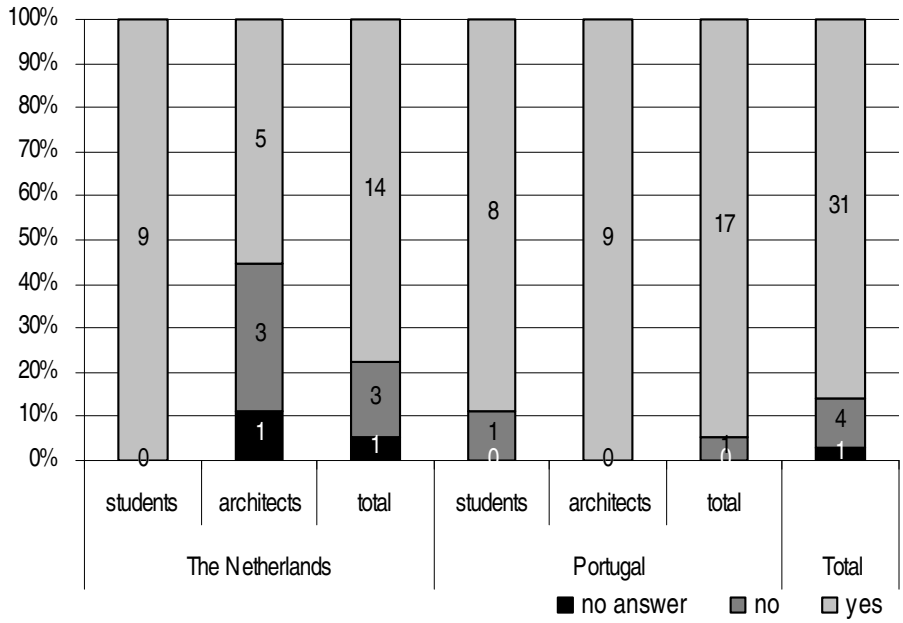


Figure 140 – The possibility to become a frequent user of RE-ARCHITECTURE®

A general overview, coming from the students from the Netherlands, was that they would freely use it again; however, as a guideline and not as strictly as they did, for achieving the experimental purposes of this doctoral research. Instead, the students from Portugal did not reflect that discomfort in their answers. They were as the architects from Portugal open for a new trial; sure to see improvements regarding what they suggested.

6.4 Tentative discussion

The results emerging from the case studies and respective experimental groups brought into evidence fundamental points of attention on how exactly practice perceives and deals with such field of expertise. They have mostly confirmed the hypotheses risen by the researcher and sustained better her arguments what before this doctoral research was mainly a opinion on base of observing society and the impact of their behaviour in our environment.

Taking as starting point the experience of both *XX Archtiecten* and *Victor Mestre | Sofia Aleixo, lda*. It was possible to verify that even when architects aim to follow lifespan conscious principles that do not necessarily mean that the rehabilitation shall result lifespan conscious. There are other actors involved, who can either contribute to such consciousness or transform it into unconsciousness.

It is undeniable that the actors involved in rehabilitation design developments of listed buildings are more varied and specialised than the ones of unlisted buildings. Therefore, the risk for lifespan unconsciousness decreases. Nonetheless, both architects from the Netherlands and Portugal have proven that with enough argumentation and sustenance either from documentary, oral and physical evidences they have found means to convince the other involved actors of the lifespan conscious aims.

From their particular experiences it was also possible to conclude that the design process had a different and more important role within the building process for listed buildings, than for unlisted buildings. In fact, it was found far more detailed and controlled for listed buildings. National legislations do not even require a design process, whenever the involved actors claim a minor intervention scale and they neither control the scale, nor the consequences of such rehabilitation interventions.

The experience in developing rehabilitation designs was not unanimously found among all students and architects from the Netherlands or Portugal. This means that contemporary and future architects are not fully acquainted with the required knowledge for developing such scale of intervention. But if lifespan consciousness is not related to the degree of experience as concluded in this doctoral research one could conclude that no further education is required. Post, Mestre and Aleixo are living evidences on how architects can become lifespan conscious and define their own design processes.

Nonetheless, it should not be forgotten that they are the exception and not the rule. Most designers do not perceive the built environment equally conscious, nor define their aims in harmony with the past, present and future. To introduce in the education level would only bring advantages, as both natural conscious and unconscious could learn together how to reach ever higher levels of lifespan consciousness.

Even if found far more accessed by architects than students, more from Portugal than the Netherlands, the final results revealed that RE-ARCHITECTURE® was mainly used by students, more from the Netherlands than from Portugal. The arguments presented by the architects, were e.g. time management, language, etc.

Students and architects with different perspectives than the pure architecture-oriented ones reacted similar to the theorized design process. Therefore, just there was not found a relation between the lifespan consciousness and the experience in rehabilitation designs; there was also no relation found with the professional expectations of designers.

Probably, when progressing on further research, the enrolment e.g. behavioural sciences in this theme would bring many more possible factors that involve the effective raise of lifespan consciousness and enable the adoption of RE-ARCHITECTURE®. The non-relation between professional expectations and lifespan consciousness, together with the registrations of many other users than architects have opened the perspective towards a future version oriented towards all actors involved in the design process and not exclusively the architect.

The interest in developing rehabilitation designs was found mainly on the new existence and what designers could promote with such rehabilitation intervention. Hardly, the arguments fall into the past or future, sustaining the hypothesis that designers, architects and students are focused on present achievements.

The architects were not sufficient in number to provide many conclusions; nonetheless among the arguments of the students an evolution has been noticed on their aims and arguments. Beyond revealing the usefulness of such theorised design process, their aims have also become more lifespan conscious. Even if the main aim remains to improve, in both test periods aims such as maintain and restore gained more arguments.

The design processes followed in rehabilitation designs were found with various similar activities among both architects and students. Most designers prioritise on two sub-stages; analysis and simulation, which they most often mix. That is considerably time saving; however, that can also end up seriously detrimental for its level of lifespan consciousness and respective impact on the building and environment. Negligence should not be hidden by ignorance, as designers have an ethical responsibility towards society and the environment.

When using RE-ARCHITECTURE® such priority remained evident, even if more sub-stages were added to their preceding design processes. Therefore, such results proved that designers do manage to find a compromise between their individual-based methods and the theory-based method recommended in this doctoral research.

The importance of rehabilitation interventions reflected different aims and cultural values; but mainly the ecological values have been present in the preceding arguments as well as before. Therefore, architects and students understand its importance and are not afraid to state it. A slight raise on lifespan consciousness was noticed from the preceding to the later answers; particularly on the choice for less interventive aims and for the increase of both general considerations for the cultural values, as well as for the ecological values.

Most designers were aware of rehabilitation designs and have appointed successes which did not differ much from the reasons for considering a rehabilitation intervention important. Moreover, they would often focus on the additions introduced by the design; rather than accurately first determine what exactly happened to the pre-existence and why, to better judge if such rehabilitation intervention could in fact be considered successful or not.

Despite the apparent rationality of both theorised design process and RE-ARCHITECTURE®, most designers understood the purpose of such work structure, stages and activities. Students have apprehended it as one possibility, which proposes the combination of theory and individual knowledge. Accordingly, they have considered to have reached higher levels of lifespan consciousness with its sustenance.

Even if architects from both countries did not use it much due to various reasons, they were still optimistic about the potential of such design process support system in their rehabilitation design developments. Even, most designers stated to become a frequent user, of the revised version which would be made based on the results of this doctoral research.

Therefore, there is nothing less than keep on researching to produce a version which makes designers not only state its importance, but really become part of their daily practice.

Chapter 7 Conclusions and Discussion

7.1 Introduction

Chapter 7 disclosures the conclusions achieved after undertaking all phases of this doctoral research and after relating them in the respective Chapters. Brief and summarised, the following conclusive Chapters shall also raise relevant points for discussion and provide the relevant rationalization towards the previous main Chapters: **Introduction**, **Scientific Method** and **Framing the Field Universe** (*vide* book I – *basis*), **Developing the Prototype** (*vide* book II – *scapus*), **Producing the Prototype** and **Testing the Prototype** (*vide* book III – *capitellum*).

Chapter 7.2 recalls the attention to the **introduction**, the right beginning of this doctoral research and to the contribution that it has managed to achieve to such problem field. Conclusions shall be taken at various levels, e.g. the global relationship between theory (guidelines and tools) and practice (designers), the unbalance between past, present and future at rehabilitation interventions, etc.

Instead, Chapter 7.3 is much more methodological and shall conclude and raise discussion on the **scientific method** followed along the four years of the doctoral research. Points of success and failure shall be presented to alert further research towards such methodological approaches and its probable outcomes, to prevent further distresses.

Chapter 7.4 goes deeper into the conclusions regarding the theory **framing the field universe** sustained by this doctoral research. The taxonomies involving the objects of cult and the actions of intervention have been motive for debate already for centuries and, hopefully, shall not end being debated with the disclosure of this doctoral research. Nonetheless, the researcher was willing to offer her contribution with a new perception of the relevant literature, to such field of expertise and their respective regent taxonomies.

The conclusions and discussion involving the prototype shall be respectively separated in Chapter 7.5 for **developing the prototype**, with the theoretical model of the design process and respective stages, sub-stages, activities, etc; Chapter 7.6 for **producing the prototype**, with the implementation of the theoretical model into a design process support system and Chapter 7.7 for **testing the prototype**, with the results of the case studies and respective experimental groups.

Chapter 7.8 presents the **overall conclusions and discussion** deduced from all previous conclusions, but perceived from a higher level of abstraction. Together, they shall provide to the researcher a clear perspective on the factual contribution of this doctoral research to its expertise field and to the respective raise of lifespan consciousness in rehabilitation interventions of built heritage.

Chapter 7.9 finalises with the most relevant **recommendations** for the field of expertise, regarding what could still be achieved with further improvements, at both research and practice. The path towards raising the levels of lifespan consciousness in current and/or future rehabilitation interventions of built heritage did not intend to end here. Contrariwise, this is just one *columna* of a much greater temple.

7.2 Concerning Introduction

C1. **The built environment is aging and claims for rehabilitation interventions. The natural environment is overexploited and claims for lifespan consciousness.**

Within every built environment; there are buildings which become obsolete and require intervention. There are different scales of intervention, but commonly the most chosen ones are highly interventive and result in a negative impact on the natural environment. Thus, there is a need to aim towards positive impacts, through more lifespan conscious interventions that truly contribute to the preservation of both natural and built environment.

C2. **Portugal and the Netherlands were chosen in this research, due to their specific fields of experience in the built environment.**

The choice for the Netherlands and Portugal, as the representative countries of Northern and Southern European cultures, was mainly to combine the experience of Portugal on rehabilitation interventions of the built environment, with the experience of the Netherlands on the implementation of lifespan and ecological principles. While BCC group was focusing Design for Lifespan on building new, this doctoral research would focus on the built heritage.

C3. **The Netherlands has economic and political means to intervene in its built environment. Maintenance is actively implemented.**

Either individually, by the owners; or collectively, by real estate management companies; various scales of interventions in the built environment are being undertaken. Maintenance interventions are actively being implemented. Consequently, interventions of rehabilitation come more as a solution to improve the technical or functional performance of buildings, rather than to decrease their levels of physical obsolescence.

C4. **Within national, local and private master plans, too many buildings are being demolished in the Netherlands.**

The facility for the Netherlands to opt for interventions of demolition, rather than for interventions of rehabilitation is disturbing. Due to the master plans and respective intervention strategies, most buildings are in a quite good condition, even if naturally loosing its adequacy facing the contemporary needs. Even in interventions of rehabilitation, a high percentage of the building's pre-existence is simply subtracted.

C5. **Lifespan values are being taken too literally in the Netherlands, when used to sustain arguments in master plans and respective interventive strategies.**

Lifespan values are truthful, but were determined on base of worst probable causes. The maximum lifespan value was theoretically set at 75 years, but none of these experts has ever stated that such building components would not last longer than 75 years. However, these values are being used to determine demolitions of buildings and/or components, without a proper assessment of their factual condition and significance.

C6. **The Netherlands underestimate the ecological contribution on active reusing, relocating or reprocessing through interventions of rehabilitation.**

The Netherlands are internationally acknowledged for their low rates on Construction & Demolition Waste, due strong recycling strategies. Moreover, there is a common behaviour of apathy to reuse, relocate or reprocess through rehabilitation interventions. Thus, probably,

to recycle such Waste is already considered enough. But, by reducing demolition through rehabilitation, not only such Waste, but also the resources spent to recycle it are saved.

C7. **Portugal does not have as much economic and political means to intervene in its built environment. Maintenance is too little implemented.**

Unlike in the Netherlands, most built environments in Portugal are managed by the small-scale private sector. Legally, owners should undertake maintenance activities, but there is hardly any control by the local authorities. Consequently, buildings stay abandoned, and rehabilitation interventions arrive in situations where physical, technical and functional performances are reaching their limits.

C8. **Portugal has been suffering strong changes with respect to urban rehabilitation and sustainability.**

Since integrated in the European Union, Portugal has undertaken several master plans that stimulate urban rehabilitation. Urban rehabilitation and sustainability became political strategies. Nonetheless, the practice is again questionable. Particularly, Energy Efficiency has now become the priority, but again, it is being implemented without an accurate assessment on its impact on the natural environment.

C9. **Lifespan values are not being used in Portugal, to sustain arguments in master plans and respective interventive strategies.**

Lifespan values have not been found implemented at any other level than the academic one, in Portugal. So, at least on that point, it is not yet sustaining practice, but it is also not being distorted by any political master plans**.** Probably, such degree of novelty had a role in the reaction of the Portuguese architects, four times higher, in terms of number of RE-ARCHITECTURE® registrations, than reaction of the Dutch architects.

C10. **Portugal underestimates the ecological contribution on active reusing, relocating or reprocessing through interventions of rehabilitation.**

There are still too little governmental means in Portugal, to implement recycling and most building components end up being wasted in a landfill or incineration. So, this argument could be one reason more to join leaders and experts in the strategy to reuse, relocate and reprocess, instead of allowing considerable amounts of man-made resources being sent to landfill or incineration, while they could still be useful for other purposes.

C11. **Slower in velocity and smaller volume of intervention, fact is that, Portugal does not follow a much different pattern than the Netherlands.**

Both built environments are being intervened; and rarely their significance condition is found correlated to the design decisions. Probably their pattern seems different, because the Netherlands freely demolish entire areas of their built environments; Portugal is strategically just as irresponsible, leaving the building abandoned till they “accidentally” ruin or they are fully demolished except for their façades.

Sustained by the previous arguments, this doctoral research was considered relevant, as well as required. For both the Netherlands and Portugal, it is urgent to raise the attention towards the eminent lifespan unconsciousness of the contemporary interventions on their built environments. Only when perceiving the problem, one can find better solutions. And, in this case, the solution found was to sustain such interventive practices, in order to subvert such dangerous tendency. However, one should only expect to find commonwealth results.

7.3 Concerning Scientific Method

C12. **The qualitative methods chosen to structure the scientific method; have been proven adequate for finding the answers to the raised questions.**

The scientific method followed in this doctoral research was structured with various qualitative methods; mostly used in "grounded theory" and "case study" research designs. These methods were recommended by the expertise as the most adequate for the problem addressed and questions raised. It allowed the research to perceive the state-of-the art of both theory and practice in a field of expertise that most could profit from this correlation.

C13. **The chosen scientific method allowed this doctoral research to provide a practice-oriented contribution to the field of expertise.**

Many doctoral researches are fundamental for the development of theories and new perceptions of practice, but do not manage to reach it; unless reality few years later comes across them. The researcher aimed for a scientific method that, instead, would lead this doctoral research beyond the borders of development of theories to provide a social and scientific contribution which would be mostly practice-oriented.

C14. **The subdivision of the doctoral research into three phases allowed the verification of its contribution to the field of expertise.**

The different phases: design theory, product and result; allowed the researcher to sustain her aims and arguments on relevant literature, develop them further and implement them into a support system. This would allow her to verify if, in fact, her contribution was meaningful for such a field of expertise, theoretically and practically. Conclusions would be based on those results, as well as the points of discussion and further recommendations.

C15. **The state-of-the-art on the taxonomies theorised internationally in this field of expertise revealed evidences for the gap identified in this doctoral research.**

While grounded on theory, this new view of the international documents clearly revealed the inconstancy of field-related taxonomies along time, as well as the most and least referenced ones. Moreover, it supported the arguments presented by the researcher when identifying a gap between what is being recommended by the scientific community and what is being applied by the practice.

C16. **Both theorised taxonomies and design process result in an accurate knowledge support for designers involved in rehabilitation design developments.**

Developing a design process and structuring the guidelines of most relevant experts would, in the assumption of the researcher, provide the necessary theory for the specific activity undertaken by the designer when involved in rehabilitation design developments. That was, in fact, pointed by many architects and architecture students. The theoretical model brought structure into their design processes, chaotic enough by nature.

C17. **This doctoral research has chosen to first theorise both taxonomies and design process, and only later, to revise and test it together with practice.**

Each method has its advantages and disadvantages. This doctoral research has chosen to first theorise both taxonomies and design process, based on preceding knowledge; and only later, revise it while still under development. But, main reason was because the

researcher was more interested in proposing theory to practice and assessing field-experts' reactions; rather than inquiring practice generating theory.

C18. **The channels of communication chosen to diffuse RE-ARCHITECTURE® among architects in both countries, were quite successful.**

The search for cooperation with technical magazines and the two professional associations might have initially seemed time consuming; but in the end was very much worthwhile. The "public invitations" sent to the whole professional community through these two communication channels; plus the "personal invitations" sent via e-mail to the acquaintances of the doctoral researcher have proven to be quite successful.

C19. **By joining education and research, not only research profits from education, but also education gains access to the latest state-of-the-art.**

Most architecture students and respective Institutions were quite pleased to cooperate with such experience and to actively promote the contribution of education into research and vice versa. The fact that this collaboration and cross-influence of students and lecturers was settled through a Socrates-Erasmus bilateral agreement made procedures run easier, without any bureaucracies resultant from eventual economic constraints.

C20. **Socrates-Erasmus bilateral agreements are fundamental to foment international cooperation and cross-influence, in both education and research.**

As Dr. Kees Doevendans (Coordinator of International Affairs at *Faculteit Bouwkunde*, TU/e) stated in his opening speech of the exhibition RE-ARCHITECTURE 05/06, this doctoral research "opened a new door for Socrates-Erasmus bilateral agreements", enabling educational exchanges result in effective contributions to the scientific community. It was surely a worthwhile experience and it is a world of opportunities to be further explored.

C21. **The cooperation of practice and education with research was fundamental for this doctoral research, to learn what could be improved on the whole process.**

Even if somehow unpredictable and temperamental as any human being designers are, the researcher was prepared for the challenge and evidential benefit of involving them in such doctoral research. After all, they would be the ones following the design process and proposing lifespan conscious rehabilitation designs, when agreeing with the guidelines provided to support them.

C22. **RE-ARCHITECTURE® would not have been produced without the cooperation of the collaborators.**

The collaborators have intervened in activities related to the production of the prototype, which would not directly influence the quality of the "original contribution to the further development of existing scientific knowledge" expected from a doctoral research. Such collaboration proved that the researcher was not only able to manage her own individual work; but also to coordinate the progress of others while producing the prototype.

Not all methods chosen were true proofs of success. Particularly, in such cooperative experience – between research, education and practice – it is natural that unexpected problems emerge. But fact is that those problems were always manageable. If education and practice would not have been integrated, the researcher would not have managed to test both theorised design theory and product. Without such a method, probably this research would have stopped at the development of theories and new perceptions of practice.

7.4 Concerning Framing the Field Universe

C23. **All buildings older than one generation should become built heritage; while all others, built by the present generation, should become built newness.**

This doctoral research proposed a new sub-division of the built environment. Built heritage would enclose buildings of varied significance and condition; however, the involved actors would be required to deal with all of them equally, independent from their age, classification, style, etc. Those differences would certainly influence decisions; however, they should not influence the process to reach such decisions.

C24. **Relevant literature has revealed that most experts tend to pursue their own sub-expertises and undervalue what is indirectly related to their field.**

While ecological experts are often found overvaluing ecological, social and economic values; cultural experts prefer overvaluing historic, aesthetical and age values. Instead, management experts are found overvaluing social, economic and political values; together with the social experts. There is hardly a compromise between experts from the different fields, involved with interventions on the built environment.

C25. **Case studies revealed that actors involved in rehabilitation interventions tend to undervalue what is indirectly related to their field.**

When actors; such as experts, leaders and constituents; are brought together into one rehabilitation intervention, each one comes with his own regent cultural values and aims. Leaders are often found overvaluing historic, political and economic values; while constituents tend to overvalue social, aesthetical and economic values. Again, there is hardly any compromise unless their regent cultural values happen to match.

C26. **Designers consider important to rehabilitate built heritage, but it seems that just to rehabilitate is enough to consider a project successful.**

Even if most designers considered important to rehabilitate built heritage and few of them considered that such intervention can contribute to the preservation of the natural environment; fact is, that what most of them perceive as built heritage is not the same as what is defined in this doctoral research. Consequently, also their aims towards built heritage through their rehabilitation interventions differ accordingly.

C27. **Designers normally do not argue their design decisions on base of ecological values. Most reasons to preserve are related to historic and aesthetical values.**

Only few designers realised the real purpose of integrating the ecological values within the cultural values. However, they only did it after much argumentation and debate. So, the break of passivity inherent in society regarding the integration of the ecological values in the cultural values, as well as the consideration of all theorised cultural values is still no more than a true wish from the researcher and few other field experts.

C28. **When built heritage is classified as "valueless", the automatic aim is to replace it with built newness, independent from its inherent cultural values.**

One might also ask how designers could consider all cultural values, when the entire society aims for exactly the contrary. In fact, it is challenging, but not that difficult to implement. It only requires a more altruistic behaviour than the common egocentric one,

accepting that their own perceptions can be complemented with the ones from other fields of expertise; so that also the results reach higher levels of quality.

C29. **The tendency is still found neglecting both past and future in unlisted buildings as well as both present and future in listed buildings.**

Listed buildings should no longer be "frozen" in their past and unlisted building should no longer be "evaporated" by the present. Future generations would appreciate the effort to reach some balance and let them also enjoy from the originality of the unlisted buildings. Currently, on might consider them as "valueless", but future generations may enjoy such buildings, even if it only by their capability of supplying man-made resources.

C30. **Lifespan rehabilitation was defined to comply with the theorised built heritage, proving that there is a way to deal with all buildings equally.**

Every designer who develops rehabilitation interventions considering consciously the building's past, present or future is developing it lifespan consciously. Not al buildings have the same age, classification, style, etc. But, designers should put their taste or interests aside and accurately discover along their design processes what shall be the most suitable solution for the present, without neglecting the past and entangling the future.

C31. **Just as in the relevant literature, the lifespan consciousness and ecological awareness is rising through the more conventional stereotypes.**

The emergence of lifespan consciousness was perceptible among the designers; just as found in the relevant literature. Nonetheless, they did not manage to fully understand the change of behaviour required for implementing such definition of built heritage. Even after realising that all buildings could become built heritage, as long as assessed of significance, and after realising the importance of the ecological values for the XXI century.

C32. **While ecological awareness is rising with dubious sustaining aims, the risk for the same to happen to lifespan consciousness is less probable.**

Over the last decades ecological awareness has been promoted and most recently has become highly recommended and implemented. Problem is, such noble actions often hide less noble aims. One might debate if, in fact, such actions are being sustained by the future commonwealth on sustainability (ecological values) as lifespan consciousness, or by the present individual profits on costs reduction (economic values).

C33. **Built heritage and lifespan rehabilitation were not defined to be taken as unchallengeable truths, but to be taken ahead in further research.**

The theorised taxonomies – built heritage and lifespan rehabilitation – are not dogmas and are expected to be challenged, either by the researcher or by other experts, in future research. The aim was clear, but not so straightforward to see implemented in our consumptive society which defends that what has no value can better be wasted! Global behaviours can change, but often that takes time to happen.

Beyond the aims of implementation, fact is that this doctoral research provided together with its taxonomies of built heritage and lifespan rehabilitation, a new perception on the relevant literature and respective international documents. The expertise field was granted with the impression of the researcher but also with an accurate state-of-the-art. So, even if the theorised taxonomies shall take longer to be implemented, they are already contributing to a more lifespan conscious perception of built heritage and respective rehabilitation interventions.

7.5 Concerning Developing the prototype

C34. **The theorised design process proposed a systematic model to sustain theoretically individual-based design processes in rehabilitation interventions.**

Such solution was found to sustain the intention to enable the implementation of lifespan rehabilitation principles into rehabilitation interventions and demystify its potential degree of complexity. Moreover, it would also create the bridge between theory and practice, by creating means for the designers to retrieve the correct guidelines at the correct stage of their design process and not when is too late and decisions taken are no longer reversible.

C35. **No similar process was identified among the relevant literature; except for models theorising design processes for common design processes.**

There were identified several guidelines for the different sub-stages and activities when surveying the literature. But, somehow they were either related to inventory techniques; or related to design decisions, etc. There was no design process found, nor a logic procedure that could guideline the designer on process versus results and what they could benefit from such approach.

C36. **The theorised design process for rehabilitation interventions was considered an innovation from both theoretical and practical point of view.**

Designers involved in this doctoral research have proven this same novelty. Probably, one of the reasons for such decree of novelty is that design processes of designers are normally their own responsibility and as long as they reach the final results and those final results have the quality expected by their clients; no one even asks, which were their design processes to reach such quality results.

C37. **Design processes are normally involved with secrecy. But, secrecy should not hide professional negligence and unsustained design decisions.**

Secrecy in rehabilitation interventions is not a problem, as long as the design process followed is sustained by lifespan conscious principles. They do not need to be the ones theorised in this doctoral research, but they need to respect the building's past, present and future. Thus, secrecy should not be used as an alibi to hide design decisions taken last-minute, without any sustenance from the pre-existence or any consciousness for their impact.

C38. **When asked to develop a rehabilitation design, designers tend to start "expressing" design proposals, before "sensing" the building or environment.**

As a designer herself, the researcher recognises and understands the behaviour; but those spontaneous "expressionisms" should not be taken more serious than any other conceptual design, resultant from moments of creative freedom, along the design process. They should not determine immediate design solutions, unless they have been proven suitable, just as a doctor trying to find the treatment for one of his sick patients.

C39. **The required creativity is higher when designers consider the pre-existence; because instead of ignoring it, designers actually have solve its problems.**

Some might argue that such guided sustenance on the pre-existence shall diminish the designers' creativity. Instead, such sustenance should provoke their creativity even more, as they would have to propose a new existence that would clearly bring benefits for the pre-

existence. Therefore, the higher level of complexity and constraints of a rehabilitation intervention, the higher level of creativity required to provide lifespan conscious solutions.

C40. **Designers have the freedom to either follow the theorised process completely or just in some particular sub-stages where they consider it most useful.**

Designers involved in this doctoral research have considered such design process useful, as a structural base to help systematising their preceding "chaotic" design processes. Aware that such chaotic behaviour can bring clear consequences for the building and respective environment, most designers did not see the model as a rigid process to follow, but a theoretical support to their design processes in rehabilitation interventions.

C41. **The two distinctive stages of pre-design and design clearly reveal the differences between the pre-existence and new existence.**

The theorised design process has proven to allow accurate comparisons between pre-design results and the design results, to verify objectively the impact of each solution on both building and environment. In general terms, that brings direct advantages not only for the designer who proposes the design proposals; but also to the involved actors who can better understand the design proposals.

C42. **The theorised design process sustains designers converting the negative impact of their rehabilitation design developments into positive.**

When acquainted with the impact of each solution on both building and environment, all involved actors can better prevent negative impacts. Therefore, even if slowly, rehabilitation interventions and the respective designers can start by actively contributing to the reduction of the negative impact and along time start contributing to the rise of the positive impact; aiming each time higher.

C43. **In rehabilitation design developments, subtractions and remainings should be designed attentively, just as presently additions are being designed.**

Consequent from the regency of present achievements, designers are more often focused on the additions that they design as new, rather than the remainings which were designed by others. Even less they are concerned with what is being subtracted. Nonetheless, in rehabilitation designs there is a pre-existence which shall eventually be divided into subtractions and remainings, which also requires consciousness and creativity.

C44. **Converting subtractions into additions is an open door for the contribution of designers to the preservation of the natural and built environment.**

The solution to convert subtractions into additions whenever changes are required due to the implementation of the new requirements, is an open door to the preservation of both natural and built environment: the natural environment because no natural resources need to be subtracted for the purpose; and the built environment because the building remains the same, even if different. Consequently, past, present and future are not neglected.

On a global perspective the theorised design process proposes the raise of lifespan consciousness of rehabilitation interventions, from the moment when the design process starts, before the decisions are taken so that there is still potential for allowing the pre-existence sustain the new existence. By taking the action to open the horizons of designers towards more accuracy and sustenance in rehabilitation design developments, the reaction expected was no more than to inspire minimal actions and maximal results. Designers have creativity enough to deal with such challenge.

7.6 Concerning Producing the prototype

C45. **RE-ARCHITECTURE® was an accessible solution to enable the implementation of the theorised design process into the daily practices of designers.**

RE-ARCHITECTURE® was produced to enable the implementation of the theorised design process and inherent lifespan consciousness into the daily practices of designers involved in rehabilitation design developments. There could have been many other ways to approach the implementation of the theorised design process, but the researcher has chosen to produce a design process support system.

C46. **Design process support systems were found preferred to design decision support systems by designers who are willing to be sustained but not replaced.**

Designers involved in this doctoral research recognised the effort to create a support system which would not make their design processes suffer too much influence of artificial intelligence (IT applications), similar to other support systems that actually end up deciding for the designer, asking for parameters, weights and automatically providing what the best options are for each specific case.

C47. **Better than presenting the design decisions, is to provide enough sustenance for the designers to take the most lifespan conscious decision.**

Each building and respective environment has its own particular significance, as well as, condition. Therefore, what could be considered lifespan conscious for one building could be found totally unconscious for other, even if similar. So, RE-ARCHITECTURE® chose for an approach that would not present the decisions and substitute the designer. Instead, it would provide a work environment where the designer could find sustenance for his own decisions.

C48. **Theory is constantly evolving such as practice. One dedicated to practice should better retrieve the last state-of-the-art from theory and vice versa.**

As it is not possible for the designers to achieve proficiency in all theories, they can better get sustenance from theory and the varied experts to supply them with the required knowledge from the fields. Nonetheless, designers need to make the effort to search, find and implement theory in their daily practices, in detriment of ad-hoc procedures, which often lead to design decisions that are no longer irreversible, when found unsuitable.

C49. **The liberalization of technical knowledge – guidelines and tools – for all interested designers was an important contribution to a field of expertise.**

In this field of expertise practice often complains about the unlikely relation between the high quantity and quality of technical knowledge developed by the theoretical expertise and the low quantity and quality of technical knowledge made available to practice. Accordingly, most high quantity and quality of technical knowledge is confidential and is not made accessible to practice, unless practice is willing to pay for it.

C50. **The access of RE-ARCHITECTURE® through the internet enabled users to retrieve easier and faster theoretical sustenance to their design process.**

There were two means to enable the implementation of the theorised design process: RE-ARCHITECTURE *scapus* (book II) and RE-ARCHITECTURE®. This last would be available on the internet, where users could retrieve theoretical sustenance to their design processes, easier and faster. Moreover, users could profit from the guidelines and tools from

everywhere in the world. At the moment, it was useful for reaching the Netherlands and Portugal.

C51. **Designers can find in RE-ARCHITECTURE® what would take hours to find in different relevant literature; especially, if it is only available on a paper version.**

The search for knowledge is normally quite time-consuming, but not with RE-ARCHITECTURE®. Designers can quickly search and find guidelines from varied field experts dedicated to rehabilitation interventions and respective required lifespan consciousness. In matters of seconds, in the sitemap or search engine one can find what would take hours finding in different relevant literature; especially, if it is only available on a paper version.

C52. **RE-ARCHITECTURE® was particularly acknowledged by its potential to become a platform of communication between all actors involved in the design process.**

The registration of other users, as well as the comments of the students from the Netherlands, revealed that more than being suitable to sustain one designer along his design process, RE-ARCHITECTURE® could become a platform of communication between designers, or even all between actors involved in rehabilitation design developments. Then, beyond emphasising their aims, actors could actually become part of the design process.

C53. **The tools available in RE-ARCHITECTURE® can become more dynamic and accurate, when information can be converted from one sub-stage to the other.**

A lack of correlation (horizontal) was evidenced between the tools of the different sub-stages, but can easily be solved in future versions. Information can be inserted in the inventories and worked further throughout the surveys; and finally, converted in the respective assessments. In such way, no parameters would be accessed without previous survey and information. Currently, RE-ARCHITECTURE® does not insure such accuracy.

C54. **Particularly, the database of building components was found successful on the sustenance of design decisions with lifespan and ecological data.**

The database of components was the tool mostly used by the students. Nonetheless, improvements would probably help users implementing the lifespan parameter more often. When the correlation would be established along the sub-stages; e.g. the support system, on its own could alert potential choices which were being less sustained, e.g. planning to subtract highly accessed components without designing its reintroduction as addition.

C55. **The functionalism of its interface was purposely chosen to enable the user to identify the structure of the theorised design process in RE-ARCHITECTURE®.**

The interface of RE-ARCHITECTURE® was structured according to its framework and clearly reflects the structure of the theorised design process. In such way, designers who would be acquainted with the model would know exactly were to go. Few users found it too “rational” and “boring”; the large majority instead, found it very “clear” and “understandable”. However, probably previous formation could have helped them profiting more from it.

Besides the qualities and defects of RE-ARCHITECTURE®, the production of the prototype was considered a major accomplishment. After all, it was the first design process support system produced for sustaining rehabilitation interventions Moreover; it accomplished feedback from designers in both the Netherlands and Portugal. Future research shall prove if, in fact, the foreseen improvements shall raise its usability, or if instead, this is the common usability of support systems that propose to sustain the raise of lifespan consciousness in design processes.

7.7 Concerning Testing the prototype

C56. **This doctoral research has profited from the contribution of various designers, from the Netherlands and Portugal, through their experience and opinion.**

While testing the proposed bridge between research and practice, on paper and when implemented in RE-ARCHITECTURE®, this doctoral research has profited from the contribution of various designers, from two different countries, through their experience and opinion. The researcher was interested not only in the experience and opinion of the contemporary architects, but also of the future architects (architecture students).

C57. **Both contemporary and future architects were challenged, so that their reaction towards a compromise between theory and practice could be verified.**

When contemporary architects would not be found interested in such compromise between theory and practice, there would be still the hypothesis of such compromise being considered more interesting for future architects. They would be architecture students now, but they could already reveal the interest of future generations of architects for implementing and personalising such lifespan consciousness in their own future practices.

C58. **The design processes of the two architectural offices revealed the variances required on the theorised design process to be suitable for all buildings.**

Particularly, two architectural offices had a high contribution to this research with their practice implementing their own principles of lifespan consciousness in rehabilitation interventions. As hypothesised, variances between listed and unlisted buildings were identified; however, these same variances sustained the definition of a design process, which was found suitable for rehabilitation of built heritage, inclusive listed and unlisted buildings.

C59. **The doubts of the students, while supported by the theorised design process, have shaped the theoretical content of each stage, sub-stage and activity.**

First, the students from the Netherlands and later, the students from Portugal who have been involved in the period to test the design theory, have contributed with their experiences while developing a rehabilitation design to the identification of the required knowledge to explain the aim of a specific stage, sub-stage and activity. Their doubts and uncertainties would be automatically be converted into guidelines.

C60. **Architects have revealed interest when registering at RE-ARCHITECTURE®, however more from Portugal than from the Netherlands.**

Their reaction towards its potential implementation in their daily activities was already considered as a point of success for this doctoral research. The level of adoption or rejection of the proposed prototype had inferior importance, because most important was the fact that such design process support system actually appealed a significant number of field experts. To make it more usable would be the task for further research.

C61. **Despite the massive adoption, far beyond the expectations, most architects ended up not exploring RE-ARCHITECTURE® as much as they could.**

The adoption of the architects from Portugal was far above the average, with approximately four times more users than the architects from the Netherlands. Most architects stopped using it after the first or second entrance. Moreover, they also did not

return to share their opinions about what was RE-ARCHITECTURE® now and what they would like it to become. The ones that did return, argued lack of previous formation, time, etc.

C62. **Students who have used RE-ARCHITECTURE® more periodically have considered it useful to sustain rehabilitation design developments.**

One could argue if the students, who used RE-ARCHITECTURE® from the beginning till the end of their design process, used it because they had to do it for educational purposes or instead, used it because they really considered it useful. Their answers, however, prove that they have considered RE-ARCHITECTURE® useful. They also suggested different aesthetics, more dynamism, national languages, exportable data, etc.

C63. **Students have shown raises of lifespan consciousness, while testing both theorised design process, and RE-ARCHITECTURE®.**

Probably because students were being oriented on a weekly basis, they have surpassed the initial moment of confrontation and realised how useful such theoretical sustenance was for their design processes. Even the ones more reticent about it have ended up understanding that all that initial workload exclusively dedicated to the building and environment had a purpose to sustain their design proposals.

C64. **Experience and perspective did not influence the initial level of lifespan consciousness in rehabilitation design developments.**

Mostly from the students, it was possible to conclude that their preceding experience on developing rehabilitation designs or different perspective on professional expectations did not influence their initial level of lifespan consciousness nor its raise along the design process. Preceding experiences brought good-practices, but also very erroneous ones; which students considered successful. Similarly, the different perspectives revealed no different.

C65. **The regent cultural values have influenced more the students and their design developments than the country from where they would come from.**

The motivation of the students from Portugal in the period for testing the design theory and the motivation of the students from the Netherlands in the period for testing the design product have clearly revealed that the motivation and interest of students for raising their levels of lifespan consciousness is independent from location, but very dependent from the regent cultural values that influence them most, as well as their will to improve.

C66. **Designers are willing to discover how to raise their lifespan consciousness, but aiming has to be translated into actions.**

Designers have given proves that they were willing to discover how to raise lifespan consciousness in their design processes and surpass the border of passiveness, aiming towards the preservation of natural and human-made resources through their rehabilitation design developments. But, aiming is not enough and acting was found still too far away from such noble aims. Hopefully, in time they shall become habits and end as common behaviour.

The first prototype of RE-ARCHITECTURE® was found suitable and useful for designers in the Netherlands and Portugal. Even if the number of designers who have ended up using it and filling in the post-survey was reduced, the raises of lifespan consciousness from the ones that where brave enough to accept the challenge, even if new and different, made all efforts worthwhile. Moreover, their experience and comments enabled many conclusions that shall bring this research till a new prototype version, which most of them already stated to be willing to try when available.

7.8 Overall conclusions and discussion

C67. **This doctoral research proved that it is possible to develop lifespan conscious rehabilitations of built heritage.**

When returning to the main research question that intrigued the researcher along the four years – Is it possible to develop lifespan conscious rehabilitations of built heritage – a new dilemma emerged, which probably shall only be solved with further research. Indeed, this doctoral research proved that it is possible to develop lifespan conscious rehabilitations of built heritage. Nonetheless, back to the fundamental factors few conclusions should be taken.

C68. **No matter the "aims" behind the "tools", the "actors" are the ones determining their adoption and to take "actions" towards its implementation.**

No matter "time" or "site"; even when "tools" are provided to sustain noble "aims", such as the theorised design process and RE-ARCHITECTURE®, the power lays at the "actors" that determine if such "aims" are compatible with their own. When that is the case, tendentiously its adoption is stronger and clear "actions" are taken for its implementation. Otherwise, such "tools" are simply considered useless; even without having been used.

C69. **"Objects" are tendentiously cultured by the regent "values" and it is hard to change them; unless the "actors" are willing to do it.**

Moreover, the "objects" are tendentiously cultured by the regent "values"; even after "actors" have been alerted and having recognised the various cultural dimensions of significance and importance for such global awareness. Even if arguing the importance to rehabilitate on ecological values, "actors" do not aim to preserve the pre-existence in their designs, arguing this same "value", as convincingly as, when arguing the regent "values".

C70. **In theory, this doctoral research tried to save the cultured "objects", through the raise of lifespan consciousness in the "actions" within rehabilitations.**

But, no matter the time spent theorising and sustaining with previous literature, the aim to divide the built environment in only two big families: built heritage and built newness; and to democratise a more lifespan conscious perception that would make "actors" respect "objects" for what they are and what to offer, rather than, for what they can gain from them; "actors" will always be the ones perceiving the built environment.

C71. **But, "actors" can be simultaneously powerful and merciless in this whole factorial system. It mainly depends on their regent "values" and "aims".**

The researcher did not realise how simultaneously powerful and merciless "actors" can actually be in this whole factorial system. After all, they are the ones that determine "time" and "site"; the ones that take the "actions" and choose the "tools" to build and intervene in the built environment, settled by "objects" of their own creation. They are also the ones deciding their "aims" and electing the regent "values".

C72. **The relation between the "aims" that guide the "actions" and the "values" that qualify the "objects" though, was a quite curious discovery.**

Even if, theoretically, there should be a safety barrier between them; fact is that practically, they have direct influence on each other. The "values" attributed to an "object" do manipulate the "aims" behind an "action" towards the cultured "objects" and vice versa.

Consequences from this relationship can be comforting, but can also devastating; especially when the "aims" are not influenced by the "object".

C73. **"Actions" of rehabilitation are noble, but can result into a much more unsustained intervention than other interventions on the built environment.**

"Actors" in general and designers in particular, have the power to "aim" for "actions" that contribute the rehabilitation of obsolete built environments. This is a very noble intervention, but quite intrusive if the chosen "aims" and "actions" are, in fact, incompatible and/or unsuitable with such building and/or environment. Other scales of intervention such as e.g. preservation do not leave such a stronger impact in the natural and built environment.

C74. **The lack of common systems and parameters to control the quality of "actions" within rehabilitation interventions is a problem far from being solved.**

European and National regulations are too unclear in these aspects. "Actions" in the built environment are recommended to preserve the "objects" of cult; but no specific constrains are imposed. So, it is no surprise to find most designers considering their rehabilitation interventions as successful, as well as, the rehabilitation intervention of other colleagues, nationally and/or internationally, when acknowledged by the Media.

C75. **Respecting past, present and future of built heritage, in rehabilitation interventions, is within all "actors" who are naturally lifespan conscious.**

Lifespan conscious "actors" know how the past is important for present and future societies; how the present needs to be supplied which is required or demanded; and how future generations can better profit from decisions taken today. This research proved that most arguments reflected the importance between *old* and *new*; but curiously, in many cases of contemporary rehabilitation there is hardly any *old* left to prove such harmony.

C76. **"Actions" of contemporary society are mostly lifespan unconscious; probably because current generation was not educated to "aim" lifespan consciously.**

Contemporary society has not been educated lifespan consciously. Most designers are taught for designing what *new* and wasting what *old*. Media has substituted Literature. Appearance rules over Essence. Therefore, when the question is raised regarding lifespan consciousness; most inherent answer is: "What do I gain with it?" Without realising, that such lifespan consciousness is not about gaining individual, but commonwealth returns.

C77. **Even if it is possible to develop lifespan conscious rehabilitations of built heritage, contemporary "actors" have not taken "actions" for it.**

Contemporary designers were found interested on lifespan conscious rehabilitations of built heritage, but did not take the required "time" to "act" according to its most basic principles. Probably, they are still too influenced by society and are not willing to give up on fame and reputation to only "act" where exceptionally required; incapable of choosing for a more sustained solution, instead of the more fashionable and trendy.

So, it is possible to develop lifespan conscious rehabilitations of built heritage and designers are perfectly capable to undertake them, when willing. They only need to realise the direct effect of their "actions", drawing and erasing lines, on the environment. However, without the involvement of the other involved actors, efforts can be limited The researcher can only promise to find better theoretical sustenance for their practices, and hope to one day answer "yes" when questioned about the lifespan consciousness of most designers involved in rehabilitations of built heritage.

7.9 Further recommendations

R1. **Countries such as the Netherlands and Portugal can contribute for the raise of lifespan consciousness of the interventions on their built environments.**

Taking as base this doctoral research, there is much that can be done to raise the level of lifespan consciousness of the interventions on their built environments. Consultancy provided by the experts from the local authorities, sustained by the experts from the field of expertise, could become fundamental to the raise lifespan consciousness. Consultancy could be provided to all scales of intervention and not just at the higher ones.

R2. **The impact of Interventions on their built environments can easily be controlled by comparing the pre-existence with the new existence.**

Local authorities can easily identify the impact of interventions on their built environments by comparing the pre-existence and the new existence. From that comparison, they will be able to identify what is designed to be subtracted, to remain and to be added. To crosscheck these realities with the respective condition and significance assessment of the pre-existence would certainly contribute for the raise of lifespan consciousness.

R3. **"Blue" could be legally added to the "reds & yellows", to incentive aims to recycle, reprocess and/or relocation.**

In Portugal, there are already the "reds and yellows" to control respectively the additions and subtractions, within a rehabilitation intervention. To incentive lifespan consciousness, a new colour - "blue" - could be added to clearly identify what is there which was previously subtracted and later added after having been recycled, reprocessed or relocated. This method to control could be also suitable in the Netherlands.

R4. **In order to diminish the identified gap and strengthen the bridge between theory and practice, further research should aim for practical application.**

Applied research is an excellent approach that helps researchers from all fields of expertise to create bridges between theory and practice. Those are not easy to build, but once established will improve communication, further developments, etc. Bridging between theory and practice was enabled by RE-ARCHITECTURE®; particularly in the field of rehabilitation of built heritage and its respective raise of lifespan consciousness.

R5. **Framing such field universe is a challenge that should not cease with this doctoral research.**

The referenced literature can be further explored to derive new theories, related to interventions on the built environment and adapted to the changing time. Specifically related to the surveyed taxonomies researchers can e.g. complement the survey with more documents following the same method or define a new method to survey the same documents and correlate the results.

R6. **The theorisation of design processes undertaken in rehabilitation interventions could only profit with different perceptions and much debate.**

The theorised design process resulted from the experience of the researcher and respective research process, contacts, literature, etc. Nonetheless, other design processes could be developed, even more efficient on sustaining the raise of lifespan consciousness

than these previous ones. Moreover, researches can be undertaken where models derive directly from practice, to better identify lifespan conscious and unconscious practices.

R7. **RE-ARCHITECTURE® produced during this doctoral research was the first and hopefully not the last design process support system.**

More perceptions on how such support system should be optimised to operate and interact with its users, together with all results emerging from this doctoral research, can only lead to a stronger bridge between theory and practice in the field of rehabilitation interventions. Further research should also focus on how practice could work together with theory and in which stages of a design process this collaboration could be most vital.

R8. **RE-ARCHITECTURE® has established a bridge which, when well maintained, shall enable prosperous exchange of experiences between theory and practice.**

From one side, theory can supply the knowledge. From the other side, practice can adopt, implement and provide outputs for such knowledge. However, contemporary, as well as future architects, still at the level of learning their future practices from theory, need to maintain such bridge. Otherwise, behaving egocentrically, theory shall stop supplying innovative knowledge and practice shall not evolve as much it could.

R9. **Lifespan consciousness should not only be applied in Europe, but everywhere. RE-ARCHITECTURE® can sustain its worldwide implementation.**

As the theorised design process intends to become an international model, similarly to the international documents that have inspired it, countries from all over the world, could profit from both current and/or new versions of such design process. These countries shall surely contribute back with other perceptions, not only on the design process of rehabilitation interventions; but also on their objects of cult and respective actions of intervention.

R10. **Further versions of RE-ARCHITECTURE® should be developed, not only taking as base what practice demands, but what theory recommends.**

Recommendations given by the architects and architecture students involved in this pioneer experience should be the base for such further developments, as they have already provided very good evidences on how designers idealise their support systems. Nonetheless, theory has the state-of-the-art on best-practice principles and techniques that should be applied and tested, even if proposed by practice.

R11. **RE-ARCHITECTURE® should become part of the daily practice of all actors involved in rehabilitation design developments.**

RE-ARCHITECTURE® was now able to enter at the level of the daily activities of students and architects from the Netherlands and Portugal; but the constant aim is not to enter, but to stay there and sustain them in their daily activities. As a team, theory and practice can raise rehabilitation interventions into levels of lifespan consciousness, which are now far beyond achievement.

A stronger cooperation between theory and practice through the strengthening of the triangle research, education and practice can only lead towards rewarding developments processes and results. No method, theory, implementation and verification shall ever be perfect, but that is exactly what makes research even more challenging. There is always something to learn from, to improve and to search for new solutions, over and over again. Nonetheless, there are moments such as this one, where research needs to stop, look back and forward, to wisely find the following path.

Appendices

■ Appendix 1: The evolution of the prototype

code		cp	pp	fp	d/f	description
01	accesslog				d	Workflow, log of data
02	aims				f	Primary aims
03	answers				d	Pre- and Post-Survey, log of data
04	assessments				f	Parameters and assessment scales
05	assessment_responses				d	Assessments, log of data
06	configurations				f	Forgotten password engine
07	documents				f	Primary and secondary documents
08	document_locations				f	Primary and secondary locations
09	oral_actors				f	Primary and secondary actors
10	oral_locations				f	Primary and secondary locations
11	questions b				f	Pre- and Post-Survey questions
12	site				f	Info boxes texts (Top menus)
13	sphidercategories				f	Search engine, categories
14	sphiderdomains				f	Search engine, domains
15	sphiderkeywords				f	Search engine, keywords
16	sphiderlinks				f	Search engine, links
17	sphiderlink_keyword0				f	Search engine, keywords 0
18	sphiderlink_keyword1				f	Search engine, keywords 1
19	sphiderlink_keyword2				f	Search engine, keywords 2
20	sphiderlink_keyword3				f	Search engine, keywords 3
21	sphiderlink_keyword4				f	Search engine, keywords 4
22	sphiderlink_keyword5				f	Search engine, keywords 5
23	sphiderlink_keyword6				f	Search engine, keywords 6
24	sphiderlink_keyword7				f	Search engine, keywords 7
25	sphiderlink_keyword8				f	Search engine, keywords 8
26	sphiderlink_keyword9				f	Search engine, keywords 9
27	sphiderlink_keyworda				f	Search engine, keywords a
28	sphiderlink_keywordb				f	Search engine, keywords b
29	sphiderlink_keywordc				f	Search engine, keywords c
30	sphiderlink_keywordd				f	Search engine, keywords d
31	sphiderlink_keyworde				f	Search engine, keywords e
32	sphiderlink_keywordf				f	Search engine, keywords f

code		cp	pp	fp	d/f	description
33	sphiderpending				f	Search engine, pending
34	sphiderquery_log				d	Search engine, log of data
35	sphidersites				f	Search engine, sites
36	sphidersite_category				f	Search engine, site category
37	sphidertemp				f	Search engine, temp
38	survey b11				d	Pre-Survey answers (1/6)
39	survey b12				d	Pre-Survey answers (2/6)
40	survey b12a				d	Pre-Survey answers (2a/6)
41	survey b13				d	Pre-Survey answers (3/6)
42	survey b14				d	Pre-Survey answers (4/6)
43	survey b15				d	Pre-Survey answers (5/6)
44	survey b16				d	Pre-Survey answers (6/6)
45	survey b21				d	Post-Survey answers (1/6)
46	survey b22				d	Post-Survey answers (2/6)
47	survey b22a				d	Post-Survey answers (2a/6)
48	survey b23				d	Post-Survey answers (3/6)
49	survey b24				d	Post-Survey answers (4/6)
50	survey b25				d	Post-Survey answers (5/6)
51	survey b26				d	Post-Survey answers (6/6)
52	surveys				f	Surveys, fields
53	survey_categories_es				f	S. Categories, environment survey
54	survey_categories_cs				f	S. Categories, condition survey
55	survey_categories_pi				f	S. Categories, physical inventory
56	survey_categories_ss				f	S. Categories, significance survey
57	survey_guidelines_es				f	S. Guidelines, environment survey
58	survey_guidelines_cs				f	S. Guidelines, condition survey
59	survey_guidelines_pi				f	S. Guidelines, physical inventory
60	survey_guidelines_ss				f	S. Guidelines, significance survey
61	survey_responses				d	Surveys, log of data
62	tb00				d	Users, log of data
63	tb00 document				f	Literature references
64	tb00 document category				f	Literature references, category
65	tb01				f	Users, years
66	tb02				f	Users, countries

code		cp	pp	fp	d/f	description
67	tb05 (0-)				f	Dtb. of components (0-.--)|(--)
68	tb05 (00)				f	Dtb. of components (00.--)|(--)
69	tb05 (000)				f	Dtb. of components (00.00)|(--)
70	tb05 (a) material				f	Dtb. of components (--.--)|(-a)
71	tb05 (a) work				f	Dtb. of components (--.--)|(A-)
72	tb05 component				f	Dtb. of components
73	tb05 info				f	Dtb. of components info
74	tb05 info type				f	Dtb. of components info type
75	tb10				d	Post-Survey, log of answers
76	tb11				f	Post-Survey, scale of evaluation
77	tb12				f	Surveys, scale of usefulness
78	tb20				d	Designs, log of data
79	tb21				f	Designs, months
80	tb03 guidelines					Level 0 - Dtb. of Guidelines
81	tb31				f	Level 1 - Stages
82	tb32				f	Level 2 - Sub-stages
83	tb33				f	Level 3 - Activity
84	tb34				f	Level 4 - Sub-Activity
85	tb35				f	Level 5 - Guidelines
86	tb04 environment					Assessments, log of data (I)
87	tb40				d	Assessments, log of data (II)
88	tb02 component list				d	Dtb. of components, log of data (I)
89	tb50				d	Dtb. of components, log of data (II)
90	tools available				f	Tools available
91	tools report				d	Report, log of results
	total	23	41	66		

■ Appendix 2: The inconsistencies of the preliminary prototype

■ Phase 1

id	description	location
1	The sitemap is not working	Sitemap
2	Conditions heading differs in Home and Database	New user account
3	Conditions text differs in Home and Database	New user account
4	Back link erases info filled in the new user account	New user account
5	Add error messages in new user account + other mistakes	New user account
6	No error message checking the e-mail	New user account
7	The user can login immediately after registering	New user account
8	Annoying error message in pre- + post-surveys	Pre- + post-surveys
9	Enable to stop the assessments and continue next time	Pre- + post-surveys
10	The tool buttons in all sub-stages are too small	All tools
11	The heading in all sub-stages are too small	All headings
12	The navigation buttons to the left menu (pop-up window)	Design process
13	Ana Rita Pereira Roders has no e-mail added	Contact us
14	Question B2.01 has a non user-friendly answer matrix	Post-survey
15	Add notice texts to explain what the user can do	Design process
16	Transform the PDF into html, under the graph	Design process
17	Transform the Matrixes into clickable tables	Design process
18	There is not enough grey in the end of the pages	All tools
19	The button send is different than others (change to save)	All tools
20	The button preview never works (can be erased)	All tools
21	The back button does not work, after clicking bottom / top	Dtb. of components
22	Arrows are not user-friendly (change to image or text)	Dtb. of components
23	When adding components into report, nothing happens	Report
24	Designer and Date are not aligned to the right	Report
25	In Designer should appear the complete name of the user	Report
26	The selection made by the user disappears	All evaluation tools
27	When re-selecting and sending nothing changes	All evaluation tools
28	Add "© 2006 RE-ARCHITECTURE Inc. All rights reserved"	Frozen frame (footer)
29	Add registered ® in from of RE-ARCHITECTURE	Frozen frame (header)
30	Add link to PDF "Copyright" to explain Copyright/IP Policy	Frozen frame (footer)
31	Add blank PDF with the name "Copyright"	Frozen frame (footer)
32	The table cell (a) is with a different format than the others	Dtb. of components
33	Technische Universiteit Eindhoven is not aligned to the right	Frozen frame (header
34	Faculty of architecture... are not aligned to the right	Frozen frame (header)

id	description	location
35	Unit Architectural... are not aligned to the right	Frozen frame (header)
36	The Table had some interrogation marks to be erased	Dtb. of components
37	There were some - missing	Dtb. of components
38	The time limit to assess website + post-survey is not there	Frozen frame (footer)
39	Ir. Peter van den Brand is missing	Acknowledgements
40	Built heritage is the 2nd and should the 3rd link in the menu	Main menu (black)
41	Introduction + Conclusion from Pre- and Design are missing	Left menu
42	After bug 41, Pre- and design can become just text	Left menu
43	The evaluation scale is from 5 to 1 and should be the inverse	All evaluation tools
44	Design Assessment tool is missing	Evaluation (4DA)
45	The selective combo box cuts the words in the bottom	Dtb. of components
46	The CI/SfB Codes are not together with the description	Dtb. of components
47	The intended facilities are inexistent (check PowerPoint)	Main menu (blue)
48	The user can logout immediately without warning message	Logout
49	Substitute "Welcome ...!" with "Goodbye...!" after logging out	Logout
50	Substitute "logout" with "log out"	Logout
51	FCT link is with problems (link in Favourites)	Acknowledgements
52	XX architecten is with problems (link in Favourites)	Acknowledgements
53	The "Stichting Bouwresearch" is missing (link in Favourites)	Acknowledgements
54	Change "more..." to "and more..."	Acknowledgements
55	The link to PDF in the Headings is not working	All headings
56	The two assessment tools should be recognisable	Evaluation (3EA, 4EA)
57	Stage 4 - Evaluation appears as Stage 3 - Decision	Report
58	The report does not distinguish page 1, 2, 3, ...	Report
59	The identification of the stage is in the wrong position	Report
60	The tools are ordered alphabetically, not process related	Pre-Report
61	The user's order choice only appears once he selects it	Report
62	If the user returns to report - tools are ordered alphabetically	Report
63	Have option for only 1 graph with 2 results (e.g. 3EA + 4EA)	Report
64	There is no button back in the report preview	Report
65	The button print is not visible enough	Report
66	There is no button in the top saying bottom (main/compare)	Dtb. of components
67	There is no button in the bottom saying top (main/compare)	Dtb. of components
68	Preview + back are unaligned with the layout	Dtb. of components
69	The table should be identified as CI/SfB TABLE1 (0-)	Dtb. of components
70	Add the other twelve tools (Analysis + Synthesis)	All tools
71	Add search function into left menu	Left menu
72	The CI/SfB Codes do not appear in the comparison	Dtb. of components
73	The sitemap available is not satisfactory	Sitemap
74	Format conditions window (letter, size, etc.)	Conditions
75	The button preview never works (can be erased)	Dtb. of components

id	description	location
76	Change the text as external works, other works	Dtb. of components
77	Cannot unselect 3PI and 4PD in "report", only in database	Dtb. of components
78	When components are selected they are part of the "report"	Dtb. of components
79	Correct the CI/SfB codes	Dtb. of components
80	No button in the top saying bottom (info) and vice versa	Dtb. of components
81	There is not enough grey in the end of the page (compare)	Dtb. of components
82	Change "sex" for "gender"	New user account

- **Phase 2**

id	description	location
1	Place all the back buttons in the same position (top right)	Tools (AN/SY/EV)
2	Place the info boxes centred with the website page	Info boxes
3	Change the background of the info box "Introduction" to blue	Big blue menu
4	Change the background of the info box "contact" to blue	Small blue menu
5	The titles should be with caps, just as in the other info boxes	Top black menu
6	Summarise the text of the info box "Introduction"	Big blue menu
7	Create the white box with a arrow to simulate "search"	Left menu
8	Place "sitemap" under the "search" box	Left menu
9	Introduce "Introduction" and "Conclusion"	Left menu
10	Move building elements database to 4PD tool	Tool (4PD)
11	Add to every tools page the blue schemes	Tools menu
12	Introduce "Sitemap" and "Report"	Left menu
13	Make blue (passing the mouse) the sub-stages with tools	Tools menu
14	Place "Report" html in both 3DR and 4DR tool	Tools (3/4DR)
15	Filter the view of sub-stages in 3DR to (Pre-Design results)	Tool (3DR)
16	Make the "Report" similar to the other tools	Tools (3/4DR)
17	Make the description of the codes visible in the combo box	Tools (AN/SY)
18	The titles should not start with big letters	Tools (AN/SY)
19	The title "information" and "observations" should be visible	Tools (AN)
20	The title "knowledge" and "observations" should be visible	Tools (3SY)
21	The title "action" and "observations" should be visible	Tools (4SY)
22	Place "add" in the bottom (right)	Tools (AN/SY/EV)
23	The designer can choose the parameters he wants to assess	Tools (EV)
24	The report should allow min. 3 and max. 9 parameters	Tools (EV)
25	Add Environment Assessment tools	Tools (3/4EA)
26	Invert the colours range (very low - red, very high blue)	Tools (EV)
27	Introduce "check risk" button and function	Tools (3/4SA)
28	Align "right" the descriptions of the parameters	Tools (EV)
29	Comparison among components should be possible	Tool (4PD)
30	Change the style of add/remove	Tool (4PD)

id	description	location
31	Possibility to add as subtractions / remainings / additions	Tool (4PD)
32	The fields with the same widths ("100" or "50") Wt="600"	Tool (4PD)
33	Align the codes and description to the "left"	Tool (4PD)
34	Correct the codes (1-) till (9-)	Tool (4PD)
35	The titles should not have frame around	Tool (4PD)
36	The "add" buttons need to add information to the "Report"	Tool (4PD)
37	The htmls should be updated with the last versions	Design Process
38	The e-mail to send password is not working yet	Login
39	The "index" page with the logo	First page
40	Disappear with the Left menu until the designer is logged in	First page
41	The left menu windows is behind the components combo box	Tool (4PD)
42	The left menu windows is behind the "Report" list	Report
43	Make the logo for the subtractions, remainings, additions	Tool (4PD)
44	Correct the text of the questions (in the website)	Pre- and Post Surveys
45	Freeze the grey window and reduce surveys to 6 pages	Pre- and Post Surveys
46	Change "date of birth" to "year of birth"	New User 2/3
47	In combo box B1.03 and B2.03, is "theory-based"	Pre- and Post Surveys
48	Black code boxes should have the same width	Pre- and Post Surveys
49	Combo boxes should be placed in the same place	Pre- and Post Surveys
50	Question 16 should be on the next page (6th page)	Pre- and Post Surveys
51	Pre- and Post Surveys should be 6 pages only	Pre- and Post Surveys
52	Correct "sitemap" (Erase the general information)	Left menu
53	Erase "building" from the title in "Introduction"	Introduction
54	Correct all hyperlinks of the htmls files	Design Process
55	Write terms and conditions	Bottom
56	Correct all wrong table and figure links	Design Process
57	Match grey area before and after logging in	Left menu / Grey area
58	Reduce grey / left menu height so bottom is visible	Left menu / Grey area
59	Correct the blue under the black boxes	Tools (3/4DR)
60	The vertical titles should all be aligned right	Tools
61	All titles should be blue (as in 4PD)	Tools (AN/SY)
62	All titles should be blue (first page is not)	Tools (4PD)
63	The table lines should all have the colour (as in more info)	Tools (4PD)
64	When clicking again in the same square, it should unselect	Tools (EV)
65	Add hyperlinks to Appendixes (support tables with values)	Tools (EV)
66	Correct "list of results" and "currently in your report"	Tools (3/4DR)
67	Back button is missing (back to respective guidelines)	Tools (3/4DR)
68	combo boxes are not aligned with each other	Tools (AN/SY)
69	Delete in 3/3 new user account	Pre-Survey
70	When the user answers no - jump to page 6 (question 16)	Pre-Survey
71	The building inventory tool is missing	Tools (3/4DI)

- **Appendix 3: Questionnaire A1**
- **Appendix 4: Questionnaire A2**
- **Appendix 5: Questionnaire A3**

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MINISTÉRIO DA CIÊNCIA E DO ENSINO SUPERIOR

RE–ARCHITECTURE: LIFESPAN REHABILITATION OF BUILT HERITAGE

QUESTIONNAIRE A1 – DESIGN PROCESS DIFFERENCES IN PROTECTED AND NON PROTECTED BUILDINGS

DESIGNATION	DESIGNER [ARCHITECTURAL]	DATE	PAGE 1/9	A1

OTHER INTERVENIENTS

COLLABORATION [ARCHITECTURAL]	CO-DESIGNER [CONSTRUCTION]
CO-DESIGNER [ELECTRICAL]	CO-DESIGNER [MECHANICAL]
CO-DESIGNER [WATER + SEWAGE]	OTHER CO-DESIGNER
APPROVAL INSTITUTION	OTHER APPROVAL INSTITUTION
OWNER / USER	CONTRACTOR

BUILDING

NAME	STREET	CITY	COUNTRY
PROTECTION INSTITUTION	PROTECTION GRADE	PROTECTION AREA	PROTECTION DATE
ORIGINAL TYPOLOGY	ORIGINAL DATE	FORMER TYPOLOGY	FORMER DATE
CATEGORY	LAND AREA	BUILT AREA	FLOOR AREA
ENVIRONMENT	LOCATION	ALTIMETRY	STATUS

DESCRIPTION	

COMMENTS

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RE–ARCHITECTURE: LIFESPAN REHABILITATION OF BUILT HERITAGE

QUESTIONNAIRE A1 – DESIGN PROCESS DIFFERENCES IN PROTECTED AND NON PROTECTED BUILDINGS

DESIGNATION	DESIGNER [ARCHITECTURAL]	DATE	PAGE 2/9	A1

BUILDING

LIFE CYCLE STAGES

COMMENTS

PRE-DESIGN SUB-STAGES

3

COMMENTS

3DI: ANALYSIS – DOCUMENTAL INVENTORY

PLACE	DOCUMENTS	REASON
PLACE	DOCUMENTS	REASON
PLACE	DOCUMENTS	REASON
PLACE	DOCUMENTS	REASON
PLACE	DOCUMENTS	REASON
PLACE	DOCUMENTS	REASON

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RE–ARCHITECTURE: LIFESPAN REHABILITATION OF BUILT HERITAGE

QUESTIONNAIRE A1 – DESIGN PROCESS DIFFERENCES IN PROTECTED AND NON PROTECTED BUILDINGS

DESIGNATION	DESIGNER [ARCHITECTURAL]	DATE	PAGE 3/9	A1

3PI: ANALYSIS – PHYSICAL INVENTORY

SURVEY Geometric	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Material	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Chronological	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Pathological	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Colour	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Complexity	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Functional	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Efficiency	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Climate	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Technical	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Aesthetical	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Lifespan	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY Real estate	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON
SURVEY	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	REASON

ORDER = ORDER IN THE DESIGN PROCESS

3SA: EVALUATION – SIGNIFICANCE ASSESSMENT

VALUE economic	ORDER	V	IV	III	II	I	REASON
VALUE political	ORDER	V	IV	III	II	I	REASON
VALUE social	ORDER	V	IV	III	II	I	REASON
VALUE historic	ORDER	V	IV	III	II	I	REASON
VALUE scientific	ORDER	V	IV	III	II	I	REASON
VALUE age	ORDER	V	IV	III	II	I	REASON
VALUE aesthetical	ORDER	V	IV	III	II	I	REASON
VALUE ecologic	ORDER	V	IV	III	II	I	REASON

SCALE: V = VERY HIGH, IV = HIGH, III = REASONABLE, II = LOW, I = VERY LOW
ORDER = ORDER OF RISK FOR THE DESIGN DECISIONS

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RE–ARCHITECTURE: LIFESPAN REHABILITATION OF BUILT HERITAGE

QUESTIONNAIRE A1 – DESIGN PROCESS DIFFERENCES IN PROTECTED AND NON PROTECTED BUILDINGS

DESIGNATION	DESIGNER [ARCHITECTURAL]	DATE	PAGE 4/9	A1

3CA: EVALUATION – CONDITION ASSESSMENT

SUBSTANCE form	V	IV	III	II	I	REASON
SUBSTANCE component	V	IV	III	II	I	REASON
SUBSTANCE material	V	IV	III	II	I	REASON
FEATURE function	V	IV	III	II	I	REASON
PERFORMANCE climate	V	IV	III	II	I	REASON
PERFORMANCE technical	V	IV	III	II	I	REASON
PERFORMANCE aesthetical	V	IV	III	II	I	REASON
PERFORMANCE lifespan	V	IV	III	II	I	REASON
FEATURE prod. complexity	V	IV	III	II	I	REASON
FEATURE costs	V	IV	III	II	I	REASON

SCALE: V = VERY HIGH, IV = HIGH, III = REASONABLE, II = LOW, I = VERY LOW

3R: REPORT **Pre-design**	YES	NOT IMPORTANT	NOT POSSIBLE	NOT WANTED	REASON

INTERVENTION

DESIGN STAGES

4

COMMENTS

4D1: ANALYSIS – DOCUMENTAL INVENTORY

PLACE	DOCUMENTS	REASON
PLACE	DOCUMENTS	REASON

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QUESTIONNAIRE A1 – DESIGN PROCESS DIFFERENCES IN PROTECTED AND NON PROTECTED BUILDINGS

DESIGNATION	DESIGNER [ARCHITECTURAL]	DATE	PAGE 5/9	A1

AI: ANALYSIS – AIMS INVENTORY

NAME	CLASSIFICATION	TYPOLOGY	DATE

CATEGORY	NATURAL AREA	BUILT AREA	FLOOR AREA

SUBSTANCE form	V	IV	III	II	I	REASON
SUBSTANCE component	V	IV	III	II	I	REASON
SUBSTANCE material	V	IV	III	II	I	REASON

SCALE: V = MAINTAIN, IV = RESTORE, III = IMPROVE, II = REPLACE, I = DECREASE

FEATURE function	V	IV	III	II	I	REASON

SCALE: V = USE, IV = REUSE (UPGRADE), III = ADAPT (COMPATIBLE), II = ADAPT (INCOMPATIBLE), I = NOT USE

PERFORMANCE climate	V	IV	III	II	I	REASON
PERFORMANCE technical	V	IV	III	II	I	REASON
PERFORMANCE aesthetical	V	IV	III	II	I	REASON
PERFORMANCE lifespan	V	IV	III	II	I	REASON
FEATURE prod. complexity	V	IV	III	II	I	REASON
FEATURE costs	V	IV	III	II	I	REASON

SCALE: V = MAINTAIN, IV = RESTORE, III = IMPROVE, II = REPLACE, I = DECREASE

4PD: SIMULATION – PRELIMINARY DESIGN

PRE-EXISTENCE Subtractions	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	NOT WANTED	REASON

COMMENTS

PRE-EXISTENCE Remainings	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	NOT WANTED	REASON

COMMENTS

PRE-EXISTENCE Additions	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	NOT WANTED	REASON

COMMENTS

ORDER = ORDER OF IMPORTANCE FOR THE DESIGNER

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QUESTIONNAIRE A1 – DESIGN PROCESS DIFFERENCES IN PROTECTED AND NON PROTECTED BUILDINGS

DESIGNATION	DESIGNER [ARCHITECTURAL]	DATE	PAGE	
			6/9	A1

4PD: SIMULATION – PRELIMINARY DESIGN

PRE-EXISTENCE	ORDER	YES	NOT IMPORTANT	NOT POSSIBLE	NOT WANTED	REASON
Connections						

COMMENTS

REMAININGS VERSUS ADDITIONS		REASON

REMAININGS VERSUS ADDITIONS		REASON

REMAININGS VERSUS ADDITIONS		REASON

VALUE	ORDER	V	IV	III	II	I	REASON
economic							
VALUE political	ORDER	V	IV	III	II	I	REASON
VALUE social	ORDER	V	IV	III	II	I	REASON
VALUE historic	ORDER	V	IV	III	II	I	REASON

SCALE: V = VERY HIGH, IV = HIGH, III = REASONABLE, II = LOW, I = VERY LOW
ORDER = ORDER OF IMPORTANCE FOR THE DESIGNER

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QUESTIONNAIRE A1 – DESIGN PROCESS DIFFERENCES IN PROTECTED AND NON PROTECTED BUILDINGS

DESIGNATION	DESIGNER [ARCHITECTURAL]	DATE	PAGE 7/9	A1

4PD: SIMULATION – PRELIMINARY DESIGN

VALUE scientific	ORDER	V	IV	III	II	I	REASON
VALUE age	ORDER	V	IV	III	II	I	REASON
VALUE aesthetical	ORDER	V	IV	III	II	I	REASON
VALUE ecologic	ORDER	V	IV	III	II	I	REASON

SUBSTANCE form	ORDER	V	IV	III	II	I	REASON
SUBSTANCE component	ORDER	V	IV	III	II	I	REASON
SUBSTANCE material	ORDER	V	IV	III	II	I	REASON
FEATURES function	ORDER	V	IV	III	II	I	REASON
PERFORMANCE climate	ORDER	V	IV	III	II	I	REASON
PERFORMANCE technical	ORDER	V	IV	III	II	I	REASON
PERFORMANCE aesthetical	ORDER	V	IV	III	II	I	REASON
PERFORMANCE lifespan	ORDER	V	IV	III	II	I	REASON
FEATURES prod. comp.	ORDER	V	IV	III	II	I	REASON
FEATURES costs	ORDER	V	IV	III	II	I	REASON

SCALE: V = VERY HIGH, IV = HIGH, III = REASONABLE, II = LOW, I = VERY LOW
ORDER = ORDER OF IMPORTANCE FOR THE DESIGNER

4SA: EVALUATION – SIGNIFICANCE ASSESSMENT

VALUE economic	V	IV	III	II	I	REASON
VALUE political	V	IV	III	II	I	REASON
VALUE social	V	IV	III	II	I	REASON
VALUE historic	V	IV	III	II	I	REASON
VALUE scientific	V	IV	III	II	I	REASON
VALUE age	V	IV	III	II	I	REASON
VALUE aesthetical	V	IV	III	II	I	REASON
VALUE ecologic	V	IV	III	II	I	REASON

SCALE: V = VERY HIGH, IV = HIGH, III = REASONABLE, II = LOW, I = VERY LOW

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QUESTIONNAIRE A1 – DESIGN PROCESS DIFFERENCES IN PROTECTED AND NON PROTECTED BUILDINGS

DESIGNATION	DESIGNER [ARCHITECTURAL]	DATE	PAGE 8/9	**A1**

ACA: EVALUATION – CONDITION ASSESSMENT

SUBSTANCE form	V	IV	III	II	I	REASON
SUBSTANCE component	V	IV	III	II	I	REASON
SUBSTANCE material	V	IV	III	II	I	REASON
FEATURE function	V	IV	III	II	I	REASON
PERFORMANCE climate	V	IV	III	II	I	REASON
PERFORMANCE technical	V	IV	III	II	I	REASON
PERFORMANCE aesthetical	V	IV	III	II	I	REASON
PERFORMANCE lifespan	V	IV	III	II	I	REASON
FEATURE prod. complexity	V	IV	III	II	I	REASON
FEATURE costs	V	IV	III	II	I	REASON

SCALE: V = VERY HIGH, IV = HIGH, III = REASONABLE, II = LOW, I = VERY LOW

4DA: EVALUATION – DESIGN ASSESSMENT

SUBSTANCE subtractions	V	IV	III	II	I	REASON

SCALE: V = USE (MAINTAIN), IV = DEMOUNT (REUSE), III = DEMOUNT (RECYCLE, REUSE), II = DEMOUNT (RECYCLE), I = DEMOLISH (WASTE)

SUBSTANCE remainings	V	IV	III	II	I	REASON

SCALE: V = ARREST DECAY, IV = REPAIR, III = CONSOLIDATE, II = REINFORCE, I = REPLACE

SUBSTANCE additions	V	IV	III	II	I	REASON

SCALE: V = OUTSIDE (APART), IV = OUTSIDE (CONNECTED), III = INSIDE (LOOSE), II = INSIDE (DEMOUNTABLE), I = INSIDE (LOOSE)

SUBSTANCE connection	V	IV	III	II	I	REASON

SCALE: V = LOOSE, IV = DEMOUNTABLE (PUNCTUALLY FIX), III = DEMOUNTABLE (LINEARLY FIX), II = PUNCTUALLY FIX (NON DEMOUNTABLE), I = LINEARLY FIX (NON DEMOUNTABLE)

SUBSTANCE remain./additions	V	IV	III	II	I	REASON

SCALE: V =]0;5]% ADDITIONS, IV =]5;25]% ADDITIONS, III =]25;50]% ADDITIONS, II =]50;75]% ADDITIONS, I =]75;100]% ADDITIONS

COMMENTS

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QUESTIONNAIRE A1 – DESIGN PROCESS DIFFERENCES IN PROTECTED AND NON PROTECTED BUILDINGS

DESIGNATION	DESIGNER [ARCHITECTURAL]	DATE	PAGE	
			9/9	**A1**

4DA: EVALUATION – DESIGNER ASSESSMENT

SELF	V	IV	III	II	I	REASON
performance						

SCALE: V = VERY GOOD, IV = GOOD, III = REASONABLE, II = BAD, I = VERY BAD

COMMENTS

AR: REPORT	YES	NOT IMPORTANT	NOT POSSIBLE	NOT WANTED	REASON
Post-design					-

COMMENTS

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QUESTIONNAIRE A2 – DESIGN PROCESS DIFFERENCES FOCUSING IN THE SAME PROTECTED BUILDING

GROUP	STUDENT NAME	DATE	PAGE 1/2	**A2**

Please fill out the questionnaire, as completed as possible. If in any question you feel that, you need more space than the presented, please make an indication and continue at the back of these papers. This information will not be used for other purposes than the doctoral research, Re-Architecture: lifespan rehabilitation of built heritage, in development by the architect Ana Rita Pereira, and supervised by Prof. Jouke Post and Dr. Ir. Peter Erkelens.

QUESTION	YES	NO	**A2.01**
Did you ever develop a rehabilitation design before?			

DESCRIPTION
Please describe it.

If the answer is no, please go directly to question A2.6

QUESTION	YES	NO	**A2.02**
Have you found the rehabilitation design interesting?			

DESCRIPTION
Please explain why and the relationship between the pre-existence and the new existence.

QUESTION	YOUR OWN	TEACHER	BOTH	**A2.03**
Which rehabilitation design process (methodology) did you follow?				

DESCRIPTION
Please describe chronologically the different stages and activities that you passed through, the approximately time spent (hours) and if it influenced the quality of the design (yes/no).

	TIME [HOURS]	YES	NO

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QUESTIONNAIRE A2 – DESIGN PROCESS DIFFERENCES FOCUSING IN THE SAME PROTECTED BUILDING

GROUP	STUDENT NAME	DATE	PAGE 2/2	**A2**

QUESTION	YES	NO	
Looking backwards, would you have followed a different design process?			**A2.04**

DESCRIPTION
What would you have changed?

QUESTION	YES	NO	
Did you need extra-support in any stage of the design process?			**A2.05**

DESCRIPTION
In which stage and where did you found the support? (e.g. library, teachers, colleagues, etc.)

QUESTION	YES	NO	
Do you consider important to rehabilitate existing buildings?			**A2.06**

DESCRIPTION
Please justify your consideration.

QUESTION	YES	NO	
Do you know any rehabilitation design, which you think successful?			**A2.07**

DESCRIPTION
Which are the building and the architect?

DESCRIPTION
How do you define a successful rehabilitation design?

We wish you a very inspiring trimester. Thank you for your contribution!

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QUESTIONNAIRE A3 – DESIGN PROCESS DIFFERENCES FOCUSING IN THE SAME PROTECTED BUILDING

GROUP	STUDENT NAME	DATE	PAGE 1/5	**A3**

Please fill out the questionnaire, as completed as possible. If in any question you feel that, you need more space than the presented, please make an indication and continue at the back of these papers. This information will not be used for other purposes than the doctoral research, Re-Architecture: lifespan rehabilitation of built heritage, in development by the architect Ana Rita Pereira, and supervised by Prof. Jouke Post and Dr. Ir. Peter Erkelens.

QUESTION
Choose in the list below your professional expectation(s) after your graduation. **A3.01**

ANSWER	YES	ANSWER	YES
Architect		Building Technology Engineer	
Building Process manager		Building Physics Engineer	
Urban planner		Structural Engineer	
Researcher / Professor			

QUESTION	YES	NO	
Have you found this rehabilitation design interesting?			**A3.02**

DESCRIPTION
Please explain why and the relationship between the pre-existence and the new existence.

DESCRIPTION
Describe the advantages your design (new existence) brings to the building + environment (pre-existence).

DESCRIPTION
Describe the most important architectural / technological factors, which have clearly influenced your design.

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QUESTIONNAIRE A3 – DESIGN PROCESS DIFFERENCES FOCUSING IN THE SAME PROTECTED BUILDING

GROUP	STUDENT NAME	DATE	PAGE 2/5	**A3**

QUESTION	YOUR OWN	TEACHER	BOTH	**A3.03**
Which rehabilitation design process (methodology) did you follow?				

DESCRIPTION
Please describe chronologically the different stages and activities that you passed through, the approximately time spent (hours) and if it influenced the quality of the design (yes/no).

	0-5	5-10	10-20	20-40	>40	YES	NO
	0-5	5-10	10-20	20-40	>40	YES	NO
	0-5	5-10	10-20	20-40	>40	YES	NO
	0-5	5-10	10-20	20-40	>40	YES	NO
	0-5	5-10	10-20	20-40	>40	YES	NO
	0-5	5-10	10-20	20-40	>40	YES	NO
	0-5	5-10	10-20	20-40	>40	YES	NO
	0-5	5-10	10-20	20-40	>40	YES	NO

QUESTION	YES	NO	**A3.04**
Did the theoretical support provided, concerning the different stages/activities of the design process (methodology), help you becoming more conscious of the building lifespan and its environment, raising the quality of your rehabilitation design?			

DESCRIPTION
Justify your consideration.

QUESTION	YES	NO	**A3.05**
Looking backwards, would you have followed a different design process?			

DESCRIPTION
Which stages/activities would you have done more and which less? Justify your consideration.

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QUESTIONNAIRE A3 – DESIGN PROCESS DIFFERENCES FOCUSING IN THE SAME PROTECTED BUILDING

GROUP	STUDENT NAME	DATE	PAGE 3/5	**A3**

QUESTION	YES	NO	
Did you need extra-support in any stage of the design process?			**A3.06**

DESCRIPTION
In which design stage and where did you found it? (E.g. library, internet, teachers, colleagues, etc.)

QUESTION	YES	NO	
Do you consider important to rehabilitate existing buildings?			**A3.07**

DESCRIPTION
Justify your consideration.

DESCRIPTION
Which buildings should be rehabilitated and which should be demolished?

QUESTION	YES	NO	
Do you know any rehabilitation design, which you think successful?			**A3.08**

DESCRIPTION
Which are the building and the architect?

DESCRIPTION
How do you define a successful rehabilitation design?

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QUESTIONNAIRE A3 – DESIGN PROCESS DIFFERENCES FOCUSING IN THE SAME PROTECTED BUILDING

GROUP	STUDENT NAME	DATE	PAGE 4/5	A3

QUESTION	YES	NO	A3.09
Would you classify your rehabilitation design successful?			

DESCRIPTION
Justify your consideration.

QUESTION	A3.10
How would you scale the importance given in your design to the:	

DESCRIPTION	V	IV	III	II	I	ANSWER	V	IV	III	II	I
Subtractions						Remainings					
Additions						Connections					

SCALE: V = VERY HIGH, IV = HIGH, III = REASONABLE, II = LOW, I = VERY LOW

QUESTION	YES	NO	A3.11
In your design, did you plan what to do with the subtracted elements?			

If the answer is yes, please select the classification that describes your main aim.

ANSWER	YES	ANSWER	YES	ANSWER	YES	ANSWER	YES
Reuse (building)		Reuse (site)		Recycle + Reuse		Recycle	

DESCRIPTION
Justify your consideration and give an example from your design.

QUESTION	YES	NO	A3.12
In your design, did you plan what to do with the building remainings?			

If the answer is yes, please select the classification that describes your main aim.

ANSWER	YES	ANSWER	YES	ANSWER	YES	ANSWER	YES
Arrest decay		Repair		Consolidate		Reinforce	

DESCRIPTION
Justify your consideration and give an example from your design.

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QUESTIONNAIRE A3 – DESIGN PROCESS DIFFERENCES FOCUSING IN THE SAME PROTECTED BUILDING

GROUP	STUDENT NAME	DATE	PAGE 5/5	**A3**

QUESTION	YES	NO	**A3.13**
In your design, did you specially plan where to locate the additions?			

If the answer is yes, please select the classification that describes your main aim.

ANSWER	YES	ANSWER	YES	ANSWER	YES	ANSWER	YES
Outside (apart)		Inside (loose)		Inside (demount.)		Inside (connect.)	

DESCRIPTION
Justify your consideration and give an example from your design.

QUESTION	YES	NO	**A3.14**
In your design, did you specially plan how connections should be?			

If the answer is yes, please select the classification that describes your main aim.

ANSWER	YES	ANSWER	YES	ANSWER	YES	ANSWER	YES
Loose		Demountable		Punctually Fix		Totally Fix	

DESCRIPTION
Justify your consideration and give an example from your design.

QUESTION	**A3.15**
Considering the original building plan (100%), which were approximately the percentage of subtractions (%) and the percentage of remainings (%)?	

DESCRIPTION	0-05	05-25	25-50	50-75	75-100	ANSWER	95-100	75-95	50-75	25-50	0-25
Subtractions						Remainings					

QUESTION	**A3.16**
Considering the original building plan (100%), which were approximately the percentage of additions (%) and the percentage of remainings (%)?	

DESCRIPTION	0-05	05-25	25-50	50-75	75-100	ANSWER	95-100	75-95	50-75	25-50	0-25
Additions						Remainings					

We hope you had an inspiring trimester. Thank you for your contribution!
Every additional remark is welcome, so feel free to expose it.

Appendix 6: Notices on RE-ARCHITECTURE®

Planned notices

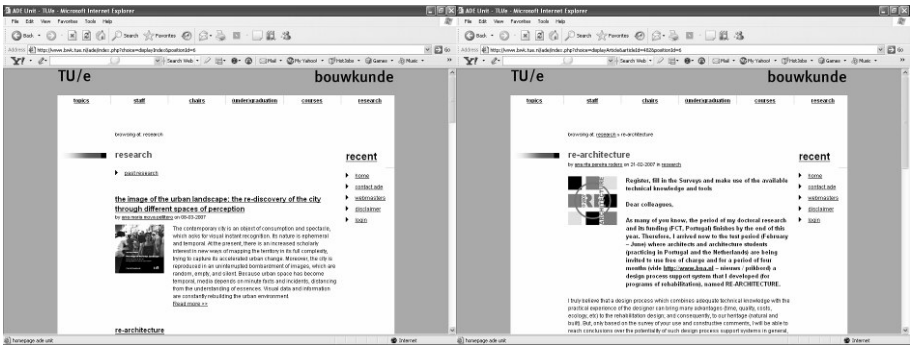

Figure 141 – The research section, in the website of ADE[28]

Figure 142 – The notice "RE-ARCHITECTURE", in the website of ADE[29]

[28] Davits, T. & Pereira Roders, A. (2007) *RE-ARCHITECTURE,* Eindhoven: Technische Universiteit Eindhoven, 21 February 2007, available at: http://www.bwk.tue.nl/ade/index.php?choice=displayIndex&positionId=6 (accessed in 20-07-2007)

[29] *Ibidem*, available at: http://www.bwk.tue.nl/ade/index.php?choice=displayArticle&articleId=482&positionId=6 (accessed in 20-07-2007)

Figure 143 – The Dutch version of the article [30]

Figure 144 – The Portuguese version of the article[31]

Figure 145 – The *Prikbord,* in the website of BNA[32]

Figure 146 – The notice "*Oproep www.re-architecture.eu"*, in the website of BNA [33]

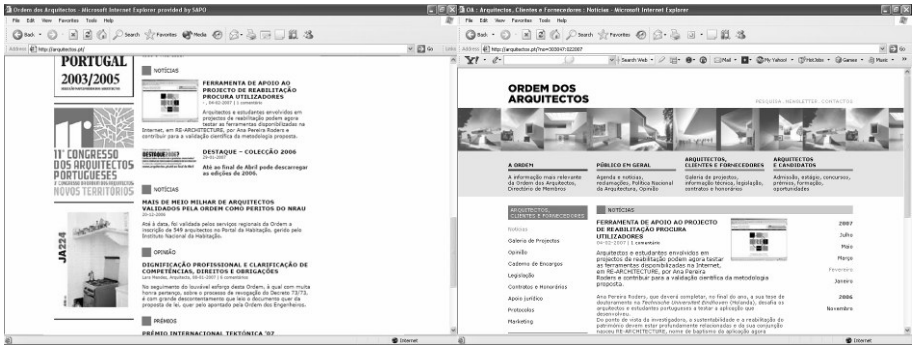

Figure 147 – The Homepage in the website of O.A. [34]

Figure 148 – The notice "Ferramenta de apoio ao projecto de reabilitação procura utilizadores", in the website of O.A.[35]

[30] Pereira Roders, A. et al. (2007) *Van gezond verstand naar wetenschappelijke objectiviteit,* Eindhoven: Technische Universiteit Eindhoven
[31] Pereira Roders, A. et al. (2007) *Do senso comum à objectividade científica,* Arquitectura & Vida, January 2007, Lisboa: Loja da Imagem
[32] Schaik, M. van (2007) *Oproep www.re-architecture.eu*, Rotterdam: Bouwkunst Bond van Nederlandse Architecten (BNA), posted in 31-01-2007, available at: www.bna.nl (accessed in 31-01-2007)
[33] *Ibidem*
[34] Meneses, C. (2007) *Ferramenta de apoio ao projecto de reabilitação procura utilizadores*, Lisboa: Ordem dos Arquitectos (O.A.), posted in 04-02-2007, available at: http://arquitectos.pt/ (accessed in 04-02-2007)
[35] *Ibidem*, available at: http://arquitectos.pt/?no=303047:022007 (accessed in 20-07-2007)

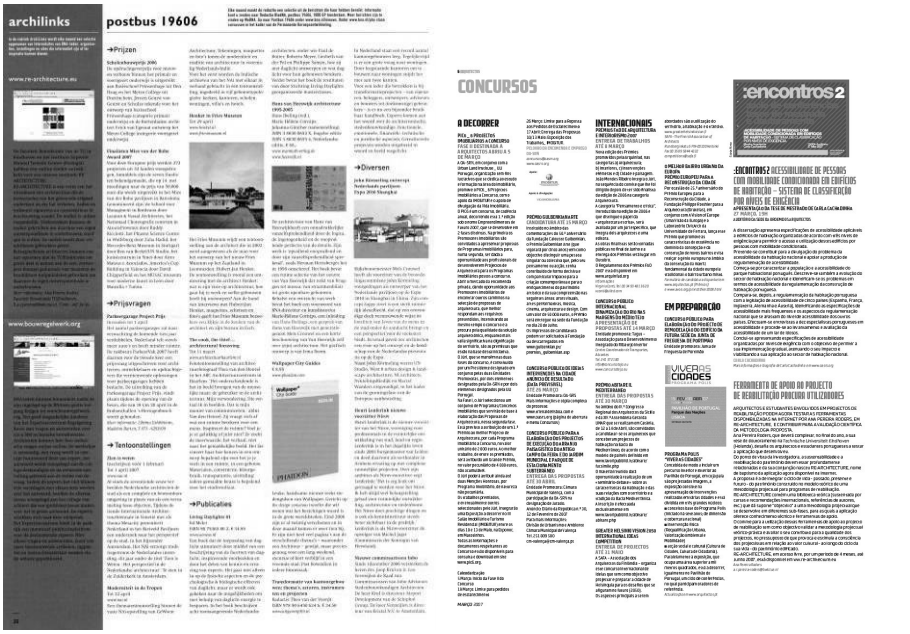

Figure 149 – The notice "*Oproep www.re-architecture.eu*", in the newsletter BladNA[36]

Figure 150 – The notice "*Ferramenta de apoio ao projecto de reabilitação procura utilizadores*", in the newsletter Arquitectos[37]

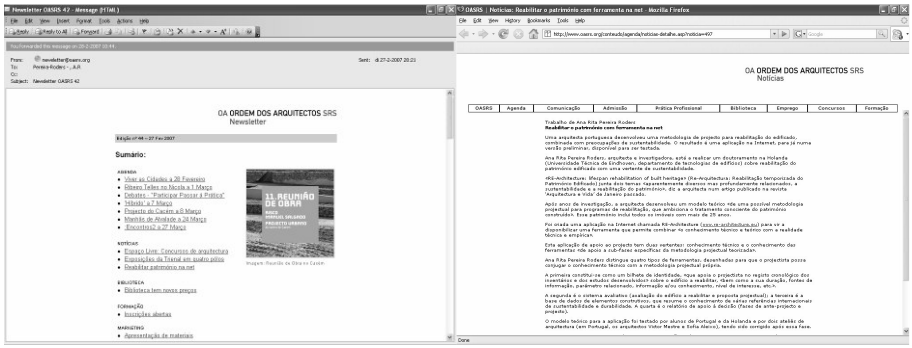

Figure 151 – The newsletter OASRS 42

Figure 152 – The notice "*Reabilitar o património com ferramenta na net*", in the newsletter OASRS 42[38]

[36] Schaik, M. van (2007) *Archilink: www.re-architecture.eu,* newsletter BladNA, n. 3, March 2007, Rotterdam: Bouwkunst Bond van Nederlandse Architecten (BNA), p.20

[37] Meneses, C. (2007) *Ferramenta de apoio ao projecto de reabilitação procura utilizadores,* newsletter Arquitectos, year XiV n. 150, March 2007, Lisboa: Ordem dos Arquitectos (O.A.), p. 6

[38] Meneses, C. (2007) *Reabilitar o património com ferramenta na net,* newsletter OASRS 42, posted in 27-02-2007: Lisboa: Ordem dos Arquitectos (via e-mail)

Figure 153 – The notice "*RE-ARCHITECTURE*", in the Renovatie[39]

Figure 154 – The notice "*Uitnodiging*", in the BouwIQ[40]

- **Spontaneous notices**

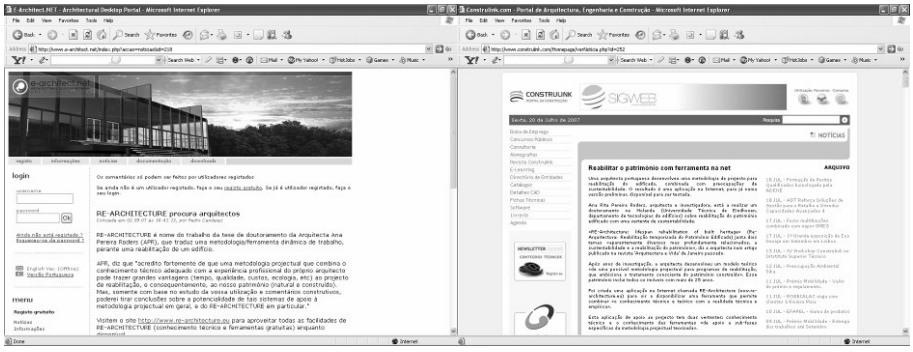

Figure 155 – The notice "*RE-ARCHITECTURE procura arquitectos*", in E-Architect[41]

[39] Koning, P. (2007) *RE-ARCHITECTURE*, year 2 n. 1, February 2007: Boxtel: Æneas, p. 4
[40] Bruysters, J. (2007) *Uitnodiging,* BouwIQ, year 12 n. 2, March 2007, Boxtel: Æneas, p. 5
[41] Candeias, J. P. (2007) *RE-ARCHITECTURE procura arquitectos,* Portimão: E-Architect, posted in 09-02-2007, available at: http://www.e-architect.net/index.php?accao=noticias&id=218 (accessed in 20-07-2007)

Figure 156 – The notice "*Reabilitar o património com ferramenta na net*", in Construlink [42]

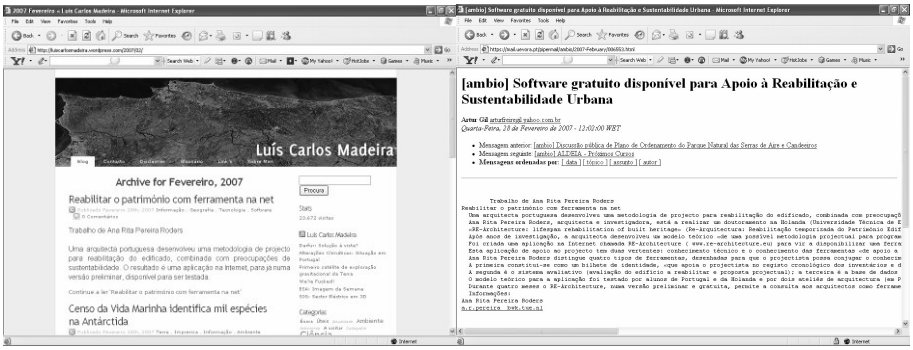

Figure 157 – The notice "*Reabilitar o património com ferramenta na net*", in Wordpress[43]

Figure 158 – The notice "*Software gratuito disponível para Apoio à Reabilitação e Sustentabilidade Urbana*", in Ambio [44]\

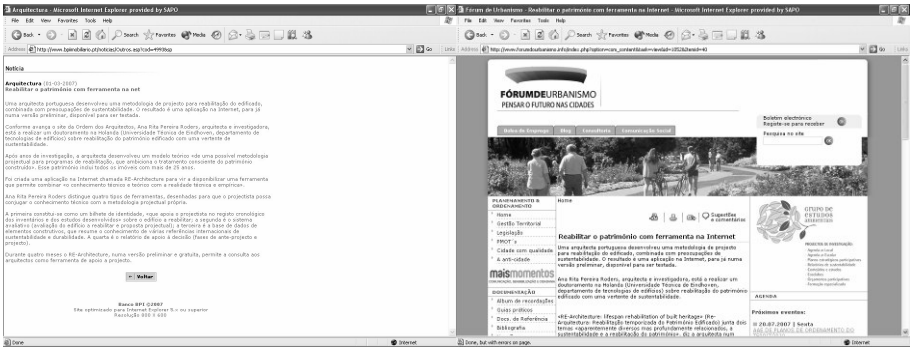

Figure 159 – The notice "*Reabilitar o património com ferramenta na net*", in BPI Imobiliário[45]

Figure 160 – The notice "*Reabilitar o património com ferramenta na net*", in Fórum de Urbanismo[46]

[42] Patrocínio, T. (2007) *Reabilitar o património com ferramenta na net,* Lisboa: Construlink, posted in 22-02-2007, available at: http://www.construlink.com/Homepage/verNoticia.php?id=252 (accessed in 20-07-2007)
[43] Madeira, L. C. (2007) *Reabilitar o património com ferramenta na net,* Évora: Wordpress, posted in 09-02-2007, available at: http://luiscarlosmadeira.wordpress.com/2007/02/ (accessed in 20-07-2007)
[44] Gil, A. (2007) *Software gratuito disponível para Apoio à Reabilitação e Sustentabilidade Urbana,* Évora: Ambio (Universidade de Évora), posted in 28-02-2007, available at: https://mail.uevora.pt/pipermail/ambio/2007-February/006553.html (accessed in 20-07-2007)
[45] BPI (2007) *Reabilitar o património com ferramenta na net*, Lisboa: BPI Imobiliário, posted in 01-03-2007, available at: http://www.bpiimobiliario.pt/noticias/Outros.asp?cod=4993&sp=n (accessed in 20-07-2007)
[46] Fórum do Urbanismo (2007) *Reabilitar o património com ferramenta na net,* Porto: Fórum do Urbanismo (Universidade Católica Portuguesa), posted in 28-02-2007, available at: http://www.forumdourbanismo.info/index.php?option=com_contact&Itemid=43 (accessed in 20-07-2007)

Appendix 7: The team work method

analysis			
3DI	618065	**Frederiks (Hannah)**	
	603910	Gabriëlse A. (Astrid)	
	553761	Leussink M.I.K. (Marieke)	
	578494	Bakker (Sijmen)	
	541759	Zajkowska (Anna)	
	622437	Alves (Bruno)	
	611166	Vieira (João)	
3OI	536997	**Blacha (Monique)**	
	510902	Tulp (Daniel)	
	621052	Ketelaars J. (Joris)	
	549728	Radermacher J. (Joep)	
	613731	Droog M.J. (Marijn)	
	620830	Westerlo B. van de (Bas)	
	611082	Arencibia (Manuel)	
	611464	García Lisón Jorge (Elena)	
3PI	617436	**Brouwer (Marit)**	
	535033	Bus B.J.A. (Bram)	
	539422	Berg S.J.H. van de (Sanne)	
	539686	Ngo N.H. (Wen)	
	622926	Moeiro (Gonçalo)	
	624350	Chiu (Langzi)	

synthesis			
3ES	618065	**Frederiks (Hannah)**	
	603910	Gabriëlse A. (Astrid)	
	553761	Leussink M.I.K. (Marieke)	
	539422	Berg S.J.H. van de (Sanne)	
	539686	Ngo N.H. (Wen)	
	549728	Radermacher J. (Joep)	
	613731	Droog M.J. (Marijn)	
3SS	536997	**Blacha (Monique)**	
	510902	Tulp (Daniel)	
	621052	Ketelaars J. (Joris)	
	622437	Alves (Bruno)	
	611166	Vieira (João)	
	622926	Moeiro (Gonçalo)	
	624350	Chiu (Langzi)	
3CS	617436	Brouwer (Marit)	
	535033	**Bus B.J.A. (Bram)**	
	620830	Westerlo B. van de (Bas)	
	578494	Bakker (Sijmen)	
	541759	Zajkowska (Anna)	
	611082	Arencibia (Manuel)	
	611464	García Lisón Jorge (Elena)	

evaluation			
3EA	618065	**Frederiks (Hannah)**	
	603910	Gabriëlse A. (Astrid)	
	553761	Leussink M.I.K. (Marieke)	
	622926	Moeiro (Gonçalo)	
	624350	Chiu (Langzi)	
	611082	Arencibia (Manuel)	
	611464	García Lisón Jorge (Elena)	
3SA	536997	**Blacha (Monique)**	
	510902	Tulp (Daniel)	
	621052	Ketelaars J. (Joris)	
	539422	Berg S.J.H. van de (Sanne)	
	539686	Ngo N.H. (Wen)	
	578494	Bakker (Sijmen)	
	541759	Zajkowska (Anna)	
3CA	617436	Brouwer (Marit)	
	535033	**Bus B.J.A. (Bram)**	
	620830	Westerlo B. van de (Bas)	
	622437	Alves (Bruno)	
	611166	Vieira (João)	
	549728	Radermacher J. (Joep)	
	613731	Droog M.J. (Marijn)	

Table 9 – The team work method for the Pre-design stage (Experimental group from the Netherlands)

analysis			
3DI	**1788**	**Alexandre Mendes**	
	1808	Sandra Gaio	
	1835	Paulo Matias	
	1809	Sérgio Hespanhol	
	1823	Gonçalo Valente	
3OI	**1828**	**Tânia Farias**	
	1811	Nuno Soares	
	1789	Lionel Estriga	
	1787	Rui Chaves	
	1791	Tânia Costa	
3PI	**1838**	**José Nabiça**	
	1832	Carlo Palma	
	2100	John Wilson	
	1867	Ricardo Francisco	

synthesis			
3ES	**1788**	**Alexandre Mendes**	
	1808	Sandra Gaio	
	1823	Gonçalo Valente	
	1787	Rui Chaves	
	2100	John Wilson	
3SS	**1828**	**Tânia Farias**	
	1811	Nuno Soares	
	1835	Paulo Matias	
	1867	Ricardo Francisco	
3CS	**1838**	**José Nabiça**	
	1832	Carlo Palma	
	1809	Sérgio Hespanhol	
	1789	Lionel Estriga	
	1791	Tânia Costa	

evaluation			
3EA	**1788**	**Alexandre Mendes**	
	1808	Sandra Gaio	
	1867	Ricardo Francisco	
	1791	Tânia Costa	
	1789	Lionel Estriga	
3SA	**1828**	**Tânia Farias**	
	1811	Nuno Soares	
	2100	John Wilson	
	1809	Sérgio Hespanhol	
3CA	**1838**	**José Nabiça**	
	1832	Carlo Palma	
	1823	Gonçalo Valente	
	1787	Rui Chaves	
	1835	Paulo Matias	

Table 10 – The team work method for the Pre-design stage (Experimental group from Portugal)

■ Appendix 8: Process Mining

When converting the usage data to ProM (*vide* Chapter 6.3.1.1), the number of designers was reduced to **140**, less than the value reached at the statistics earlier presented in Chapter 6.3.1.3. The identified designers were more architects than students, and more from Portugal than from the Netherlands (*vide* Figure 161).

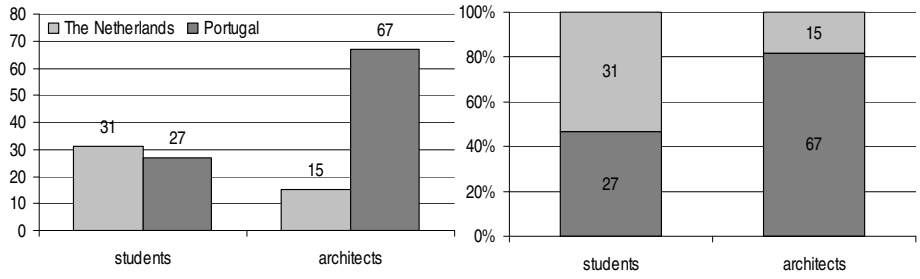

Figure 161 – The universe of RE-ARCHITECTURE® users, who have created a design process

The design process theorised in this doctoral research was structured into a sequential process of stages, sub-stages and respective activities. On a general sense, the second stage would be dependant on this first; just as at the sub-stages, where e.g. a proper evaluation should always progress from the synthesis; which should be ground at the sources inventoried during the analysis sub-stage.

Despite the apparent rationality, process mining techniques revealed that designers have found their own manner of using RE-ARCHITECTURE®; to sustain their design processes and respective results.

As a first attempt, a mined model was created containing all the events in the log (i.e. a model that does not abstract from low frequent events and/or dependencies between these events). The result was considerably unstructured model (*vide* Figure 162). In fact, such process is what process mining experts call as “spaghetti model”. This result does not mean that the process mining technique was not able to provide a clear model.

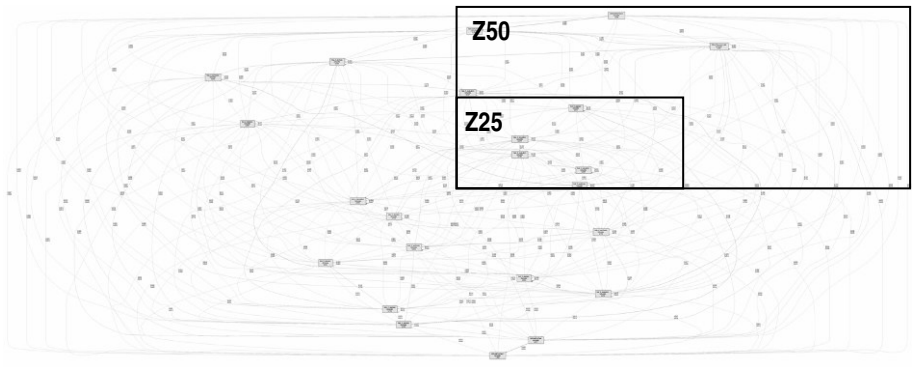

Figure 162 – Mined model with all events in the log and their mined dependencies (Alves de Medeiros)

This means that the usage behaviour of RE-ARCHITECTURE® users is generally wide-ranging and unstructured. Therefore, the Fuzzy Miner process mining algorithm is a suitable choice. Figure 163 and Figure 164 contain the zoomed-in view of the highlighted parts. Particularly, in Figure 164 such characteristic is quite visible, where the same "activity node" (or event) has several correlated "activity nodes".

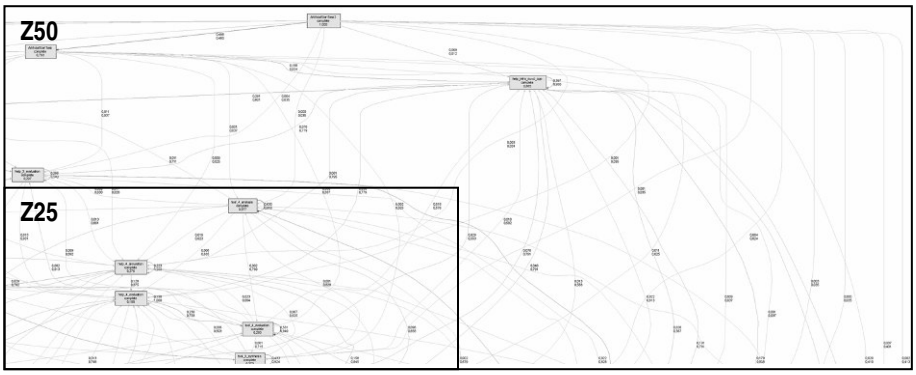

Figure 163 – Zoomed-in (50%) view of the highlighted area Z50 in Figure 162

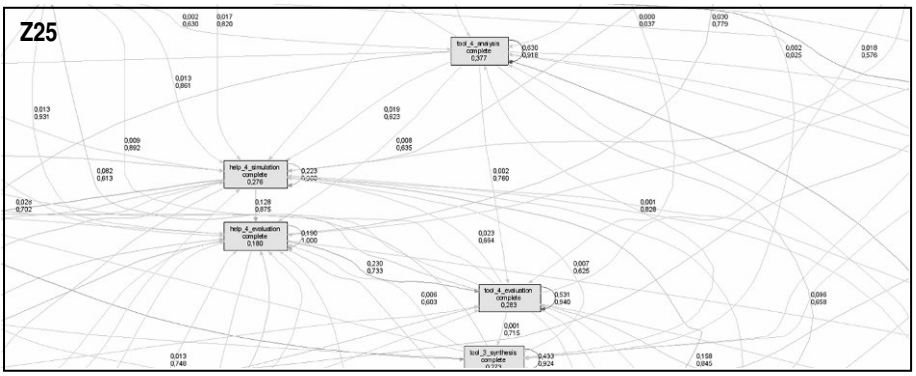

Figure 164 - Zoomed-in (25%) view of the highlighted area Z25 in Figure 162

The desired level of abstraction is defined by metrics. In a nutshell, two metrics of the Fuzzy Miner were used by the researcher to survey the results presented in this section. The metrics are the **significance** and the **correlation**. While significance regards the "relative importance of the behaviour"[47], correlation regards "how closely related two events following one another are" [48].

According to Günther & Aalst; when clustering process models towards its simplification, behaviours of **highly significance** are **preserved**; behaviours of **less significance** but **high correlation** are **aggregated** and hidden into clusters; and behaviours of **low significance** and **correlation** are **abstracted** and removed from the process model.

[47] Günther, C. W. & Aalst, W. M. P. van der (2007) *Fuzzy Mining – Adaptive Process Simplification based on Multi-Perspective Metrics*
[48] *Ibidem*

Additionally to these two metrics, the researcher also used the option “best edges” provided by the Fuzzy Miner. This option keeps just the best dependency between any two activities (or events) in the model. The best dependency is the one with the highest significance. For instance, the model in Figure 165 shows the “best edges” for the spaghetti-like model in Figure 166.

Considering Figure 167, the squares represent the activities (or events). The numbers inside the squares represent the significance of the event. The first and second numbers next to the dependencies (or arcs) respectively indicate the significance and the correlation of these dependencies. Additionally, the researcher has manually highlighted some of the events by attaching numbers (like N3.06).

When surveying the “best edges” result of the global process model (*vide* Figure 168), it was possible to verify that, the Fuzzy Miner had identified the guidelines (help) and tools available at most stages (e.g. Analysis) from both pre-design (3) and design (4) stages, in a considerably structured pattern. However, the values of significance or of correlation differed.

It was necessary to apply higher levels of simplification and verify if the previously mentioned behaviours – preservation, aggregation and abstraction – would prevail and reveal more accurate results. In fact, when comparing Figure 169 with Figure 170 it was possible to verify the following variations.

The researcher highlighted some of the nodes in the models returned by the Fuzzy Miner. The nodes related to the pre-design stage got a three at their code and the nodes related to the design stage got a three at their code, similar to the default codification of the nodes (e.g. tool_4_simulation). Whenever the researcher is describing values of frequency, significance and correlation the following assumptions were considered: **0-20%** as **very low**; **20-40%** as **low**; **40-60%** as **reasonable**; **60-80%** as **high** and **80-100%** of **very high** value.

There were nine “nodes”, which were assessed significant enough to be preserved in the result. To distinguish them from the nine nodes aggregated in Cluster 23 or in Cluster 24 and from the one abstracted, such significant “nodes” were highlighted in black bold. Moreover, the abstracted “node”, illustrating the guidelines of the Pre-Design stage / **synthesis** sub-stage (help_3_synthesis), was also whitewashed (*vide* Figure 169).

Most “nodes” preserved were illustrating tools, except for the node illustrating the guidelines of the Pre-Design stage / **analysis** sub-stage (help_3_analysis). However, this particular node had low significance (29%), but probably due to the high correlation (73%) with its tool (tool_3_analysis) and initial page of RE-ARCHITECTURE® after logging in (help_intro_concl_app), it has been kept in the mined model.

When doing a full survey from the most frequent to the least used frequent tool; the tool of the Pre-Design stage / **analysis** sub-stage (tools_3_analysis) was the most frequently used (71%) by the designers. Furthermore, the self-dependency (or serf-arc) shows that the designers played with different aspects of this tool, since this self-dependency has very high significance (100%) and correlation (91%). Secondly, but very closely scored (68%), was the tool of the Design stage / **simulation** sub-stage (tools_4_simulation), where again the self-dependency has a very high significance (80%) and correlation (90%).

The tool of the Design stage / **decision** sub-stage (tools_4_decision) was the third most frequently used (60%). This tool has a self-dependency with low significance (33%), but high correlation (91%). Equally frequent (55%) were two tools of the Design stage; available to sustain the **analysis** sub-stage (tools_4_analysis) with high significance (63%) and very high correlation (92%); and the **evaluation** sub-stage (tools_4_evaluation), with reasonable significance (53%) and very high correlation (94%).

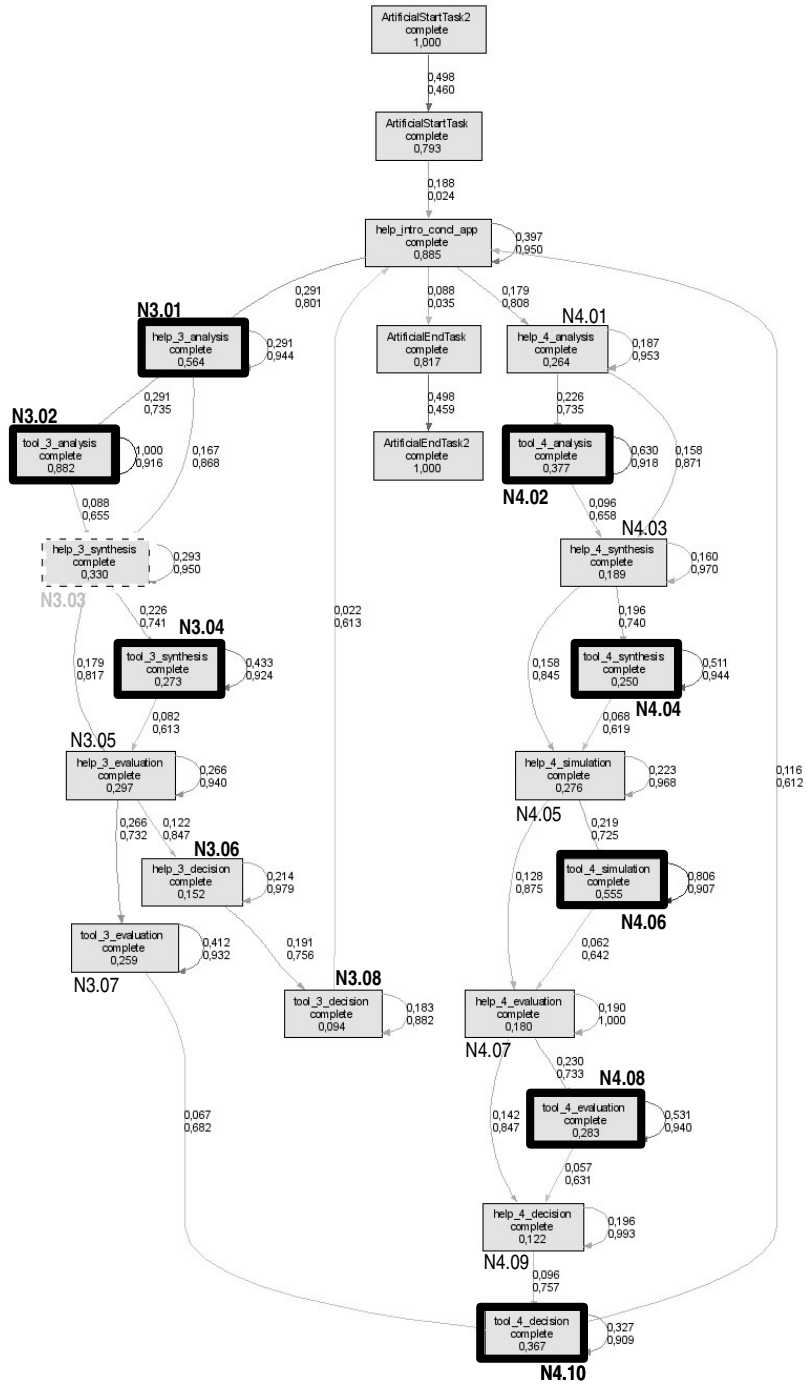

Figure 169 – Mined model containing the “best edges” (Alves de Medeiros & Pereira Roders)

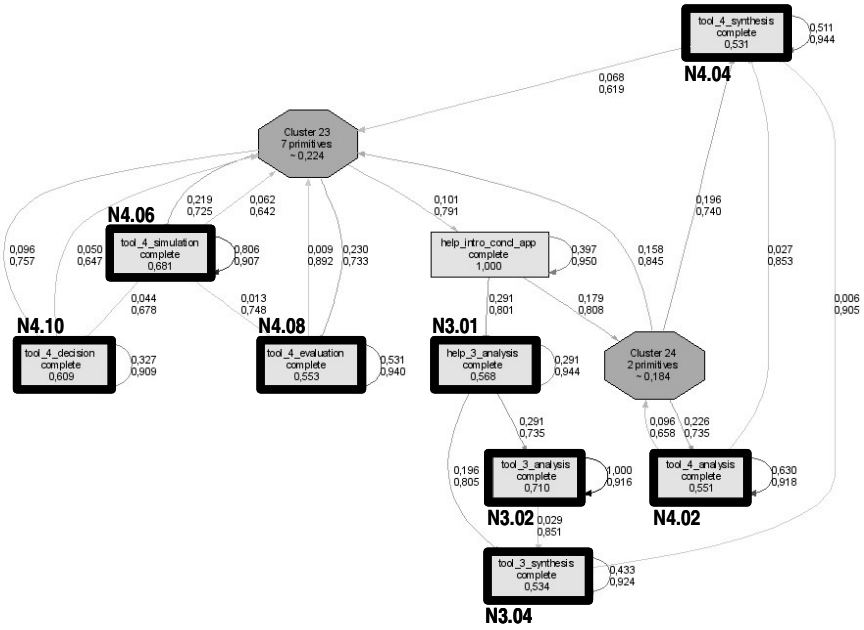

Figure 170 – Mined model when the default settings of the Fuzzy Miner are used (Alves de Medeiros & Pereira Roders). Note that the events were grouped into clusters.

Both tools of the **synthesis** sub-stage at both Pre-design and Design stages were used with a reasonable frequency (53%). Their significance was assessed as reasonable, few more at the Design (51%) than at the Pre-Design stage (43%). Similarly, the correlation was assessed as very high, few more at the Design (94%) than at the Pre-Design stage (92%).

With the purpose to understand their particular preferences and differences towards the global process model, the logs have been filtered according to the two variables; country (values: the Netherlands and Portugal) and occupation (students and architects). The level of simplification (default) was similar to the one previously presented, where Fuzzy Miner voluntarily abstracts the less significant; aggregates the less significant but with high correlations and highlights the ones of high significance.

The mined model, illustrating the behaviour of the students from the Netherlands (*vide* Figure 171), did not have more "nodes" than the mined model in Figure 170. Instead, there were two "nodes" which were not so significant that have been aggregated. Those were respectively, the guidelines of the Pre-Design stage / **analysis** sub-stage (help_3_analysis) and the tool of the Design stage / **evaluation** sub-stage (tool_4_evaluation).

Moreover, most "nodes" increased their values of frequency. The three "nodes" of the tool of the Pre-Design stage, for the **synthesis** sub-stage and of the tools of the Design stage, for both **analysis** and **decision** sub-stage increased from reasonable to high. The "nodes" of the tool of the Pre-Design for the **analysis** sub-stage and of the tool of the Design stage for the **simulation** stage increased from high to very high.

Last, the biggest raise of frequency was the "node" of the tool of the Design stage, for the **synthesis** sub-stage, from reasonable (53%) till very high (84%). However, despite the increases of frequency, most "nodes" have also reduced both significance and correlation. Though, there is the exception of the tool of the Design stage / **analysis** sub-stage

(tool_4_analysis) which has increased its significance within the high range of values; and has increased its frequency, from reasonable (55%) to high (67%).

The behaviour of the architects, was indeed deviant from the behaviour of the students from the Netherlands (*vide* Figure 171) and from the total behaviour of the designers (*vide* Figure 170). Besides the fact that the two "nodes" of the tools of the Design Stage, for the **evaluation** and the **decision** sub-stages were aggregated; there were also four new "nodes" inexistent at the global process model. All this four "nodes" illustrated guidelines; two from the Pre-Design, for the **synthesis** and **decision** sub-stages; and two from the Design stage, for the **simulation** and **evaluation** sub-stages.

When comparing the results of the whole group of designers with the results of the architects from the Netherlands, it is possible to verify that six "nodes" increased, while four decreased their frequency. The two "nodes" that increased of the Pre-Design stage were the guidelines of the **decision** sub-stage, from very low (15%) to high (68%); and the tool of the **analysis** sub-stage, from high (71%) to very high (86%). This means that the Dutch architects have used this tools relatively more than the group of designers as a whole.

The other four "nodes" that increased of the Design stage were; the guidelines of the Simulation, within the reasonable range (from 28% to 30%); and of the **evaluation** sub-stage, from very low (15%) to high (68%); and the tools of the **synthesis** stage, from reasonable (53%) to high (62%); and of the **simulation** stage, from high (68%) to very high (93%).

Four were the "nodes" that decreased frequency. Only one was from the Design stage, the tool of the **analysis** sub-stage, from reasonable (55%) to low (26%). The remaining three of the Pre-Design stage regarded the guidelines of the **analysis** sub-stage, within the reasonable range (from 57% to 44%); and of the **synthesis** sub-stage, within the low range (from 33% to 27%). Last, the tool of the **synthesis** sub-stage decreased, also within the low range (from 27% to 26%).

All values of correlation decreased at the respective "nodes", as well as, the majority of the significance assessments. The only "nodes" that increased significance were the ones illustrating both guidelines and tool of the **simulation** sub-stage, and particularly the tool achieved the maximum significance (100%). Not so considerably high, but still facing an increase of significance, were the guidelines of the Pre-Design stage / **analysis** sub-stage.

The students from Portugal, got the process model most similar to the process model illustrating the behaviour of the designers (*vide* Figure 172). The only difference at the level of the "nodes" was the aggregation of the tool of the **synthesis** sub-stage, from the Pre-Design stage into the Cluster 24.

Most values of frequency, significance and correlation decreased. There were, however, "nodes" which increased both frequency and significance. Those were the "nodes" of the tools of both Simulation and **evaluation** sub-stages, from the Design stage. Respectively, the tool of the **simulation** stage rose from high (68%) into very high (85%) frequency of use and reached the maximum of significance (100%); while the tool of the **evaluation** stage rose from reasonable (55%) into high (67%).

Similarly to what happened with the designers from the Netherlands, the behaviour of the students and architects from Portugal was also deviant (*vide*). Even if the architects also had one "node" emerging into their process model, the "node" was illustrating the guidelines of the **decision** sub-stage, from the Design stage. Nonetheless, its frequency (38%) or significance (28%) was of low value; such "node" had very high correlation.

Two "nodes" were aggregated. Similarly to the architects from the Netherlands, one of the missing "nodes" was the tool of the **evaluation** sub-stage, from the Design stage. The

second one is the tool of the **synthesis** sub-stage, also from the Design stage. From the remaining "nodes", three decreased and four increased frequency.

The tool of the **analysis** sub-stage at the Design stage was the most frequently used (78%) by the architects from Portugal, globally assessed of reasonable frequency (55%) and now of high frequency (78%). From the other three "nodes" that saw their frequency levels increased, two were from the Design stage; the tool of **evaluation** sub-stage, from reasonable (55%) to high (69%) and the guidelines of the **decision** sub-stage, from very low (12%) to reasonable (38%). The third and last was the illustration of the guidelines of the Pre-Design stage / **analysis** subs-stage, also from reasonable (57%) to high (62%).

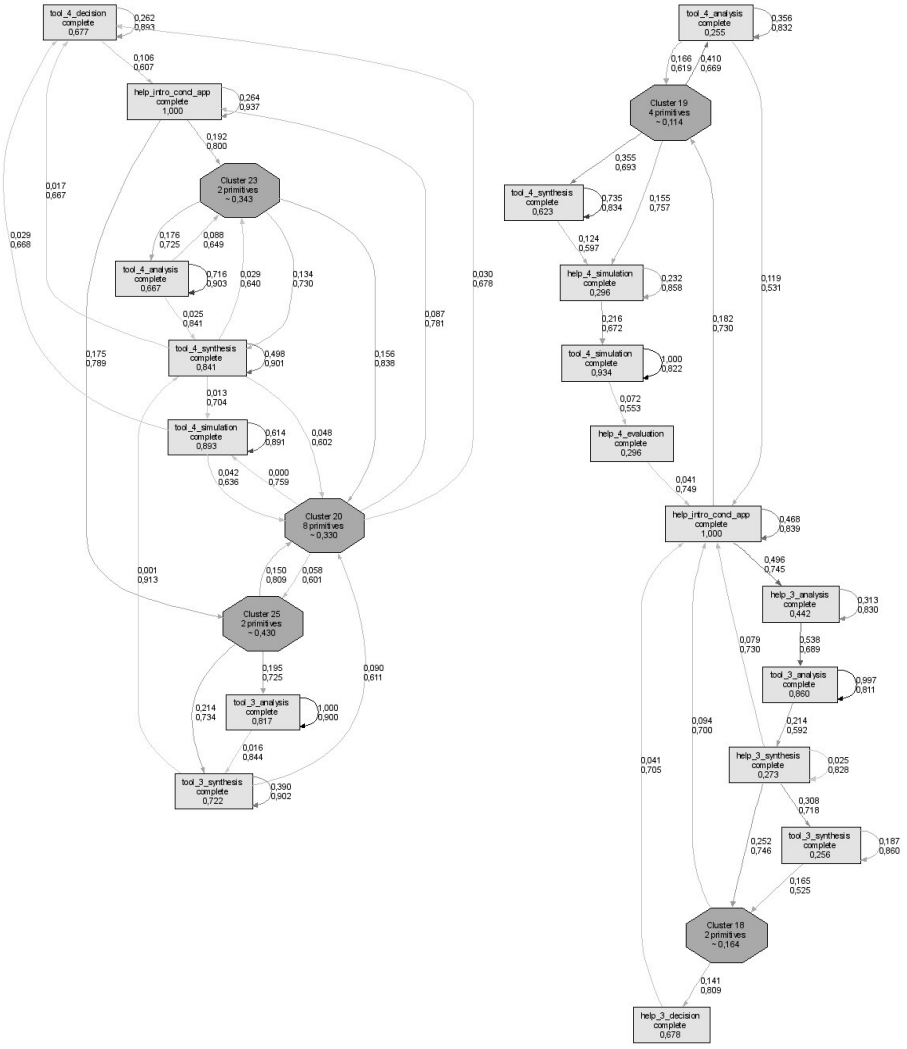

Figure 171 – The mined model for the students and architects from the Netherlands (Alves de Medeiros)

The tool of the Design stage / **decision** sub-stage was together with the tools of the Pre-Design stage / **analysis** and Synthesis sub-stages, the ones which decreased frequency at the group of architects, from Portugal. The first tool decreased from high to reasonable (from 60% to 44%) the other two decreased still within their own range. Respectively, the tool of the **analysis** sub-stage remained at the high frequency (from 71% to 63%) and the tool of the **synthesis** sub-stage remained at the reasonable frequency (from 53% to 42%).

When overviewing all graphs illustrating the mined models, it is possible to verify the success achieved by the tool of the Pre-Design stage / **analysis** sub-stage (N3.02); with its high values of frequency, and very high values of significance and correlation. Except for the architects from Portugal, the tool of the Design stage / **simulation** sub-stage (N4.06) had also frequency, very high significance and correlation.

From Portugal, the tool of the **synthesis** sub-stage was hardly used by the students on the Pre-Design stage (N3.04); and by the architects at the Design stage (N4.04). Inversely, the guidelines of the **synthesis** sub-stage (N3.03), at the Pre-Design stage, were considered only by these students. Further, the guidelines of the **analysis** sub-stage (N3.01), at the Pre-Design stage, were used by all groups but the students, from the Netherlands.

The tool of the **analysis** sub-stage (N3.01), at the Design stage, was considered by all groups; but not with as much frequency as the similar tool at the Pre-Design stage. Last, only the students and architects from Portugal made reasonable use of the **evaluation** sub-stage (N4.08). Moreover, together with the students from the Netherlands, these three groups made use of the tool of the **decision** sub-stage (N4.10), from the Design stage.

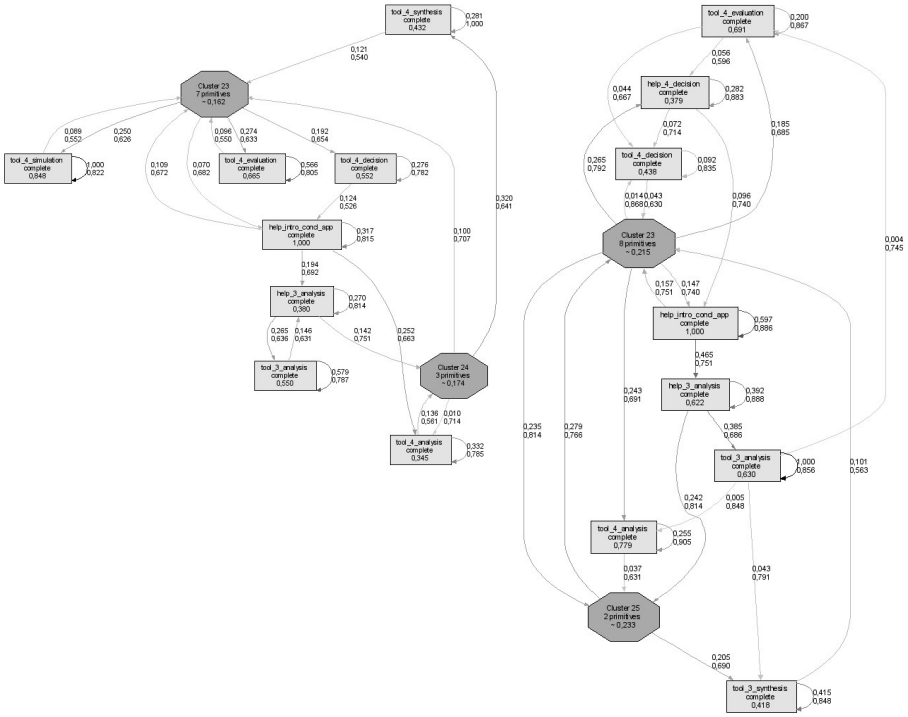

Figure 172 – The mined model for the students and architects from Portugal (Alves de Medeiros)