

Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI (Eds.)

PLAN IT SMART

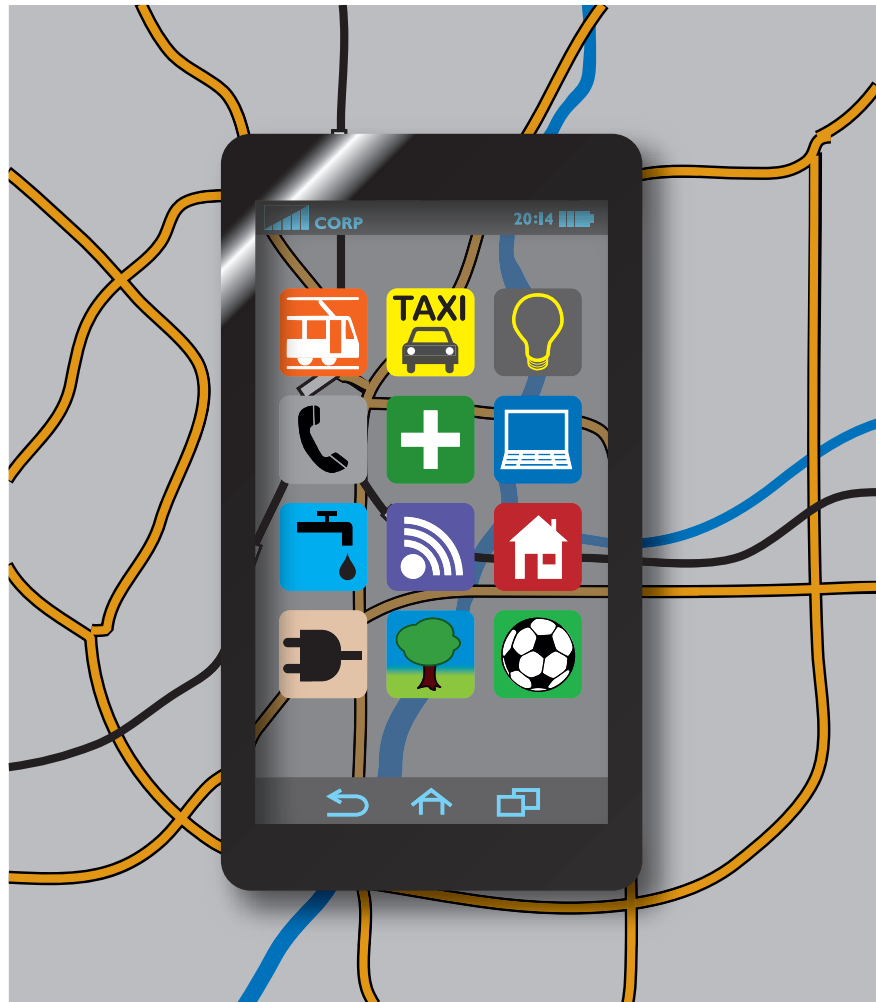
CLEVER SOLUTIONS FOR SMART CITIES

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Clever Solutions for Smart Cities**

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Edited by

Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI

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Table of contents – Inhaltsverzeichnis:

PREFACE	5
Manfred SCHRENK, Conference Director.....	5
A Back Step before Proposing Smart Interventions. Fitting People Needs with Innovations	15
Aniana Mereu.....	15
A Simulation of Land Use/Cover Change for Urbanization on Chennai Metropolitan Area, India	25
Vijayalakshmi Rajendran, Toshiyuki Kaneda.....	25
A Smart Researching and Planning Tool for the Neuralgic Urban Zone: 3D-ZPA	35
Angelika Psenner.....	35
A Visionary Study on Urban Neighbourhood Models in Kabul City Based on Actual Surveys	45
Sofia Sahab, Rim Meziani, Toshiyuki Kaneda.....	45
An Urban Sensing System as Backbone of Smart Cities	55
Benjamin Allbach, Sascha Henninger, Eugen Deitche.....	55
Ancient Smartness of Tomorrow	65
Cecilia Scoppetta.....	65
ARchitecture – Augmented Reality Techniques and Use Cases in Architecture and Urban Planning	75
Daniel Broschart, Peter Zeile.....	75
Assessing Smart Locations – the MORECO Project	83
Susanne Franz, Ulrike Reutter, Eva Haslauer, Dagmar Schnürch, Thomas Prinz.....	83
Assessment of BIM Potentials in Interdisciplinary Planning through Student Experiment and Practical Case Study	91
Iva Kovacic, Lars Oberwinter, Christoph Achammer, Michael Filzmoser.....	91
Automated Urban Management Processes: Integrating a Graphical Editor for Modular Domain-Specific Languages into a 3D GIS	99
Michel Krämer, Andreas Stein.....	99
Building Smart Applications for Smart Cities – IGIS-based Architectural Framework	109
Alexander Vodyaho, Nataly Zhukova.....	109
Challenges and Opportunities to Develop a Smart City: A Case Study of Gold Coast, Australia	119
Bhishna Bajracharya, David Cattell, Isara Khanjanasthiti.....	119
Checking Smartness “On the Ground”: Historically Rooted Dilemmas, Future Challenges and Visions for a Smarter Metropolitan Area of Rome	131
Cecilia Scoppetta.....	131
CitInES Project – Tool for the Sustainable Energy Action Plan for Cities	141
Nicolás Pardo García, Rébecca Aron, Clémence Bénévent, Sofia Burioli, Silvia Morigi.....	141
City in Transition: Urban Open Innovation Environments as a Radical Innovation	151
Gert-Joost Peek, Peter Troxler.....	151
Competition between Cities and Regions in Europe – Can Smart Spatial Planning Interact with Gravitational Site Location Models for External Investment?	161
Jan Zaman.....	161
Concept of “Smart City” and its Practice in Poland. Case Study of Łódź City	169
Ewelina Szezech.....	169
Der Einsatz von Social Media im Stadtmarketing	181
Alexander Masser, Hans-Jürgen Seimetz, Peter Zeile.....	181
Deteminants of the Value of Houses: a Case Study Concerning the City of Cagliari, Italy	191
Michele Argiolas, Sabrina Lai, Corrado Zoppi.....	191
European Academic Smart Cities Network – Renewable Urban Energy Systems, Sustainable Mobility and ICT Technology Nexus for Smart Cities Studies	207
Darya Bululukova, Harald Wahl, Mathias Ballner.....	207
Externalities and Local Government Policy as Braking Factors of the Development of Water Supply Systems in the Russian Towns	217
Andrey D. Maksimov.....	217
Games in Urban Planning – a Comparative Study	239
Bärbel Reinart, Alenka Poplin.....	239
Global Competition needs Smart Solutions, Urban Design Elements on City Branding	249
Hossein Mohamad Hassani.....	249
Identifikation von Kriterien für den smarten Einsatz von Elektrobussen in den Netzen des ÖPNV	259
Carina May, Conny Louen.....	259

Identifying Cultural Ecosystem Services of Urban Green Infrastructure – Report about a Pilot Project undertaken in Lower Austria	269
Christine Rottenbacher, Tim Cassidy	269
In the Public Eye: Toward the Electronic Transparency of Planning Process	279
Aleksandra Stupar, Aleksandra Djukic	279
Influence of Transport on Urban and Rural Development in Bosnia and Herzegovina	287
Nusret Drešković, Rahman Nurković	287
Information-Analytical System for Managing Cities of Perm Region Spatial Development	295
Didier Vancutsem, Svetlana V. Maksimova, Alexey Y. Zavalov, Kseniia O. Mezenina, Petr S. Mikushin	295
Institutional Framework of Brownfield Regeneration in Serbia	303
Ana Perić, Danilo Furundžić	303
Integration of Emotional Behavioural Layer “EmoBeL” in City Planning	309
Rania Raslan, Khaled Al-Hagla, Ali Bakr	309
It’s Not Big, It’s Large: Mapping and Characterizing Urban Landscapes of a Different Magnitude based on EO Data	319
Michael Wiesner, Hannes Taubenböck	319
Lampertheim effizient – Herausforderungen für Mittelstädte im Rahmen der Smart-City-Debatte	329
Carolin Dietrich, Anika Trum, Andreas Witte	329
Land Acquisition Policy in India: An effective Inclusive Planning or Exclusive Planning Policy?	337
Bikram Kumar Dutta	337
Leben2050 – Bürgerbeteiligung in einer vorausschauenden Studie zu selbstbestimmtem Leben im Alter in Wien	349
Niklas Gudowsky, Mahshid Sotoudeh, Leo Capari	349
Leitprojekt ECR Energy City Graz-Reininghaus	357
Ernst Rainer, Kersten Hofbauer, Hans Schnitzer, Thomas Mach, Stephan Maier, Alexander Passer, Helmuth Kreiner, Thomas Wieland, Yvonne Bormes	357
Linked Open Data for Environmental Protection in Smart Regions – the New Challenge for the Use of Environmental Data and Information	367
Karel Charvat, Sarmite Barvika, Maris Alberts	367
Metrical Analyses on Population and Economic Growth and Urban “Quality Of Life” of Metropolitan Cities in China during the 00s	377
Toshiyuki Kaneda, Meiying Tian, Yang Wang, Mingji Cui, Renbao Jin	377
Urban Sensing App – A Mobile Tool for Urban Sensing and Climate Monitoring in Smart Cities	387
Benjamin Allbach, Sascha Henninger, Oliver Griebel	387
Modelling Day and Night Time Population using a 3D Urban Model	397
Monika Kuffer, Richard Sliuzas	397
More Green Open Space in a Densified City	407
Silja Tiltner	407
Moving Objects Tracking in Distributed Maritime Observation Systems	417
Vasily V. Popovich, Victor I. Ermolaev, Andrei V. Makshanov, Stanislav A. Vlasov	417
New Concepts for Urban Highways Control	423
Martin Gregurić, Edouard Ivanjko, Sadko Mandžuka	423
Open Street Map for Multi-Modal Freight Transport Planning	433
Markus Mayr, Gerhard Navratil	433
Ökotopia – Multidimensional Cities need Multidimensional Data	443
Hans-Georg Frantz	443
Planning Smart Cities ... Sustainable, Healthy, Liveable, Creative Cities ... Or Just Planning Cities?	447
Judith Ryser	447
Quality of Time Spent Matters!	457
Barbara Goličnik Marušić, Damjan Marušić	457
Recycling Architecture: the Redefinition of Recycling Principles in the Context of Sustainable Architectural Design	467
Milan Šijaković, Ana Perić	467
Resilient and Smart Public Spaces: the Div@ter Digital Platform	477
Marichela Sepe	477
Rethinking the Strategic Dimensions of Smart Cities in China’s Industrial Park Developments: the Experience of Suzhou Industrial Park, Suzhou, China	487
Joon Sik Kim, Xiangyi Wang	487
Scenario Approach for Image Processing in Smart City	497
Filipp Galiano, Nataly Zhukova, Maksim Pelevin	497

Scientific and Practical Understandings of Smart Cities	507
Corinne Moser, Thomas Wendel, Vicente Carabias-Hütter	507
Share it – Don't Own it: Space Sharing as a Smart Solution for Cities and Regions?	515
Petra Hirschler, Sibylla Zech.....	515
Simulation Game for Future Mobility – Support Tool for the Discussion Process about Scenarios of Future Mobility in SUMP Processes	525
Conny Louen, Daniel Horn	525
Smart Cities and ICT – Insights from the Morgenstadt project	533
Willi Wendt, Dominik Kalisch, Thomas Vandieken, Wolf Engelbach	533
Smart Cities between Ethics and Aesthetics	543
Chiara Garau, Luigi Mundula, Andrea Salustri	543
Smart Cities Need Smart Citizens, but What About Smart Children?	553
Sabine Hennig	553
Smart City – a Quest for Innovation within the EPS Framework	563
Małgorzata Hanzl, Antonina Młynarczyk, Alizee Tessier, Marcos Meiriño Munoz, Iban Micieces, Fanny Noirot.....	563
Smart Environment for Smart Cities: Assessing Urban Fabric Types and Microclimate Responses for Improved Urban Living Conditions	573
Katrin Hagen, Beatrix Gasienica-Wawrytko, Wolfgang Loibl, Stephan Pauleit, Richard Stiles, Tanja Tötzer, Heidelinde Trimmel, Mario Köstl, Wolfgang Feilmayr	573
Smart Kids Make Cities Smarter	583
Cecilia Scoppetta.....	583
Smart Navigation for Modern Cities	593
Nataly Zhukova, Oksana Smirnova.....	593
Smart Planning & Smart Cities	603
Jan-Philipp Exner	603
Smarter Cities – ein Modell lebenswerter Städte	611
Bettina Mandl, Susanne Zimmermann-Janschitz	611
Smarting the City or Development: The Dilemma of the Post-Oil Countries in sub-Saharan Africa	621
Alexander Boakye Marful	621
Social Media Geographic Information: Current Developments and Opportunities in Urban and Regional Planning	631
Pierangelo Massa, Michele Campagna.....	631
State Space Model for Accounting Smart City Heating by Municipal Solid Waste Management	641
Sanhita Bandyopadhyay	641
Technological Solutions for Knowledge Management in Smart Cities	653
Nataly Zhukova	653
The City of Matera and the Sassi: Smart Places with a Dantean Attraction	665
Tiziana Cardinale, Laura Pavia, Giovanni Zucchi	665
The E-City or the City on the Cloud	675
Josep Lluís Miralles i Garcia	675
The Effect of Potential-based Land Tax on Land Utilization	685
Gerhard Navratil, Reinfried Mansberger, Christoph Twaroch, Gerhard Muggenhuber, Reinhold Wessely	685
The Reification of Resilience and the Implications for Theory and Practice	693
Ksenia Chmutina, Gonzalo Lizarralde, Lee Bosher, Andrew Dainty	693
The Research on New Town Development Strategy in Metropolitan Outskirts: A Case Study of Liangzhu New Town	701
Qi Fan, XM. Hu, Y. Zhao	701
The TRANSFORM DSE – an Interactive Decision Support Environment for Serving Smart City Strategy Development and Local Measure Implementation	711
Wolfgang Loibl, Stefan Vielguth, Jan Peters-Anders, Sebastian Möller, Daiva Jakutyte-Walangitang, Joost Brinkman, Ivo Wenzler, Alex Cramwinckel, Michele Fumarola	711
The Use of Social Media in Public Transit Systems: The Case of the Gautrain, Gauteng Province, South Africa: Analysis and Lessons Learnt	721
Walter Musakwa	721
TRANSFORM – Governing the Smart City by Projects	729
Christof Schremmer, Heidi Collon, Max Kintisch, Stephanie Kirchmayr-Novak, Ursula Mollay, Barbara Saringer-Bory	729
Unort Gewerbegebiet? Qualitätsvolle Freiräume als Grundlage für Arbeitsorte	739
Martina Jauschneg, Myriam Maier, Peter Höger, Volkmar Pamer, Rainer Holzer	739

Urban Development Simulator: An Interactive Decision Support Tool for Urban Planners Enabling Citizen's Participation.....	749
Ernst Gebetsroither-Geringer, Wolfgang Loibl	749
Urban Green Infrastructure Planning as a Contribution to the Smart “Green” City.....	757
Florian Reinwald, Doris Damyanovic, Christiane Brandenburg, Brigitte Alex, Birgit Gantner, Christina Czachs, Jürgen Preiss	757
Use of ICTs and Mass Media in the Planning Processes: the Two Sides of the Same Coin.....	763
Federica Leone	763
Virtuelle Leerstandsbespielung – „Pop-Up-Zwischennutzung“ mittels Augmented Reality	773
Christoph Holderle, Stefan Höffken, Martin Memmel, Peter Zeile	773
Wer plant die Planung? – Widersprüche in Theorie und Praxis.....	783
Harald Frey	783
„What is planning for?“ Die Evaluation von strategischer Stadtentwicklungsplanung am Beispiel Wohnen	793
Judith Bornhorst	793
Application of Aggregated Indices Randomization Method for Prognosing the Consumer Demand on Features of Mobile Navigation Applications	803
Sergey Dotsenko, Andrey Makshanov, Tatiana Popovich	803
Beiträge innovationsorientierter Unternehmensförderung zur Umsetzung des Smart-City-Konzepts am Beispiel Wien	807
Alfried Braumann, Dominic Weiss.....	807
Blue City Mannheim – innovative Konzepte für Konversionsflächen in Mannheim.....	817
Alexander Kuhn, Dorothea Bartnik, Walter Rhiem.....	817
CentropESTATISTICS – a Tool for Cross-Border Data Presentation.....	823
Manfred Schrenk, Clemens Beyer, Norbert Ströbinger	823
Climate Neutral City Districts – the Smartest Form of a City's Districts?	831
Michael Erman	831
Daten, Informationen und Wissen zu Alltagswegen – eine Voraussetzung für Smart Cities?!	839
Bente Knoll.....	839
Digging into the Smartness: A Short Technopolitical (Pre)History of Vienna's Urban Lakeside	845
Anibal García Arregui	845
EmoCycling – Analysen von Radwegen mittels Humansensorik und Wearable Computing.....	851
Stefan Höffken, Johann Wilhelm, Dennis Groß, Benjamin S. Bergner, Peter Zeile	851
European Standards for Vocational Training in Urban Regeneration	861
Krzysztof Jan Chuchra, Marek Bryx, Julia Neuschmid	861
Exploring Population Distribution and Motion Dynamics through Mobile Phone Device Data in Selected Cities – Lessons Learned from the UrbanAPI Project	871
Jan Peters-Anders, Wolfgang Loibl, Johann Züger, Zaheer Khan, David Ludlow	871
Garden in Motion – an Experience of Citizens Involvement in Public Space Regeneration	877
Sara Lorusso, Gerardo Sassano, Michele Scioscia, Antonio Graziadei, Pasquale Passannante, Sara Bellarosa, Francesco Scaringi, Beniamino Murgante	877
Infographics for Smart People in Smart Cities	887
Kersten Nabielek	887
L(i)ebenswerte Quartiere – Wohnportraits als Beitrag zur smarten Planung?!	897
Mechtild Stiewe, Regina Sidel.....	897
Mobilstationen – Bausteine für eine zukunftsfähige Mobilität in der Stadt	903
Jan Garde, Hendrik Jansen, Daniel Bläser	903
Modellierung raum-zeitlicher Bevölkerungsverteilungsmuster im Katastrophenmanagementkontext	909
Klaus Steinnocher, Christoph Aubrecht, Heinrich Humer, Hermann Huber	909
Multilayer Information Management System for Personalized Urban Pedestrian Routing	915
Harbil Arregui, Patrick Krejci, Estibaliz Loyo, Oihana Otaegui.....	915
Narrative Urban Mapping	921
Renate Krause, Stefan Höffken, Bernd Streich.....	921
Neue Einblicke – Social Media Monitoring in der Stadtplanung	931
Lucas Joa, Stefan Höffken	931
Regional Identity and Culture in Intercompany Networks – a Case of Transdanubian Winery Networks	941
Árpád Brányi, László Tamándl.....	941
RegioProjektCheck – New Instruments to Evaluate the Impacts of Housing, Industry and Retail Projects. Case Study: New Supermarkets and their Effects on Existing City Centres	947
Sascha Anders	947

Sharing Geographic Data: How to Update Distributed or Replicated Data	959
Andrew U. Frank.....	959
Smart Cities as a Tool to Tackle Global Challenges.....	967
Marc Montlleó, Gustavo Rodríguez, Itzel Sanromá	967
Smart City Labs als Möglichkeitsraum für technologische und soziale Innovationen zur Steigerung der Lebensqualität in Städten	975
Barbara Hammerl	975
Smart Governance for Smart Region: The Yaroslavl Region Case	983
Anastasia Dubova, Dmitriy Razumov	983
Smarte Städte brauchen smarte Unternehmungen	985
Hans Schnitzer	985
Smartes Straßendesign für Smart Cities	991
Dieter Schwab, Stefan Mülleher.....	991
Social Media Data in Tourism Planning: Analysing Tourists’ Satisfaction in Space and Time	997
Roberta Floris, Michele Campagna.....	997
Spatial Plan of the Republic of Serbia in the light of Digital Agenda for Europe 2020.....	1005
Ljiljana Živković.....	1005
Städtebauliche Kalkulation mit Decision Support Infrastructure – das Beispiel der Analyse ökonomischer Wirkungen eines kommunalen Baulandmodells.....	1015
Dominik Weiß, Theo Kötter.....	1015
The Path Towards Smart Cities in China: From the Case of Shanghai Expo 2010.....	1023
Yanlin Zhou	1023
The Role of Logistics Services in Smart Cities: the Experience of ENCLOSE Project.....	1029
Giorgio Ambrosino, Stefan Guerra, Irene Pettinelli, Carlos Sousa	1029
Urban Living – Smart & Sustainable!? – Tool für den Wohnungsvergleich	1035
Susanne Supper	1035
What could be the “Imaginary Institution” of the City?	1041
Olivier Lefebvre	1041
Will the Guidebook “Green and Blue Spatial Planning” be a Value Help for Styrian Cities to Become a “Smart City”.....	1047
Christine Schwabegger	1047
Smart Governance Answers to Metropolitan Peripheries: Regenerating the Deprived Area of the Morandi Block in the Tor Sapienza Neighbourhood (Rome)	1051
Pietro Elisei, Angela D’Orazio, Maria Prezioso.....	1051
A Smart “Cairo” in the Making: A Strategic Approach towards a Better Quality of Life.....	1063
Heba Safey Eldeen	1063

Recycling Architecture: the Redefinition of Recycling Principles in the Context of Sustainable Architectural Design

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1 ABSTRACT

The sustainable management of city resources (land, infrastructure, suprastructure) is one of the crucial urban processes to which the ‘smart cities’ concept should be addressed. In other words, resource conservation is highly important question nowadays. Namely, only a small percentage of the total building stock is made up of new works. This inevitably means that the general refurbishment and adaptive reuse will significantly benefit the sustainability agenda in the next twenty years, which will, further, make our cities smarter. Since most buildings are physically suitable to various uses, flexibility and ‘long life – loose fit’ should be a guiding principle behind most design briefs. The recycling of existing buildings has several benefits, such as: decreasing the pressure on new land, preserving the embodied energy of building materials, saving new materials from being used, cutting the associated environmental impacts of producing and transporting new materials, and, finally, involment the lesser generation of residues in relation to a totally new construction. Thus, the subject of this research relates to the definition of recycling principles for sustainable architectural design. According to this, contemporary literature on recycling in architecture has been evaluated, compared and analysed. It is hypothesised that in order to produce least environmental damage the recycling intervention should use as much of the original building’s material as possible. Thus, physical characteristics of the original building define which design principle is most adequate for its recycling. Such an literature overview enabled the creation of so-called recycling model, which establishes a link between the physical characteristics of underused buildings, on the one hand, and the design principle most environmentally sustainable for its recycling, on the other. This model provides a fresh understanding of how an extensive range of physical characteristics of building can be considered in a systematic way in order to choose the most suitable design principle in the recycling process. Its elaboration is the focus of the research.

2 SUSTAINABLE DEVELOPMENT AND CONSTRUCTION INDUSTRY

The influence of human activity on numerous subtle changes in the environment over time is becoming increasingly clear, from the bleaching of coral reefs and the polluting of oceans by regular oil spills, to the damage of human health caused by harmful processes, materials and buildings (Bragança & Cuchí, 2007). Out of all resources consumed across the planet fifty per cent are used in construction, which makes it one of the least sustainable industries in the world. However, contemporary human civilization depends on buildings for its continued shelter and existence even though our planet cannot support the current level of resource consumption (Edwards, 2005).

The definition of the sustainable development coined in the “Brundtland report” (1987) has spawned a series of sub-definitions to meet particular sector needs. Typical of these is that used by the practice of Foster and Partners, which defines the sustainable design as creating buildings which are energy-efficient, healthy, comfortable, flexible in use and designed for long life (Edwards, 2005). The Buildings Service Research and Information Association (BSRIA) has defined sustainable construction as the creation and management of healthy buildings based upon resource efficient and ecological principles (Edwards, 2005).

The Earth Summit (1992), United Nations Conference on Environment and Development (UNCED), included environmental degradation and resource depletion into their agenda. The discourse was broadened in “Agenda 21” and the “Rio Declaration” in which the principles of sustainable development were laid down. With the “Declaration of Interdependence for a sustainable future” at the Chicago Congress of the International Union of Architects (IUA) in 1993, architecture also joined the movement, and many national bodies and institutions of architecture began producing energy and environmental policies (Szokolay, 2004). The timeline of main environmental agreements is briefly shown in the Figure 1.

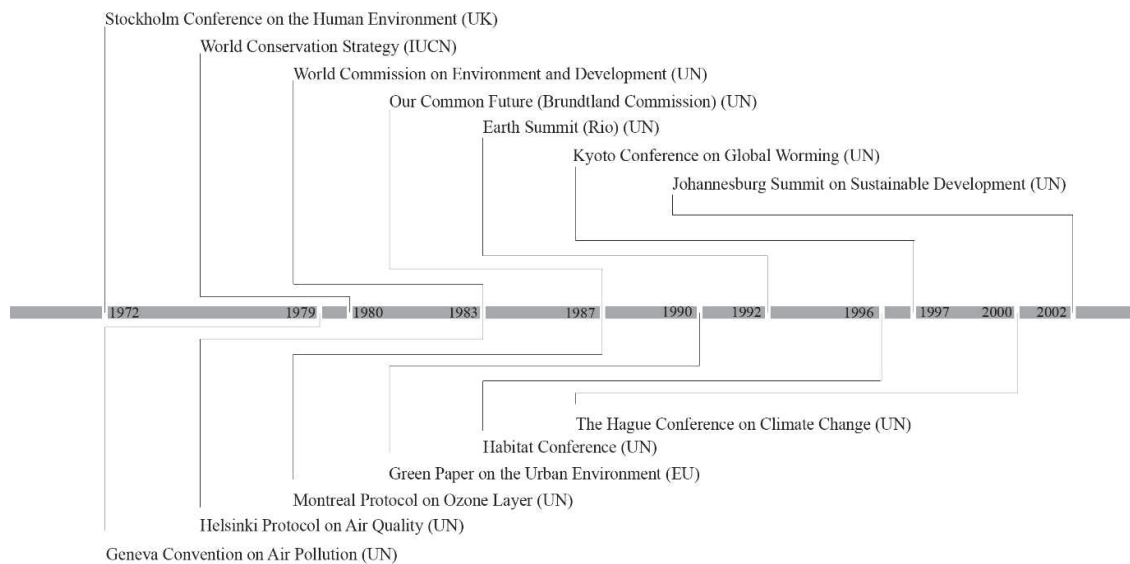


Fig. 1: Major global environmental agreements (Source: Author according to Edwards, 2005).

Unquestionably buildings are big users of raw materials. The environmental capital locked in buildings is enormous, as is the waste footprint, making them one of the biggest users of raw material. The waste produced from the construction and demolition activities constitute one of the biggest waste streams produces in Europe (Bragança & Cuchí, 2007).

It is not enough to develop principles for a sustainable design only for the new projects. The existing buildings must also be taken into account as structural issues are usually not the reason why buildings come to their end-of life, but rather the shift of the building's original purpose, making the existing building unsuitable for new roles and functions (Lee, Trcka & Hensen, 2011). Existing buildings are crucial to any strategy for carbon-emission reduction. Buildings are durable goods which can reach 100 years of useful life or more and building renewal can extend the use of the existing buildings with diverse benefits, such as the exploitation of the existing urban infrastructure (with no need for new site development) and the lesser generation of residues in relation to a totally new construction (Bragança & Cuchí, 2007).

3 RECYCLING DESIGN PRINCIPLES

All major global environmental agreements state that recycling our building stock is one of the most effective strategies in reducing carbon footprint and environmental degradation in general. A number of publications have been written on what is considered 'good practice' of recycling architecture in general and of architectural design of an intervention on existing buildings. These publications are usually in the form of a catalogue, where projects are divided into several categories, usually depending on the intensity of the intervention, or in other words, the relationship between the old and the new. In contemporary literature dealing with reconversion of existing buildings projects are divided into three categories, where the alterations to existing fabric are of low, medium and high intensity.

The comparative analysis of four sources and their categorization of recycling principles, Brooker & Stone (Intervention–Insertion–Installation), Feireiss & Klanten (Add-On, Inside-Out, Change Clothes), Jäger (Addition–Transformation–Conversion) and Rogic (Coexistence–Imposition–Fusion), is conducted with the aim of understanding the logic behind the definition of these design principles.

3.1 Intervention, Insertion, Installation

The design concepts of Intervention, Insertion and Installation defined by Brooker & Stone (2004) are determined by the relationship between the existing and the new building, the host and the intruder. Depending on the level of the autonomy of the new elements, the recycling project gathered in their study fall into one of the described categories. This autonomy is represented both in structural terms, as the extent to which the new structure is dependant on the old, and formal-spatial terms, as the level to which the original building's form and spatial organization influenced new design.

Intervention is defined as a process which transforms the host building, but new and old elements become completely dependent upon each other. Through this process the original building may be changed but Brooker & Stone explain that all the changes are informed by the original building, its volume, scale, geometry and in this process old and new become one. Yet in one of the projects selected as the representative of this design principle, Museum Küppersmühle by Herzog and de Meuron, it is clear that the intervention executed on the façade of the building disrupts the symmetry of the host building and changes its appearance. Inside of the building, a number of floors were removed to provide space for large art pieces. A new element was added in front of the building, staircase, in a form of a prismatic tower which introduces new architectural vocabulary into the scene. It is not clear to which extent the original building can be changed and still fall into this category but it is evident that all the changes were influenced by the character and physical characteristics of the old building. In material terms all new elements are executed in materials clearly distinguishable from the old. In structural terms new elements depend on the host building.

Insertion is defined as a process through which a building accommodates new elements, build to fit, but stays very much unchanged. Its exterior remains largely intact but interior space is subjected to substantial change. Just like in the previous category, the new elements depend on the particular qualities of the host building, yet they have a much greater level of independency and can be even confrontational. The most obvious difference is in material expression as this design principle implies a clearest possible distinction between the old and new. Structurally the inserted elements can rely on the old building for its support, but can also be structurally independent, without touching the existing structure.

Installation implies complete separation of old and new, they simply exist together and very little rapport is established between them. Like with the design principle of Insertion, new elements can be structurally dependent or independent to the host building. In material terms new and old are completely at odds, and have their own formal logic independent from the original building. Yet the scale and dimensions of the new elements depend on the host building as these elements are usually installed into the old buildings space.

It can be concluded that the design principle of Intervention, even though it allows for a substantial change and disruption of the old building, implies the predominance of the old building as all the characteristics of the new elements depend on the character of the host building. Second design principle, Insertion, preserves the image of the old building but changes substantially its inner spaces, making both old and new equality present and dominant. The third design concept, Installation, implies the highest autonomy of the new elements, both materially and structurally, even though its scale and dimensions depend on the old building's physical characteristics.

3.2 Add-On, Inside-Out, Change Clothes

Just like in the Brooker & Stone's "Re-Reading", the relationship between the old and the new was the leading criteria in determining the design principles of recycling in Feireiss & Klanten's study "Build-On converted architecture and transformed buildings".

The design principle of *Add-On* includes all types of additions that can be executed upon the existing structure. This category is very broad as it contains both projects that simply restore the original structure by adding elements that follow the formal logic of the old, and also projects that almost completely change the face of the original building. One of the projects selected as representative of this design concept, CaixaForum in Madrid, shows that completely different architectural vocabulary was used for the new addition, both in material, formal and structural terms. The interior of the old building was also substantially changed. Compared to Brooker & Stone's principle of Intervention, the principle of Add-on allows for a much more aggressive approach to the host building's exterior and interior.

The second category, *Inside-out*, presents projects that change fundamentally old building's interior, but leave its exterior and appearance intact. The original image of the building stays almost unaltered just as in Brooker & Stone's principle of Insertion. However, in one of the selected projects for this category, Haworth Tompkins's Temporary Theatre, it is clear that the new intervention was completely governed by the old buildings spatial logic. New elements were simply placed in the open space of the derelict power station. New auditorium was made by following the spatial organization of the old building. Therefore it can be concluded that this design principle implies minimal change to the building's exterior. If any changes are made, they are always informed by the old building itself. Since this design concept follows a change of function of the host building a greater degree of alteration can be executed in buildings interior. New

elements can be both structurally independent from the old building, following its own spatial logic or dependant on it, respecting the host building disposition of spaces. Nevertheless, as the new intervention is conducted within the host building, its scope, dimensions, rhythm and scale is completely dependent on the physical characteristic of the host building.

The third design principle, *Change Clothes*, implies the predominance of the new structure. The level of autonomy of the new element is the highest here, as in Brooker & Stone's Installation category. This concept implies change not only to the building's interior but exterior as well, changing its appearance completely. However, unlike the principle of Installation, which confines the change mainly to the building interior, this principle allows for the new element to break the formal logic of the host building's exterior as well. The selected project for this category, Jægersborg Water Tower, clearly shows that, in order to gain more space, apartment units were allowed to protrude from the old building's envelope. Even though this design principle should entirely change the face of the original building, in this project it is clear that the importance of the host building was recognised and its landmark qualities and appearance preserved.

It can be concluded that as in the Brooker & Stone's classification the relationship between the old and the new was the leading criterion for the definition of design principles of intervening with the existing buildings. Yet here, it cannot be said that the dominance of the new elements rises from first to the last principle. New elements are executed in materials clearly distinguishable from the old in all three design concepts. The main difference between the first two concepts is the localization of change. The design principle of Inside-out confines the change within the old building leaving its interior unchanged while the concept of Add-on implies substantial change to the building interior as well. The third design concept, *Change Clothes*, just like the first one allows the change of the building's formal logic as well, but should imply the higher level of alteration of the building fabric. There is no clear difference in structural dependence of the old and the new between these design principles.

3.3 Addition, Transformation, Conversion

According to Jäger (2010), the main criterion for the classification of selected projects in his study named „Old & New: Design manual for revitalizing existing buildings” was the architectural quality and maturity of the treatment of the existing building. Like in previously analysed cases, three categories have been established, Addition–Transformation–Conversion, each one corresponding to a different level of independency of the new elements.

Jäger's first category *Addition*, just like Feireiss & Klanten's category Add-On, implies a multitude of architectural actions that change the original building, but are always informed by the host building itself. In material terms new and old can be strictly divided, as seen in the selected example for this category, Cafeteria in the Zeughouse ruin. Exterior of the original building was preserved and changes were made only in its interior. Structurally new and old are separated in this project, though other projects in this same category show structural dependence on the old building. Examples in this category also show that different architectural vocabulary could be used, forms which follow its own logic, but can also be influenced by the host building. In general it can be said that this category gathers projects where both the old and new have the same presence and importance and are coexisting.

The second design principle, *Transformation*, implies more aggressive approach, and the change to the old building's structure as well. In the first category there is usually clear distinction between the old and new, and according to Jäger, the principle of Transformation dissolves the boundary between the old and new. The selected example, Punta della Dogana, shows that just like in the previous example, no changes have been made to the building exterior, preserving its appearance completely. New elements are executed in materials different from the host building and the spatial logic of the interior spaces was mostly followed. Other examples in this category show that the change was usually constrained to old building interior where it is clearly recognizable and can both follow or alter the host building's spatial logic. This design principle implies more invasive approach than the previous one.

The third category, *Conversion*, also includes wide variety of examples that change the old building function, from projects that add elements, to ones which alter only the host building's interior. The selected example, the Fahle Building, shows that new addition is conceived in material which separates it clearly from the old building, and is structurally independent. Examples in this category are to great extent influenced by the

original building's formal and spatial logic. It can be concluded that somewhat abstract criteria were used to separate these design principles and that there is a rather blurry line which separates one from the other.

3.4 Coexistence, Imposition, Fusion

Rogic (2009) went a step further in her PhD thesis, "Converted Industrial Buildings: Where Past and Present Live in Formal Unity". She extracts three design principles, Coexistence–Imposition–Fusion, from the six proposals (David Chipperfield, Renzo Piano, OMA, Herzog & de Meuron, Tadao Ando and Jose Rafael Moneo) shortlisted for the second stage of the competition for the reactivation of the Bankside Power Station and analyses them on two levels, building tectonics and spatial-formal composition.

Coexistence is defined as parallel existence of the old and new. And all projects shortlisted for the second phase of the competition clearly distinguish between the old material, brick and steel, and the new introduced materials, usually concrete and glass. However, she explains that the interventions differ in the level of rendering visible the coexistence of old and new materials. By detaching new and old materials one from the other in terms of their structural and environmental behaviour, Chipperfield and Piano, demonstrated transparently the principle of coexistence, whereas in the other four interventions (OMA, Ando, H&M and Moneo) there is no divided role between old and new materials (Rogic, 2009).

The concept of *Imposition* implies the predominance of the new element introduced to the host building. It also means that the original building's characteristic were not taken into account while designing the new intervention. OMA's (Office for Metropolitan Architecture) intervention proposes the insertion of three blocks into the building's interior and one addition in front of the eastern part of the northern elevation (Rogic, 2009). On the outside, the old building's symmetry was broken not only by the placement of windows but also by the addition of the sixth level which created a new asymmetrical composition.

If old and new structure and materials could not be recognised, are dependent on each other and work together then the concept of *Fusion* is at play. The spatial composition of the intervention derives from the physical characteristics of the host building. New and old structure work together.

Rogic analyses these three principles, established by the architects themselves, on two levels. The first level of the analysis is the building tectonics. Here Rogic refers to building material and its structure, and to what extent is the original tectonics changed and new intervention governed by the old building. The second level of the analysis is the spatial-formal composition, which she divides in two categories, building interior and exterior. The extent to which the spatial organisation of the old building influences and governs the new intervention was examined. Based on this analysis Rogic defines four new concepts: *Tectonic fusion* if new and old structure and materials are completely interwoven; *Tectonic coexistence* when new and old structure and materials work separately and are clearly distinguishable; *Spatial composition conservation* if the old spatial organisation was preserved and influenced the new intervention; *Spatial composition transformation* if the old spatial organisation was altered.

4 REDEFINITION OF RECYCLING DESIGN PRINCIPLES – RECYCLING MODEL

It can be concluded that a general criteria for the definition of design principles of recycling in all above mentioned examples, was the relationship between the host building and the new intervention, i.e. the level of independency of newly introduced elements. Thus, in all cases one design principle was presented which implies obedience to the host building and minimal change to its appearance. The original building governs the intervention and decides how it is going to be changed. All characteristic of the new elements derive from the physical characteristics of the host building.

The second design principle implies higher level of autonomy of the new elements. The new intervention is influenced by the host building, their characteristics can derive from the original building itself, but the 'new' speaks equality loud as the 'old'. The substantial change to the original building can be done, but always following the spatial logic of the old building. Its volumetric composition, rhythm and scale are the elements which should be respected and which define the new intervention.

The third design principle implies the highest level of the autonomy of the new elements. New intervention and the host building speak different languages. The physical characteristics of the old building are not factors that define the new intervention. These new elements are dominant and follow their own spatial logic.

Some of the above analysed design principles limit the recycling intervention almost exclusively to the host building's interior, as Inside-Out and Insertion.

Yet due to a rather abstract criteria for the definition of these design principles, there is no clear and direct distinction between them, and example from one category can easily fall into another one. This problem calls for a systematization of existing principles and formulation of a clear set of criteria which would define design principles of recycling.

The criteria for the analysis of the chosen design principle were material relationship and structural dependence on one hand, formal disruption and change of spatial organisation on the other. Table 1 confirms that there is a rather blurry line which defines and separates these principles. In order to redefine design principles and make the distinction between them clearer, a clarification and more precise definition of criteria should be established.

	Materials		Structure		Form		Inner special organization	
	Clear distinction	Interwoven	Dependent	Independent	Changed	Preserved	Changed	Preserved
Intervention	x		x			x		x
Insertion	x		x	x		x		x
Installation	x			x		x		x
Add-On	x		x	x	x		x	
Inside-Out	x			x		x	x	
Change Clothes	x		x	x	x		x	
Addition	x		x	x	x	x		x
Transformation	x		x			x		x
Conversion	x			x	x		x	
Coexistence	x			x		x		x
Imposition	x			x	x		x	
Fusion		x	x		x	x	x	x

Table 1: Analysis of all four groups of design principles

Criteria for the analysis of the intervention:

Structure

- Old structure retained, no new structure added.
- Old structure retained and upgraded.
- New structure added, independent from the old structure.
- New structure added, dependent from the old structure.
- Old structure completely replaced.

Materials

Exterior

- Old and new materials are completely interwoven.
- Clear division between the old and new material which form a harmonious union.
- Clear division between the old and new material which are confrontational.

Interior

- Old and new materials are completely interwoven.
- Clear division between the old and new material which form a harmonious union.
- Clear division between the old and new material which are confrontational.

Form

- Formal logic of the old building (volumetric composition, symmetry) is respected and unchanged, no new elements are added.
- New elements are added respecting the old building's formal logic.
- Formal logic of the old building is disrupted.

Spatial organization

- Spatial logic of the interior spaces is preserved and unaltered.
- Spatial logic of the host building's interior spaces is altered but the size and the position of the new elements depend on the physical characteristics of the host building (its size, volume, organisation).
- Spatial logic of the host building's interior spaces is altered.

On the other hand, in order for the recycling intervention to be as environmentally sustainable as possible, a range of existing building's physical characteristics has to be taken in consideration. The level of the environmental sustainability of the intervention can be measured by the amount of the old building materials used (the use of existing material minimizes pollution and energy waste related to excavation, production, transportation), and the level of change imposed to the old building (the less change, the less energy and material waste). Thus it can be concluded that the most environmentally sustainable recycling intervention will be one which fully exploits the host building, inducing as minimal change as possible, given that the condition of the host building allow it.

Hence, the first step in planning the recycling intervention and deciding which design principle is most adequate/environmentally sustainable for a given building the following set of its physical characteristics has to be taken into account.

Criteria for the analysis of the existing building:

Structural characteristics:

- Foundations condition
- Vertical load bearing structures condition
- Horizontal load bearing structures condition
- Roof structure condition
- Internal partitions condition

Material characteristics:

- Façade condition
- Cladding system and fenestration
- Internal surfaces condition
- Floor coverings condition
- Wall and ceiling coverings condition

Therefore, according to the above described criteria for the analysis of both existing building and the intervention a recycling model, which implies a new set of redefined design principles of recycling (3S classification: Subjection–Symbiosis–Subversion), can be proposed. This model links the physical state of the host building and the most environmentally sustainable design approach for its recycling. Which of these design principles should be used depend entirely on the state in which the host building is found, i.e. its physical characteristics.

4.1 Subjection

Longman dictionary of English language and culture defines the term as: the act of bringing under firm control; not allow to have free expression; contingent or dependent. This design principle implies the subjection of the new intervention to the old buildings. In structural terms, the new intervention will retain the existing structure and upgrade it if necessary. If new structure is added it is dependent on the old one,

relies on it for its support, they work together. Material-wise the exterior of the building is left unchanged. If any reparation work has to be done to the building's façade (e.g. material replacement, crack repairs, patching, cleaning and painting), they will preserve and reveal its aesthetic and historic value and will be based on respect for original material. All new interventions to the building's interior will be executed in materials which follow the aesthetic logic of the old, thus the new and old will be interwoven, or in materials which are distinguishable from the original but integrated harmoniously with the whole.

The form of the building stays untacked. Its volumetric composition, fenestration rhythm and proportion are preserved in its totality. No additions are executed to the building envelope. If some parts of the building are in state beyond repair, selective demolition can be applied but this process will not change the building's character and appearance. All newly introduced elements will follow the host building's spatial logic. The division of spaces within the building, its organisation, is preserved and governs the new intervention. New elements are defined by host building's physical characteristics, its dimensions, scale and disposition of spaces. The character of the old building's interior will not be changed by the intervention. The original building is dominant, fully governs the new intervention, and decides how it is going to be recycled.

If the host building is found in an excellent state, both structurally and materially, and can be used 'as found' and only a negligible physical change is required the design principle of Subjection should be applied, given that this design concept implies the predominance of the old and the maximum use of its material.

4.2 Symbiosis

Heinrich Anton de Bary coined the term symbiosis (from Ancient Greek σύν – together, and βίωσις – living) in 1879 to explain an internal, mutually beneficial partnership between two organisms. This term defines a relationship in which one symbiont lives within the tissues of the other, either within the cells or extracellularly and it also refers to any relationship in which the symbiont lives on the body surface of the host, including the inner surface (Paracer & Ahmadjian, 2000). Oxford dictionary defines the term as: interaction between two different organisms living in close physical association, typically to the advantage of both. Organisms living in a symbiotic relationship have different physiognomy, yet together they form a harmonious, mutually beneficial, union.

The new intervention will retain and upgrade, if necessary, the existing structure. If new structural elements are introduced, they can both be dependent or independent on the existing structure, according to the scope of the intervention. If new structural elements are self-sufficient they are certainly conditioned by the pure physical characteristics of a host building, its size and disposition of its structural elements. The positioning, size and rhythm of new structure depends entirely on the old building's organization.

In many cases the building's exterior, its envelope, façade will be preserved, or if necessary, restored to the original state, preserving its appearance and integrity. Yet this design principle implies greater degree of change to the buildings fabric than the previous one. Additions, can be made to the host's building volume, and they will always be executed in materials clearly distinguishable from the old, yet carefully chosen to create a harmonious relationship with the existing materials. Even though new and old are not interwoven, they form a union. All the changes done in the old building's interior are executed in materials different from the old. There is a clear distinction between what is new and what was already there. The form of the old building, the balance of its composition, is not altered by new intervention. Elements which are added to the buildings envelope follow the formal logic of the old building, its symmetry and relationship between its parts. New follows the old but is equally present and dominant.

New intervention is governed by the old building's inner space distribution. Building's interior organization influences the design of the new intervention. This influence is limited to new intervention's dimension, not character. There is a clear distinction between what belongs to the old and what was newly introduced, both in material and formal terms. Compared to design principle of Subjection, Symbiosis creates more dynamic relationship with the old. Additions and alterations of the old building can be executed, yet buildings spatial and formal logic will not be jeopardised by this act. In most cases the alterations are restricted to building's interior. Whereas in Subjection old dominates and fully conditions the new, in Symbiosis old and new are equally present but speak different languages.

When a host building is found in a relatively good state, structurally and materially, and requires only minor physical change, upgrading of its structure or replacements of certain parts, the design principle of Symbiosis

should be applied, given that this concept implies preservation of all usable elements of the old and yet leaves space for equally powerful new intervention.

4.3 Subversion

Subversion (lat. *subvertere* – overthrow) refers to a process by which the values and principles of a system in place, are contradicted or reversed (Blackstock, 1964). Through this act the established system is changed or damaged. This concept involves infiltrating, penetrating and manipulating existing system.

This design principle, in structural terms, implies introduction of new structure independent from the old, and in some cases complete replacement of the old structure. The positioning and size of the new structural elements depend entirely on the new intervention and does not follow the structural logic of the old building. Additions, and alterations to the host building's fabric are executed in materials clearly distinguishable from the old, and even confrontational. Newly introduced materials do not pretend to form a harmonious union with the old but follow completely different material logic, defined by the new intervention entirely. In the host building's interior the clear separation of old and new materials is also at play. The clash between existing and newly introduced materials produces dynamic and very intense relationship between old and new.

The form of the existing building is substantially changed by this design principle. The balance of its composition, symmetry, and fenestration are broken and altered by new intervention. New volumes will be added following its own formal logic, confrontational with the old. Host building can endure substantial subtractions as well, which can change its appearance. New elements belong to a clearly different style, the style which is defined by the commissioned architect.

This intense relationship extends to the building's interior as well, where new intervention changes the spatial composition of the old building. The logic of interior spaces is altered and the character of the host building completely changed. New intervention is fully governed by its own formal and spatial logic, independent from the existing one.

This design principle implies the highest level of change to the original building. Compared to Subjection, where the old building has the predominance, and Symbiosis, where both new and old are equally present and powerful, the design principle of Subversion implies complete obedience of the old building to the new intervention, new overpowers the old. If significant physical change, reconfiguration and reconstruction are required for the host building to be usable once again the design concept of *Subversion* can be applied. As only small part of the original building can be used, overpowering new intervention, composed of entirely new structure, materials and space logic is entirely justified.

5 CONCLUSION

The global concept of sustainable development is imposed as a general context for all urban questions in the last few decades. This concept implies the integration of various aspects of urban development, which affects the modification of the contemporary design principles.

Adaptation of the design principles to the demands of sustainable development concept has great potentials, reflected in increasing quality of land as a non-renewable resource. During this and the past decade, sustainability in construction industry, represented a central theme of the most important international conferences. Further, our existing building stock plays a fundamental role in our society. It contains large quantities of embodied energy, materials and resources and contributes to the streetscape, character and embodied memory of our communities. When buildings no longer meet expectations, demolition is frequently employed, contributing to the building industry as the single largest consumer of resources and the single largest contributor to the waste stream.

Thus, recycling architecture has many historic, environmental, social and economic benefits, all of which make it an essential component of sustainable development. By analysing recommendation in most important international documents regarding sustainable development and by analysing design concepts used in contemporary practice of recycling architecture a recycling model has been created. It fully exploits the host building, by analysing its structural and material state and characteristic and assigning the most environmentally sustainable design principle for its recycling accordingly. In this way the embodied energy

of host building's materials is preserved and energy necessary for excavation, manufacturing and transportation saved.

6 REFERENCES

- BLACKSTOCK, Paul: The Strategy of Subversion. Chicago, 1964.
- BRAGANÇA, Luis & CUCHI, Albert: Portugal SB07. Sustainable construction, materials and practices. Lisboa, 2007.
- BROOKER, Graeme & STONE, Sally: Re-Reading. London, 2004.
- EDWARDS, Brian: Rough guide to sustainability. London, 2005.
- FEIREISS, Lucas & KLANTEN, Robert: Build-On converted architecture and transformed buildings. Berlin, 2009.
- JÄGER, Frank Peter: Old & New-Design manual for revitalizing existing buildings. Basel, 2010.
- LEEL, Bruno, TRCKA, Marija & HENSEN, Jan: Embodied energy of building materials and green building rating systems - a case study for industrial halls. In: Sustainable Cities and Society, Vol.1, Issue 2, pp 67-71.
- PARACER, Surindar & AHMADJIAN, Vernon: Symbiosis-An Introduction to Biological Associations. Oxford, 2000.
- ROGIC, Tamara: Converted Industrial Buildings. Delft, 2009.
- SZOKOLAY, Steven: Introduction to Architectural Science-the basis of sustainable design. London, 2004.