DOTTA

SCIENTIFIC COMMITTEE
Denise Akason - Kellogg School of Management
Alessandra Bellicoso - Università degil Studi de L'Aquila
Paola Boarin - Università degli Studi di Ferrara
Andrea Ciaramella - Politecnico di Milano
Pierluigi De Berardinis - Università degli Studi de L'Aquila
Romano Del Nord - Università degli Studi di Firenze
Maria Antonietta Esposito - Università degli Studi di Firenze
Avi Friedman - McGill University
Francesca Giofré - Università di Roma "La Sapienza"
Liliana Giraldo Arias - Universidad de La Salle
Alessandro Greco - Università degli Studi di Pavia
James Kessler - Hellmuth, Obata + Kassabaum Inc.
Arto Kiviniemi - University of Liverpool
Serge Latouche - Université Paris-Sud XI, Institut d'études du developpement économique et social (IEDES)
Giuseppe Lotti - Università degli Studi di Firenze
Adriano Magliocco - Università degli Studi di Genova
Corrado Marcetti - Fondazione Michelucci
P.E. Rivero Martins - Univ. Federal do Rio Grande do Sul
Juan Luis Mascaró - Univ. Federal do Rio Grande do Sul
Marie-Hélène Maurette - Reichen et Robert et Associés
Ovidio Morales - Universidad Rafael Landívar
Kristen Parrish - Arizona State University
Giuseppe Pedeliento - Università degli Studi di Bergamo
Rossana Raiteri - Università degli Studi di Genova
Alessandro Rogora - Politecnico di Milano
Rafael Sacks - Israel Institute of Technology
Marco Sala - Università degli Studi di Firenze
Ali Sayigh - World Renewable Energy Congress / Network
Carlo Terpolilli - Università degli Studi di Firenze
Ferdinando Terranova - Università di Roma "La Sapienza"
Callum Thomas - Manchester Metropolitan University
Michael Trübestein - Lucerne U. of Applied Sciences and Arts

PUBLISHED VOLUMES

1. *Tecnologia dell'architettura: creatività e innovazione nella ricerca*, a cura di Maria Antonietta Esposito, 2006
2. *Interazione e mobilità per la ricerca*, a cura di Alessandro Sonsini, 2007
3. *La ricerca a fronte della sfida ambientale*, a cura di Elisabetta Ginelli, 2008
4. *Innovation in research: the challenge and activities in progress / L'innovazione nella ricerca: la sfida e l'attività in corso*, a cura di Orio De Paoli, Elena Montacchini, 2009
5. *Produzione dell'Architettura tra tecniche e progetto / Architectural Planning between build and design techniques*, edited by Massimo Lauria, 2010
6. *Permanenze e innovazioni nell'architettura del Mediterraneo / Mediterranean Architecture between Heritage and Innovation*, edited by Maria Luisa Gemanà, 2011
7. *La ricerca tra innovazione, creatività e progetto / Research among Innovation, Creativity and Design*, edited by Roberto Bolici, Matteo Gambaro, Andrea Tartaglia, 2012
8. *Teorie e sperimentalismo progettuale per la ricerca in tecnologia dell'architettura / Theories and experimental design for research in architectural technology*, edited by Federica Ottone, Monica Rossi, 2013
9. *Looking to methods and tools for the Research in Design and Architectural Technology*, edited by Filippo Bosi, Paolina Ferrulli, Elisabetta Fossi, 2015

Looking to methods and tools for the Research in Design and Architectural Technology

edited by

Filippo Bosi, Paolina Ferrulli and Elisabetta Fossi

Firenze University Press
2015

Looking to methods and tools for the Research in Design and Architectural Technology / edited by Filippo Bosi, Paolina Ferrulli and Elisabetta Fossi. – Firenze : Firenze University Press, 2015
(Scuole di dottorato ; 41)

http://digital.casalini.it/9788866558484

ISBN 978-88-6655-848-4 (online)

Peer Review Process
All publications are submitted to an external refereeing process under the responsibility of the FUP Editorial Board and the Scientific Committees of the individual series. The works published in the FUP catalogue are evaluated and approved by the Editorial Board of the publishing house. For a more detailed description of the refereeing process we refer to the official documents published on the website and in the online catalogue of the FUP (www.fupress.com).

Firenze University Press Editorial Board
G. Nigro (Co-ordinator), M.T. Bartoli, M. Boddi, R. Casalbuoni, C. Ciappei, R. Del Punta, A. Dolfi, V. Fargion, S. Ferrone, M. Garzaniti, P. Guarnieri, A. Mariani, M. Marini, A. Novelli, M. Verga, A. Zorzi.

This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0: http://creativecommons.org/licenses/by/4.0/legalcode)

CC 2015 Firenze University Press
Università degli Studi di Firenze
Firenze University Press
Borgo Albizi, 28, 50122 Firenze, Italy
www.fupress.com

Contents

Green Airport Design Evaluation Method and Tools

Paolina Ferrulli
PhD Candidate, XXVIII cycle
Università degli Studi di Firenze, Dipartimento di Architettura

Abstract

The paper illustrates ongoing research focused on the process of evaluation of project compliance with green building requirements during preliminary stages of the design process. The primary aim of the research is to develop method and tools to check and evaluate the sustainability design performances during the whole project development. The application case study is airport infrastructure design.

Airports can be constrained by environmental issues which restrict current operations and limit future potential growth. In order to maximize opportunities for growth, it is necessary to consider all the specific factors involved in airport design that can have an influence upon the environmental consequences of its subsequent operations and therefore impact upon integrated sustainability strategies. Life cycle and long-term planning of airport infrastructures also demand a systemic approach to meet the need for change through better definition of the design process and compliance with green building requirements.

A number of tools using sustainability indicators have been developed in the last two decades. International Green Building rating systems such as LEED, BREEAM, and others have been used as an effective framework for assessing building environmental performance and integrating sustainable development into building and construction processes. But the individual buildings that comprise a major part of the airport infrastructure are often not, on their own, the critical elements that determine the longer term sustainability of the site.

An in-depth study has been carried to define an airport-wide sustainability index. The study has been focused on the concept of airport environmental capacity[1] and the good/best practices complying with sustainability indicators already adopted during the planning, construction, management, maintenance and decommission of European and international airports.

F. Bosi, P. Ferrulli, E. Fossi (edited by), *Looking to methods and tools for the Research in Design and Architectural Technology,* isbn 978-88-6655-848-4 (online), CC BY 4.0, 2015 Firenze University Press

The research will define specific method and tools enabling both design project control and sustainability appraisal. The method will be based on systematic process, linked to modeling studies and the development of sustainability indicators that would inform a site wide approach to the design of airport infrastructure. The proposed method and tools will also create new opportunities for aviation regulatory organizations and airport managers to define strategies and anticipate decisions to enhance sustainable airport infrastructure design.

Keywords
Project Design Management, Integrated Approach, Sustainability Index, Green Airport Design, Environmental Capacity Evaluation

Airport Infrastructure constraints to growth

Airports are critical nodes in the transport system and can have a vital role in supporting the socio-economic development of city regions. The structure and organization of the transport systems have determined the evolution and changes of human settlements in each age, influencing the creation of public spaces designed to accommodate nodes and connections (Button et al., 1995; Trinder, 2001; Woudsma & Jensen, 2003). Airports have the ability to re-model the location of economic activities and urban development (Department for Transport (DfT), 2004; Knippenberger & Wall, 2010; Blonigen & Cristea, 2012). Therefore strategies for the development of air transport must be considered a priority, integrating them in the context of broader strategies for economic development and the infrastructure of the country.

Europe faces a particular challenge in respect of its airport infrastructure because of limited capacity that prevents aviation responding to demand when and where it arises and the difficulty of securing planning approval for new airport infrastructure development (ACARE[2] , 2008). This is due to the dense urbanisation of the continent, the complex system of rules and planning regulations that have arisen as a result and opposition from local residents and their politicians to airport growth. Airport operations are not only limited by their infrastructure. Airports can be constrained by environmental issues which restrict current operations and limit future growth potential.

This has given rise to the concept of airport environmental capacity (Coleman, 1999; Upham et al., 2003; Thomas, 2013). It is evident that the debate on the subject is not only focused on the noise and air quality impacts on the areas surrounding the airport, but has expanded the focus on the effect that airport and aviation activities have on climate change through carbon emissions (EEA[3] , 2007, 2012; Thomas et al., 2010; NATS[4] , 2011; DEFRA[5] , 2012; Eurocontrol, 2013).

The European Commission communication COM (2011) 823 EU "Airport policy in the European Union - addressing capacity and quality to promote growth, connectivity and sustainable mobility", confronts this problem by proposing a European regulation scheme that could address three challenges, namely capacity, service quality and environment, through improving technologies, efficient operations and infrastructure design. Sustainable development at an airport concerns developing an infrastructure that facilitates the long term growth of the site so that the airport can continue to respond to demand when it arises. The conventional capacity of an airport is considered in terms of its infrastructure capacity (runways, taxiways, terminal, etc.) and how well that is managed. It is becoming increasingly clear however, that the operational capacity of an airport and its ability to grow (i.e. obtain planning approval for growth) is increasingly linked to the environmental impacts of its operations.

Principles of sustainable airport infrastructure development

A wide range of impacts on local communities and the natural environment can constrain the operation of airports and restrict their ability to secure planning approval for future growth (Upham et al., 2003; Thomas, 2004). Airport infrastructure growth depends on the assessment of those issues and the opportunity to strategically and systematically manage them during the design process. Even though the operational capacity strictly depends on infrastructure factors – such as requisite airspace, number of runways, extent of taxiway and apron development, number and size of terminals and landside facilities and the ease of access – a number of environmental constraints may prevent their potential traffic growth and future development (Thomas et al., 2010; Thomas & Hooper in Ashford, 2011; Thomas, 2013). Environmental impacts are associated with the operations of the airport and the specific conditions and characteristics that pertain the area in which the airport is located – proximity to the houses, other polluting

sources and industries, water supplies, energy resources and materials availability, climate changing conditions, sensitive habitats and others. They are even more critical when additional airport infrastructure has to be provided in order to maintain the operational efficiency related to the increasing air traffic demand (Thomas et al., 2004).

The European Commission explicitly notes that 'the development of transport systems must not be at the expense of the quality of life of citizens or the destruction of the environment. The indefinite continuation of current trends in transport in certain modes (road, air) would be unsustainable in relation to its environmental impact, in particular as regard climate change' (European Commission, 1998). This single definition of sustainable development needs to be implemented on the basis of specific social and economic conditions related to the different situations (e.g. regional and local policies, urban configuration, etc.). As a result, even if there is a general definition of this concept, this must be "translated" and adapted for every single piece of infrastructure, evaluating the magnitude of social, economic and environmental concerns, in order to define the specific conditions that impact upon sustainable development. Defining and indicating sustainability will always depend on the definition of all these interrelated aspects.

Developing Green Airport Design Evaluation (GrADE)'s method and tools

The development of sustainable airport infrastructure depends on achieving correct balance between social and economic objectives within the limits imposed by the environment (Upham et al., 2003). The integration of these concepts implies the definition of what are the environmental constraints to airport development and how this is affected by the design of infrastructure and its configuration, and technological, operational and business features. Therefore, environmental and operational capacity can be maximised through a long-term planning ensuring an effective environmental management that compensates for growth through the introduction of eco-efficient infrastructure, technological, and operating strategies (Thomas et al., 2001).

The research proposed in this paper investigates the issues concerning the project design management and the way in which

the design process affects airport terminal quality both on the environmental and technological sides (Esposito, 2010). Literature shows how acting on organizational models which emphasize the principles of collaborative process among all stakeholders, the added value derived from the integration of all the contributions is clear (Brown, 2001; Emmitt & Gorse, 2003; Dainty et al., 2006; Esposito, 2007; Rizal, 2007; Carrara et al., 2009; Kleinschmidt et al., 2010). The research for project design management and sustainability evaluation has a direct impact on the design process itself, influencing the way the product development is made, better focusing on aspects of project information integration. This matter falls within the scope of the *Framework Horizon 2020*[6] initiative, which has as main objective to bridge the gap between research, various industrial sectors and the market supporting the development of technologies and processes that have resulted in products of commercial interest toward sustainability (European Commission, 2014).

Green building assessment models

A number of tools using sustainability indicators have been developed in the last two decades. International Green Building rating systems such as LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), CASBEE (Comprehensive Assessment System for Built Environment Efficiency), GBTool (Green Building Tool), Protocollo ITACA (Istituto per l'Innovazione e Trasparenza degli Appalti e la Compatibilità Ambientale), and others have been used as an effective framework for assessing building environmental performance and integrating sustainable development into building and construction processes (Cole, 2003; Forsberg & von Malmborg, 2004; Ding, 2008; Haapio & Viitaniemi, 2008; Reed et al., 2009; Robichaud & Anantatmula, 2011; Berardi, 2012). These models, which initially represented only a tool for analysis and recognition of the environmental performance of green buildings, today are evolving into systems that combine the certification objective with that of the real performance management during the design process, providing a structured platform for the definition of the "green" project requirements and the performance measures to guide the sustainable design (AlWaer et al., 2007; Ali & Al Nsairat, 2009; Malmqvist et al., 2011). But these programmes have focused in particular upon the design of the individual building and does not consider the whole system of constraints and impacts

which specifically affects the airport development as an integrated infrastructure. Evidence suggests that in terms of sustaining the future growth and development of an airport, environmental impacts that give rise to capacity constraints and refusal of planning approval are not those associated with the energy efficiency of buildings, but rather other environmental impacts associated with the airports operation such as the disturbance caused to local residents from aircraft noise, local air quality, that is adversely affected by air and ground transport traffic etc. Therefore the research aims to define a set of sustainability indicators related to the airport design, providing infrastructural and technological solutions for minimising the environmental impacts.

Airport sustainability appraisal

Airport capacity and performance objectives and plans to achieve service level targets are not simply limited to the problems of air traffic, but also cover the ground infrastructure and the airport layout plan. The design of the airport - as infrastructure consisting of multiple functional spaces and facilities and integrated with the surrounding territory (accessibility, business investment, social return, etc.) - requires many levels of analysis and assessment to evaluate the development constraints and the impacts on the environment at different scales, in function of traffic capacity. Working in this way means that long-term planning of airport areas has to take into account environmental and social constraints (e.g. legal, community, lack of resources, etc.) and the relationship with the urban functions set up in proximity of airport areas.

Climate change, regulations and resource constraint, environmental impacts and the improving of passengers flows and changing safety requirements, increasingly demand systemic changes in the definition of the design process and of the green building requirements to comply. Strategies to make airports environmentally sustainable and climate resilient should include design methods and tools, allowing a proper design process focused on the analysis, evaluation and management of all the airport infrastructure environmental constraints. Designers have also to deal with impacts on urban planning, business costs and revenues, new financial opportunities, increased security challenges. The balance between environmental, social and economic evaluation criteria represent the core of a sustainable development.

The development of a sustainable airport - that can continue to grow in response to the arising air transport demand - requires an

architectural approach that encompasses not simply the whole airport site, but includes the wider infrastructure into which that airport is embedded. Rating systems - in order to be efficiently used in the airport infrastructure design - need to be improved through the development of methods and tools that will enable the life cycle planning incorporating considerations about the whole infrastructure as it relates to the transport demand, to its social impact – both on the passengers and the surrounding community – and the environmental constraints. All these aspects must be considered since early stage of the design process and properly evaluated in order to inform an integrated and balanced system of architectural and engineering solutions. A new airport rating system could be promoted in planning policies, harmonizing the process of growth and urban transformation with the development of the airport, which should not be considered as an isolated and autonomous entity.

Methodology

In order to achieve the proposed objectives, an initial phase of analysis and study has been carried out concerning the airport project design process and the state of the art of regulations, standards and operational and project strategies related to the green building design and the aviation industry. The analysis has been carried on through the scientific literature review and the study of international research results concerning in particular the development of sustainability rating systems.

Literature and web review has focused on methods to define, analyse and assess the concept of environmental capacity and sustainable airport development through in-depth study of the impacts arising from airport operations and infrastructure designed to:

- Identify the impacts related to the airport infrastructure development and operation;
- Define how they can act as a constraint to airport growth;
- Indicate methods for assessing their magnitude, forecasting, and monitoring those impacts;
- Examine the infrastructural design, technological, operational and business practices required to minimize those impacts.

In-depth study has been carried to define the airport-wide sustainability index. The study has been focused on the concept of airport environmental capacity: a list of "green airports" case studies

has been selected in order to identify methods, tools and best practices complying with sustainability indicators already adopted during the planning, construction, management, maintenance and decommission of European and international airports which include a sustainable vision within their development plans.

A second phase of analysis of the selected case studies is currently going on through interviews, workshops, focus groups and semi-structured questionnaires, in collaboration with the TxP Research group (Dipartimento di Architettura, Università di Firenze, Italy), the Centre for Aviation, Transport and the Environment (School of Science and the Environment, Manchester Metropolitan University, UK), academics, researchers, architects and airport design experts and Airport Industry authorities such as the Italian National Civil Authority (ENAC, Ente Nazionale Aviazione Civile), Eurocontrol and the ACI (Airport Council International).

The research is also enhanced by the proposal of a training module within the Laboratorio di Progettazione Ambientale (Environmental Design) in the Architecture Master Degree Programme at the Dipartimento di Architettura, Università degli Studi di Firenze. Students are asked to deal with the environmental issues related to the airport infrastructure using tools and methods developed through the doctoral research, providing the opportunity to evaluate their effectiveness in supporting the project design process and evaluate the most effective strategies for minimising airport impacts and improving design and technological performances.

Beyond the specific objectives of the research, these activities have raised awareness of the role of the researcher to create a dialogue between different disciplines and collaboration within experts from various fields in order to increase his/her expertise and - at a broader level - of the architect/technologist as effective interface between operators, stakeholders and experts involved in the project design process of airport infrastructure.

Expected results and research recipients

The result of this study is the application of sustainability criteria in airport design through the support of innovative operational tools. The research will define specific method and tools enabling both design

project control and sustainability appraisal. The method will be based on systematic process, linked to modeling studies and the development of sustainability indicators that would inform a site wide and Life cycle approach to the design of airport infrastructure. This type of project design organization enables the management of the sustainability requirements and it also ensures the consistent verification of all project levels of development, from the project conception to the construction and operation and maintenance.

The Green Airport Evaluation Design method and tools will contribute in achieving the goal of sustainable development of airport infrastructure providing a methodological framework to measure and monitor environmental performance and creating new opportunities for the aviation regulatory organisations and airport managers to define strategies and anticipate decisions to enhance sustainable airport infrastructure design.

Future developments

In order to achieve higher levels of sustainability the proposed method and tools represent a good practice for the airport system which is always open to revisions and implementations imposed by the continuous increase of passengers flows, development of technology, updating of standards and evolution of the sustainability design approach itself (Zografos and Madas, 2006). The next step is the integration between the decision-making and design process in the airport field already green aimed and BIM (Building Information Modelling) simulation emerging in the international panorama. Possible future developments of the research are then aimed at the elaboration of green performance specifications integrated with Building Information Modeling & Management (BIM(M)) suitable for the airport industry (Whyte, 2012).

Notes

1. The operational capacity of an airport can be constrained to below its infrastructure capacity if the environmental consequences of its operation exceed environmental regulatory limits, public acceptability or the airport is unable to secure adequate supplies of resources to meet customer service requirements.
2. Advisory Council for Aviation Research in Europe

3. European Environment Agency
4. National Air Traffic Services
5. Department for Environment, Food and Rural Affairs
6. Horizon 2020 is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. Seen as a means to drive economic growth and create jobs, Horizon 2020 has the political backing of Europe's leaders and the Members of the European Parliament. They agreed that research is an investment in our future and so put it at the heart of the EU's blueprint for smart, sustainable and inclusive growth and jobs (www.ec.europa.eu).

References

ACARE – ADVISORY COUNCIL FOR AIRPORT RESEARCH IN EUROPE (2008) Addendum to the Strategic research Agenda

ALI H.H., AL NSAIRAT S.F. (2009) Developing a green building assessment tool for developing countries: case of Jordan, Building and Environment (44), pp. 1053-1064.

ALWAER H., SIBLEY M., LEWIS J. (2007) Factors and Priorities for Assessing Sustainability of Regional Shopping Centres in the UK, Architectural Science Review, 51:4, 391-402

BERARDI U. (2012) Sustainability assessment in the construction sector: rating systems and rated buildings. Sustainable Development (20), pp.411-424.

BLONIGEN B.A., CRISTEA A.D. (2012) Airports and urban growth: evidence from quasi-natural policy experiment

BROWN S. A. (2001) Communication in the Design Process, Spon Press, London

BUTTON K., LEITHAM S., MCQUAID R.W., NELSON, J.D. (1995) Transport and industrial and commercial location, The Annals of Regional Science, 29, 189-206

CARRARA G., FIORAVANTI A., KALAY Y. E. (2009) Collaborative working environments for architectural design, Palombi & Patrner Srl Rome

COLE R.J. (2003) Building environmental assessment methods - a measure of success

COLEMAN R.J. (1999) Environmentally sustainable capacity.

Proceedings of the ECAC/EU Dialogue with the European Air Transport Industry: Airport Capacity—Challenges for the Future, Salzburg 15–16 April, European Civil Aviation Conference, Neuilly sur Seine, France, pp.118–125.

DAINTY A., MOORE D., MURRAY M. (2006) Communication in Construction: Theory and Practice, Taylor and Francis, Oxon

DEFRA - DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS (2012) Adapting to Climate Change: helping key sectors to adapt to climate change Government Report for the Adaptation Reporting Power, London, available at www.gov.uk/government/publications/adapting-to-climate-change-helping-key-sectors-to-adapt-to-climate-change, accessed 13 July 2013

DFT – DEPARTMENT FOR TRANSPORT (2004) The importance of transport in business' location decisions, London

DING G.K.C. (2008) Sustainable construction - The role of environmental assessment tools, Journal of Environmental Management (86), pp. 451-464

EMMITT S., GORSE C. A. (2003) Construction Communication, Blackwell Publishing, Oxford

ESPOSITO M.A. (2007) I sistemi organizzativi per progettare in qualità e la qualità del progetto, Qualità, Gennaio-Febbraio, AICQ, Torino, 37–39

ESPOSITO M.A. (2010) Envelope's Detail for the Green Airport Terminal, Firenze University Press, Firenze.

EUROCONTROL (2013) Challenges of Growth 2013 Summary Report, Eurocontrol, available at https://www.eurocontrol.int/sites/default/files/content/documents/official-documents/reports/201307-challenges-of-growth-summary-report.pdf

EUROPEAN COMMISSION (1998) The Common Transport Policy. Sustainable Mobility: Perspectives for the Future, Commission Communication to the Council, European Parliament, Economic and Social Committee and Committee of the Regions, DG VII. Brussels: European Commission.

EUROPEAN COMMISSION (2011) Airport policy in the European Union - addressing capacity and quality to promote growth, connectivity and sustainable Mobility, COM(2011) 823, available at http://ec.europa.eu/transport/modes/air/airports/doc/2011-airport-package-communication_en.pdf

EUROPEAN COMMISSION (2014) Horizon 2020 in brief. The EU Framework Programme for Research & Innovation, Luxembourg

EEA - EUROPEAN ENVIRONMENT AGENCY (2007) Climate for transport change. TERM 2007: indicators tracking transport and environment in the European Union, EEA Report No. 1/2009, Copenhagen

FORSBERG A, VON MALMBORG F. (2004) Tools for environmental assessment of the built environment. Building and Environment (39), pp. 223-238.

HAAPIO A. AND VIITANIEMI P. (2008) A critical review of building environmental assessment tools, Environmental Impact Assessment Review (28), pp. 469-482

KLEINSCHMIDT T., GOONETILLEKE A., FOOKES C.B., YARLAGADDA P.K.D.V. (2010), A Multi-Disciplinary Approach for the Design and Management of Airport Terminals, in 3rd International and 24th All India manufacturing Technology, Design and Research Conference (AIMTDR 2010), 13-15 December 2010, Visakhapatnam, India

KNIPPENBERGER U., WALL, A. (2010) Airports in cities and region. Research and practice, Universität des Landes Baden-Württemberg und nationals, Karlsruhe

MALMQVIST *et alii* (2011) A Swedish environmental rating tool for buildings, Energy 36, 1893e1899

NATIONAL AIR TRAFFIC SERVICES (2011) Climate Change Adaptation Report, Issue 1.0; available at http://archive.defra.gov.uk/environment/climate/documents/adapt-reports/08aviation/nats-climate-change-report.pdf

REED R, BILOS A, WILKINSON S, SCHULTE K-W. (2009) International comparison of sustainable rating tools. Journal of Sustainable Real Estate (1), pp.1-22.

RIZAL S. (2007) Managing collaborative design, Eburon, Delft

ROBICHAUD L.B., ANANTATMULA, V.S. (2011) Greening Project Management Practices for Sustainable Construction, journal of Management in Engineering (27), pp. 48-57

THOMAS C., UPHAM P., RAPER D. (2001) Environmental capacity

of aviation: theoretical issues and basic research directions. Journal of Environmental Planning and Management 44 (5), 721–734.

THOMAS C. S., HUME K.I., HOOPER P. D. (2004) Aircraft Noise, Airport Growth and Regional Development, in Proceedings of the Royal Aeronautical Society/American Institute of Aviation Acoustics Conference, Manchester, May 10–12

THOMAS C., HOOPER P., RAPER D. (2010) Air transport in an environmentally constrained World, Journal of Airport Management, 5(1): 4-6

THOMAS C., HOOPER P. (2011) Sustainable Development and Environmental Capacity of Airports, in Ashford, N.J., Mumayiz, S., Wright, P.H. (2011) Airport Engineering. Planning, Design, and Development of 21st Century Airports, Fourth Edition

THOMAS C. (2013) Aviation and its environmental impacts, Manchester Metropolitan University

TRINDER D. (2001) Transport Infrastructure and Economic Growth, Structural Issues Development Group Working Paper 01(06)

UPHAM P., THOMAS C., RAPER D., GILLINGWATER D. (2003) Environmental capacity and airport operations: current issues and future prospects, Journal of Air Transport Management 9, p: 145-151.

WHYTE J. (2012) Building Information Modeling in 2012: Research Challenges, Contributions, Opportunities, Design Innovation Research Centre, working paper 5(1.01).

WOUDSMA C., JENSEN J.F. (2003). Transportation's influence on land use development: a historical spatial-temporal approach

ZOGRAFOS K.G., MADAS M.A. (2006) Development and demonstration of an integrated decision support system for airport performance analysis, Transportation Research Part C (14), 1–17

Titoli pubblicati

1. Daniela Romagno, *Geni TBX e patologia umana*
2. Paolo Fabiani, *La filosofia dell'immaginazione in Vico e Malebranche*
3. Gabriele Paolinelli, *La frammentazione del paesaggio periurbano*
4. Andrea Zorzi (a cura di), *Storia di un dottorato: storia medievale nell'Università di Firenze*
5. Aglaia Viviani, *Strange spirits and even stranger bodies*
6. Giulio Gino Rizzo, Antonella Valentini (a cura di), *Luoghi e paesaggi in Italia*
7. Enrica Dall'Ara, *Costruire per temi i paesaggi?*
8. Emanuela Morelli, *Disegnare linee nel paesaggio*
9. Francesca Capone, *I sistemi locali turistici in Italia*
10. Maristella Storti, *Il paesaggio storico delle Cinque Terre*
11. Fabio Lucchesi, *Il territorio, il codice, la rappresentazione*
12. Luigi Burroni (a cura di), *L'agenda del lavoro*
13. Massimo Carta, *Progetti di territorio*
14. Giovanni Bonaiuti, *Strumenti della rete e processo formativo*
15. Alessandra Cazzola, *I paesaggi nelle campagne di Roma*
16. Barbara Bruni, *La Biblioteca della Külliye di Kavála*
17. Laura Ferrari, *L'acqua nel paesaggio urbano*
18. Antonella Valentini, *Progettare paesaggi di limite*
19. Michele Ercolini (a cura di), *Dalle esigenze alle opportunità*
20. Maria Antonietta Esposito, *Tecnologia dell'architettura: creatività e innovazione nella ricerca*
21. Anna Lambertini, *Fare parchi urbani*
22. Tania Salvi, *La contabilità ambientale regionale*
23. Piergiuseppe Calà, *Studio sulla contaminazione ambientale delle acque causata dall'escrezione umana dei farmaci*
24. Michele Ercolini, *Fiume, paesaggio, difesa del suolo*
25. Giovanna Del Gobbo, *Il processo formativo tra potenziale di conoscenza e reti di saperi*
26. Romina Nesti, *La "vita autentica" come formazione*
27. Lorenzo Pubblici, *Dal Caucaso al Mar d'Azov*
28. Claudia Cassatela, Enrica Dall'Ara, Maristella Storti (a cura di), *L'opportunità dell'innovazione*
29. Alessandro Sonsini (a cura di), *Interazione e mobilità per la ricerca*
30. Guido Ferrara, Giulio Gino Rizzo, Mariella Zoppi (a cura di), *Paesaggio: didattica, ricerche e progetti (1997-2007)*
31. Marco Giosi, *Stanley Cavell: un percorso "dall'epistemologia al romanzo"*
32. Elisabetta Ginelli (a cura di), *La ricerca a fronte della sfida ambientale*

33. Giorgio Costa, *Nessuna isola è un'isola*
34. Patrizia Meli, *Gabriele Malaspina marchese di Fosdinovo*
35. Andrea Zorzi (a cura di), *Percorsi recenti degli studi medievali*
36. Orio De Paoli, Elena Montacchini (a cura di), *Innovation in research: the challenge and activities in progress. L'innovazione nella ricerca: la sfida e l'attività in corso*
37. Massimo Lauria (a cura di), *Produzione dell'Architettura tra tecniche e progetto. Ricerca e innovazione per il territorio. Architectural Planning between build and design techniques. Glocal oriented research and innovation*
38. Maria Luisa Germanà (a cura di), *Permanenze e innovazioni nell'architettura del Mediterraneo: ricerca, interdisciplinarità e confronto di metodi. Mediterranean Architecture between Heritage and Innovation: research, Interdisciplinary Approach and Comparison of Methods*
39. Roberto Bolici, Matteo Gambaro, Andrea Tartaglia (a cura di), *La ricerca tra innovazione, creatività e progetto. Research among Innovation, Creativity and Design*
40. Monica Rossi, Federica Ottone (a cura di), *Teorie e sperimentalismo progettuale per la ricerca in tecnologia dell'architettura. Theories and experimental design for research in architectural technology*
41. Filippo Bosi, Paolina Ferrulli, Elisabetta Fossi (edited by), *Looking to methods and tools for the Research in Design and Architectural Technology*