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Research in Design and Architectural  
Technology

edited by

FILIPPO BOSI, PAOLINA FERRULLI AND ELISABETTA FOSSI

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# Airport Lean Design

FILIPPO BOSI

*PhD Candidate, XXVIII cycle*

*Università degli Studi di Firenze, Dipartimento di Architettura*

## *Abstract*

The Aviation Industry challenge airports with capacity and quality demands. Airport Terminal Design is becoming more critical as a part of the aviation industry supply chain because it affects the operation phase of the airport, therefore capacity, efficiency and passenger experience quality.

Traditional design methodologies based on schematic approaches are not sensible to the general variability of the operation phase. Expensive design errors showed the need to push design towards more integrated processes based on information sharing within the Design Team, Airport Owner, Authorities, etc.

The research introduced in this paper proposes the experimentation of innovative methodologies and tools for Airport Design, aiming to simplify project activities, eliminate errors (wastes) and to improve the value of the design itself to the user. Such methodologies are identified as Lean Processes. The originality of the research is in its transfer to Project Design Management, integrating aspects of the operation phase since the inception of the design.

Generating value during the design is crucial to identify needs and to convert them in design requirements and performance sets, i.e. project information.

Consequentially, construction, operation and de-commissioning are driven by knowledge-intensive and model-based information. Lean methodologies enable an integrated approach throughout the whole project life cycle, increasing the reliability of the process.

The aim is to define a Lean Design Methodology to be field-tested on international airport case studies. Integrated Lean Design goes through all the phases of the design and project life cycle, offering a general methodology that can be tailored according to the case studies through the tools. National and international airport terminal project case studies will be used for testing the methodology and its tools in the field.

The expected results of this research are a project design and management methodology and design tools. BIM tools are seen as a technological backbone for project information management and documentation production in the life cycle, improving integration of the process and allowing coherence in project information creation and management. Areas for improvement of common practices based on Lean mindset principles are defined within this research.

### *Keywords*

Project Design Management, Airport Terminal Design, Lean Design, Design Science Research, Information Modeling, Design Methodologies and Tools, Project development, Building Information Modeling & Management

### *Capacity and quality challenge for the Aviation Industry*

The European Commission with its 2011 Communication (EU: European Commission, 2011a) to the European Parliament has set new quality, capacity and environment targets for the development of the Common Air Space 2030. The EC Regulation Single European Sky II (EU: European Commission, 2011b) aims to increase economic growth, connectivity and sustainable mobility. It also introduces a set of Key Performance Indicators for the Aviation Industry.

To confront the traffic growth foreseen for 2030 (Eurocontrol, 2013a) airports have to align their development with the other means of transport, considering the resistance and the resilience of the system. They have to maintain an acceptable Level of Service (de Neufville R., Odoni A., 2003) under any circumstances to deliver a quality passenger experience (Bosi, 2014b). Therefore is necessary to manage the quality of the service and the entire life cycle of the project. Often the airport owner and the designers do not have the required profiles and skills to achieve and manage an integrated project (Esposito & Macchi, 2012).

The Architecture, Engineering and Construction Industry (AEC) needs to include the technical prescriptions of the specific sector. The airport project is characterized by the participation of many experts coming from different areas and the impermanence of their rapport. This causes the need for a greater level of integration in comparison to other typologies of projects.

In recent years the necessity to improve project development process performances has grown in parallel with market competitiveness



and projects' general complexity. Inefficiency of communication, lack of information and document output errors are the most common and important problems of Design Management, causing disruptions in the integration of multidisciplinary contributes in the project. In addition, reworkings cause overlaps in the latter phases, between Final Proposals and the start of the construction phase. This rework leads to incremental cost and schedule increases (Tzortzopoulos & Formoso 1999; Esposito & Macchi, 2012).

Moreover documental output planning and control do not have the required level of efficiency in common practices, culminating in project non-compliances with technical references and current regulations (Bosi, 2014a).

Traditional design methodologies based on schematic approaches are not sensible to the variability of the operation phase of airports. According to Harrison and Popovic (2012) the greatest failures of common practices are:

- Constrictions originated by the airport and the outer system.
- Aviation Industry Stakeholders' vagueness about the Level of Service (LOS) concept. A higher LOS – being based on metrics – does not necessarily convey superior services to the passenger.
- Asymmetry in the LOS/Passenger Experience relationship. Adhering to required LOS does not imply a satisfying passenger experience.

Common practices in design are mostly guided by previous experiences and are lacking in a structured approach. This has led to million-dollar-worth “cut and try” designs that failed (Harrison & Popovic, 2012). Understanding final user needs – i.e. their meaning of value – is one of the pillars of the Lean Theory (Koskela, 2000) and is necessary to achieve airport terminal projects that convey a quality passenger experience, fulfill capacity requirements and provide an adequate overall LOS in every condition, that is infrastructure resilience achieved through design.

Transferring the Lean Mindset from construction (Biton & Howell, 2013) to Project Design Development (Mesa & Howell, 2013) implies the involvement of all parties, to identify and define the specific meaning of value for the project, along with the sub-processes that generate and add it to the final product (Bosi, 2014a). Starting from this synergies will be developed an Airport Design Process Value Stream Map (Emmit et al., 2004; Bogus et al., 2008).

In Airport Terminal Design the performance-based approach prevails, responding to the evolving nature of the airport project and the Life Cycle Design model. Issues related to the integration of Information Modeling to solve design problems and its implementation will be examined, together with the management of the disposal of the building.

The AEC Industry is based on products and services, therefore focusing on the project development flow might result in major benefits for the final users in terms of value (Koskela, 2000), where the project is intended as final product (Emmitt et al. 2004; Bertelsen, 2013).

The International Group for Lean Construction defined in 1993 the fundament of Lean Mindset: The principle at the base of Lean is meeting requirements of the project with a lower consumption of resources. Its focus are delivering the maximum value for the customer (i.e. final user) and the continuous improvement of the process.

Lean implementation in common practices can boost the performances of the design team. Prerequisites for its integration are:

- Definition of design conventions;
- Management of communication processes in project teams.

Lean Project Management aims to integrate project objectives and defined requirements using methods and tools that increment the effectiveness and efficiency of the single processes. This reduces wastes (Koskela, 2000; Koskela et al., 2013) and improves the coordination and integration of the project team (Tzortzopoulos & Formoso, 1999; Emmitt & Sander 2004; Rocha & Formoso, 2012).

Value pursuit has to be carried out with proper tools. Both Lean and Building Information Modeling are having a deep impact on the Industry. Research have proven that the project visualization capabilities allowed by Building Information Modeling improve the reliability of the process, permitting the Design Team to view and control the project development process and to map the tasks for every project element and stakeholder (Dave et al., 2010; Sacks & Koskela, 2010; Eastman et al. 2011; Ciribini, 2013). Process reliability is one of the keys of Lean.

Involving the stakeholders in a downstream flow to gather feedbacks on the model and granting access to the most updated information on production is also important. At the inception of design their contribution is most valuable, especially regarding the constructability of the model and the Level of Detail (Dave et al. 2013; Sacks & Koskela, 2010).

The novelty of the research is applying Lean theory to the project development process, developing a methodologies that applies two transformative technologies (Sacks & Koskela, 2010) to the design process.

### *Transferring Lean to Design Management & Project Development*

The problem addressed by the research is the implementation Integrated Design Methodologies in the Design Process of green airport terminals.

The research deals with methodological aspects of the project, using case studies and field experimentation to draw useful elements to define a design methodology and tools based on the Lean Mindset. These aim to generate value for the end users with the project, reducing and possibly eliminating wastes in project development activities. Wastes are defined for this work as man-hours and re-workings.

Moreover the research aims to clarify the contemporary scenario and to foresee tendencies in project design emerging from surveys conducted on case studies, best practices and problems observed in the current Airport Terminal Design Project methodologies.

The interactions between Lean and Information Modeling and their combination can have a transformative power on the project development process and the design process as a whole. The transformation-value mindset and by consequence Integrated Lean Design goes through all the phases of the design and project life cycle, having also strong constructive interactions with the later phases of the building life cycle.

BIM tools are seen as a technology backbone for project information management and documentation production in the life cycle, improving integration of the process and allowing coherence in project information creation and management.

### *Research methodology overview*

The research program foresees the definition of the industrial and scientific problem, through the analysis of the state of the art , international best practices and Integrated Airport Design case studies, where innovative project methodologies were used with Integrated Design tools and technologies.

A literature review on the topics of Airport Design, Lean Mindset, Lean Processes, Lean Project Delivery, Lean Design Management,

Integrated Project Delivery and Information Modeling deepened the scientific problem and study the interactions between Lean Project Design Delivery and Airport Terminal Design. Most of the references are international, considering the relevance of related studies conducted by universities and research groups worldwide. Manuals produced on the subject by international researchers allow to acquire the theoretical foundations of Building Information Modeling with specific reference to the organization of the Information produced in the project output of the design industry.

Is expected the involvement of airport owners and multidisciplinary design teams, using both synergies already developed thanks to previous researches (PLANe©, GAME©, GREAT©, BASIC©, LEAD©, etc.; [www.txpresearch.wordpress.com](http://www.txpresearch.wordpress.com)) and newly instituted relations developed within seminars, workshops and the research in general.

From the State of the Art analysis is drawn the needed knowledge to understand the Project Development Process for airport terminals and its relationship with the building life cycle and specifically the Operation and Maintenance phase of the building, the longest in terms of time. The stakeholders involved in the project will be profiled with interviews and semi-structured questionnaires.

The main criticalities of the common practice in Airport Terminal Design will be pinpointed with custom Process Register forms, to highlight bottlenecks and wastes.

Will be drawn elements useful to the research according to the main objectives of the research:

- Definition of a scenario related to the inherent problems in the design process of the airport terminals
- The identification of the information needs of different stakeholders - users involved in the design process and the corresponding methodological approaches and ICT/IM used in relation to the various design activities.

These activities will be sided by the analysis of already completed projects on topics of interest for the research regarding collaborative design (Project Avanti, 2009) and Airport Design (Queensland University of Technology, 2012).

Case studies of BIM integration in Airport Design practices will be analyzed, to study the penetration of Information Modeling & Management technologies in the industry.

This will allow to define the state of the art and draw elements for Lean Project Development methodology. In addition to these, the

information modeling tools already developed by TxP Research will be refined and field tested on international case studies.

### *Expected results*

The research and its final products aim to define a Lean project design development methodology for airport terminals through the technological-performance analysis, the use of tools and models useful for improving process efficiency and therefore value. The methodology will provide Integrated Project Delivery teams a medium for close collaboration and integration that crosses normal company boundaries. The general methodology can be tailored according to the case studies through the tools. National and international airport terminal project case studies will be used for testing the methodology and its tools in the field.

It will be possible to arrive at the development of terminal concepts, that are needed to translate reference requirements into specific design details. These terminal concepts will be applicable to new projects as well as to those projects in the masterplan or preliminary design phases and will allow users to achieve the sustainability requirements of the Horizon2020 Research & Development framework.

The developed methodology is expected to streamline the project flow. These meets the wishes of the Italian Authority for Civil Aviation's (Ente Nazionale Aviazione Civile, ENAC), that aims to a faster projects approval to reduce times and costs for the national airport network.

### *Recipients of the research and feasibility*

The recipients and potential funders are:

- The scientific field of reference, which can further research and further develop its products;
- Stakeholders from the civil aviation industry;
- Managers interested in airport development methodologies and design verification . The client - especially if it also has to manage the work - takes decisions based on projects' risks and could use the integrated IM tools to optimize procurement and contract management.

The civil aviation industry and airport owners will be direct beneficiaries, the latter being the earliest adopters of the production facility: the airport is intended as an embarking factory. Indirect recipients are the other parties involved in the Airport supply chain:

customers (eg. Airlines), users (passengers), designers, construction companies and manufacturers of components and systems that can integrate the information model that is the backbone of the methodology. The research will constitute a database on the state of the art of design methodologies for green terminals, in addition to defining methodologies and tools for project delivery management. Another strength is the integration and the impetus to the improvement of Information Modeling-related methodologies for the design, with the possibility of obtaining technical and scientific support from stakeholders from the industry, multidisciplinary design teams and professional software developers.

Possible difficulties may arise from potential lack of information, due to the asymmetry of information channels regarding already published case studies and available material during the field-tests of the methodology.

#### *Future developments*

The definition and development of a Lean methodology leaves questions unanswered and areas for development. It provides the possibility to extend field-proven methodologies to other types of buildings with a knowledge transfer.

Interest for the research could be expressed by universities, the industry, airport management companies, project participants in general and especially designers of the Aviation Industry.

It is assumed the finalization of the research results in a form of learning, aimed to align the design cultures of Architecture, Engineering, Economics & Finance with the quality requirements of civil aviation, with the PhD Candidate seen as vehicle of expertise. Studies in Design Science Research applied to Design Process Management offer an opportunity to reflect and discuss on Lean theory application in general and its transfer to the other phases of the building process.

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*References*

- AIRPORTS COMMISSION (2013) Airports Commission: Interim Report (published Dec 17th 2013), Airports Commission, available at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/271231/airports-commission-interim-report.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/271231/airports-commission-interim-report.pdf)
- ARAYICI Y., COATES P., KOSKELA L., KAGIOGLOU M., USHER C., O'REILLY K. (2011) BIM adoption and implementation for architectural practices, *Structural Survey*, vol. 29, n. 1, p.7-25.
- BITON N., HOWELL G. (2013) The Journey of Lean Construction Theory Review and Reinterpretation. In: FORMOSO, C.T. & TZORTZOPOULOS, P., 21th Annual Conference of the International Group for Lean Construction. Fortaleza, Brazil, 31-2 Aug 2013, 125-132
- BOGUS S., SONGER A.D., DIEKMANN J. (2000) Design-Led Lean. In: 8th Annual Conference of the International Group for Lean Construction. Brighton, UK, 17-19 Jul 2000.
- BOSI F., ESPOSITO M.A. (2014a) Achieving Lean Project Design Delivery. In ESPOSITO M.A., CIRIBINI A., DELL'OSSO G., DANIOTTI B., CARBONARI A., ALAIMO G. (2014) Energy, sustainability and building information modeling and management energia, sostenibilita' e dematerializzazione operativa – Proceedings of the 2014 ISTeA Conference, Bari, 10-11 Luglio 2014, Maggioli Editore, Milano, p. 512.
- BOSI F., ESPOSITO M.A. (2014b) Passenger Experience Design. In *Miradas a la investigación arquitectónica: construcción, gestión, tecnología – Architectural research findings: building construction, management, technology*, Proceedings of the CONSTEC2014, I Congreso Internacional sobre Investigación en Construcción y Tecnología Arquitectónicas, Madrid, June 11th-13th 2014, Escuela Técnica Superior de Arquitectura de Madrid
- BOSI F., ESPOSITO M.A. (2014c) Lean-enabling tools for Airport Terminal Design – Overview of the application of tailored Information Modeling Tools to promote team efficiency, support optioneering and project control, Proceedings in Conference of Informatics and Management Sciences, 3rd International Virtual Conference ICTIC, March 24th-28th, 2014, Zilina, EDIS – Publishing Institution of the University of Zilina.

- CHUNG J.K.H., KUMARASWAMY M.M., PALANEESWARAN E. (2009) Improving megaproject briefing through enhanced collaboration with ICT, *Automation in Construction*, Vol. 18, n. 7, p. 966-974.
- CIRIBINI A. L. (2013). L'information modeling e il settore delle costruzioni: IIM e BIM. Maggioli Editore., Milano, p. 458.
- DAVE B. , BODDY S. & KOSKELA L. (2011) Visilean: Designing a Production Management System With Lean and Bim. In ROOKE, J. & DAVE, B. (2011) 19th Annual Conference of the International Group for Lean Construction. Lima, Peru, 13-15 Jul 2011.
- DE NEUFVILLE R., ODONI A. (2003) *Airport Systems: Planning, Design, and Management*, New York, NY: McGraw-Hill Professional, p. 883.
- EASTMAN C., TEICHOLZ P., SACKS R., & LISTON K. (2011). *BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors*, Wiley & Sons, Hoboken, New Jersey, p. 648.
- EMMITT S., SANDER D., CHRISTOFFERSEN A.K. (2004) Implementing Value Through Lean Design Management. In BERTELSEN S., FORMOSO C.T., 12th Annual Conference of the International Group for Lean Construction. Helsingør, Denmark, 3-5 Aug 2004.
- ESPOSITO M. A., MACCHI I. (2012) Low Carbon Airport projects development using the Design Gap Risk Threshold approach, *International Journal of Design Sciences and Technology*, Vol. 19, n. 1, p. 45–62.
- 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 UNION: EUROPEAN COMMISSION (2011a) *Airport policy in the European Union - addressing capacity and quality to promote growth, connectivity and sustainable mobility*, December 1st 2011, COM(2011) 823 final. Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF>
- EUROPEAN UNION: EUROPEAN COMMISSION (2011b) *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*, March



- 28th 2011, COM(2011) 144 final. Available at: [http://ec.europa.eu/transport/modes/air/airports/doc/2011-airport-package-communication\\_en.pdf](http://ec.europa.eu/transport/modes/air/airports/doc/2011-airport-package-communication_en.pdf)
- EUROPEAN UNION: EUROPEAN COMMISSION, SE n.d., Single European Sky. Available at < [http://ec.europa.eu/transport/modes/air/single\\_european\\_sky/](http://ec.europa.eu/transport/modes/air/single_european_sky/)>
- HARRISON A., POPOVIC V., KRAAL B.J., KLEINSCHMIDT T. (2012) Challenges in passenger terminal design : a conceptual model of passenger experience. In ISRASENA, P., TANGSANTIKUL, J., DURLING, D. (2012) Proceedings of the Design Research Society (DRS) 2012 Conference, Department of Industrial Design, Faculty of Architecture, Chulalongkorn University, Chulalongkorn University, Bangkok, p. 344-356.
- KOSKELA L. (2000). An Exploration towards a Production Theory and its Application to Construction (Ph.D.). Finland: VTT Technical Research Centre of Finland, p. 408.
- KOSKELA L. BØLVIKEN T. (2013) Which Are the Wastes of Construction? In FORMOSO, C.T., TZORTZOPOULOS, P., 21th Annual Conference of the International Group for Lean Construction. Fortaleza, Brazil, 31-2 Aug 2013. p. 3-12
- ALARCÓN L.F., MESA H. & HOWELL G. (2013) Characterization of Lean Project Delivery. In FORMOSO, C.T., TZORTZOPOULOS, P., 21th Annual Conference of the International Group for Lean Construction. Fortaleza, Brazil, 31-2 Aug 2013, p. 247-255.
- QUEENSLAND UNIVERSITY OF TECHNOLOGY (2012) Airports of the Future Project annual report 2011. Available at [http://www.airportsofthefuture.qut.edu.au/publications/documents/AOTF\\_AnnualReport2011.pdf](http://www.airportsofthefuture.qut.edu.au/publications/documents/AOTF_AnnualReport2011.pdf)
- SACKS R., KOSKELA L., DAVE B. & OWEN R. (2010) Interaction of Lean and Building Information Modeling in Construction, Journal of Construction Engineering and Management, Vol. 136, n. 9, p. 968–980.
- TZORTZOPOULOS P., FORMOSO C.T. (1999) Considerations on Application of Lean Construction Principles to Design Management. In 7th Annual Conference of the International Group for Lean Construction, Berkeley, USA, 26-28 Jul 1999, p. 335-344.

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