

Roadmap on the Future Research Needs of Tall Buildings

Editors: Philip Oldfield, Dario Trabucco & Antony Wood





Bibliographic Reference:

Oldfield, P., Trabucco, D. & Wood, A. (eds.) (2014) *Roadmap on the Future Research Needs of Tall Buildings*. Council on Tall Buildings and Urban Habitat: Chicago.

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Layout & Design: Marty Carver & Steven Henry

Copy Editor: Daniel Safarik

First published 2014 by the Council on Tall Buildings and Urban Habitat

Published by the Council on Tall Buildings and Urban Habitat (CTBUH)

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Printed and bound in the USA by Source4

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ISBN13 978-0-939493-36-4

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Executive Summary

Aims and Objectives

This Roadmap has three primary aims:

1. To identify research which is important in tall buildings.
2. To identify immaturity (research gaps) in the field of tall buildings.
3. To suggest research priorities in the field of tall buildings.

“Research gap” is defined as an area of research that is significantly immature and/or is suffering from a significant lack of available information and knowledge in the field.

“Priority research” is defined as an area of research that requires priority funding and scientific interest in order to advance the typology of tall buildings in the coming years.

The main objective of the Roadmap is to create a guide for the CTBUH, CIB, UNESCO and all those involved in tall buildings to assist in the planning of future research and the pursuit of funding, in order to advance the typology to its optimum level. This may include, for example:

- Funding bodies using the Roadmap to establish the potential impact of funding bids, or for the development of specific calls for projects.
- Researchers/research organizations using the Roadmap to focus their research activities and develop funding bids.
- PhD candidates using the Roadmap to explore research topics that are under-developed and worthy of PhD proposals.

The Roadmap’s intended audience includes intergovernmental organizations, national governments and agencies, non-governmental organizations, academia and research institutes, industry and industry umbrella organizations.

This Roadmap has been initiated as a joint venture between the Council on Tall Buildings and Urban Habitat (CTBUH), the International Council for Research and Innovation in Building and Construction (CIB) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

In order to facilitate the dissemination of the Roadmap findings and to promote the opportunities for research for both individuals and companies, this document is available for free download on the CTBUH website at: www.ctbuh.org/roadmap

In addition, a physical copy of the Roadmap will be mailed to the following:

- All CTBUH organizational members
- Key public and private research funding bodies
- Selected city authorities
- Selected universities
- Other organizations with a high interest in research in these fields

Approach

Discussion on such a document started in 2010 when more than 80 researchers from all over the world gathered at the Iuav University of Venice for the inaugural meeting of the CTBUH Academic Research and Postgraduate Working Group. In 2012 a first open-ended questionnaire was released to 20,000 colleagues to initiate the Research Roadmap; its aim was to identify what possible research topics were considered to be of importance, across all disciplines, by researchers and professionals around the world. In 2013 a second questionnaire was released. This was aimed at ranking and prioritizing the 1,243 research topics resulting from the first questionnaire that had been divided into 11 broad research fields covering all aspects of tall building planning, design, construction and management. These 11 fields are:

1. Urban Design, City Planning and Social Issues
2. Architecture and Interior Design
3. Economics and Cost
4. Structural Performance, Multi-Hazard Design and Geotechnics
5. Circulation: Vertical Transportation and Evacuation
6. Fire and Life Safety
7. Cladding and Skin
8. Building Materials and Products
9. Sustainable Design, Construction and Operation
10. Construction and Project Management
11. Energy: Performance, Metrics and Generation

Highlighted Findings

The results of the investigation are described in detail in each specific section of this publication. The ten most important findings of the Roadmap are highlighted below:

1. The social sustainability of tall buildings

A clear trend for priority research identified in the Roadmap is a focus on the social sustainability of tall buildings, at both an urban and a building scale, with topics related to the social role of tall buildings and tall building living among the highest ranked topics in the field of both *Urban Design, City Planning and Social Issues* and *Architecture and Interior Design*.

There is a clear trend across the two fields, suggesting that a significant group of responders believe research to improve the social impact of tall buildings on both surrounding communities, and on those who live and work at height, is a significant research priority.

2. Energy performance of tall buildings

Energy: Performance, Metrics and Generation has the highest mean priority value of all sections (7.6) denoting that research in this broad area is a priority to evolve the typology of tall buildings. This is also reflected by the highest average immaturity score in all sections (3.6), showing that even though a lot has been written on the subject in recent years, topics of this category still need to be developed .

3. Safety in tall buildings

Four out of the five topics that scored highest research priority across the entire Roadmap, deal with safety and security in tall buildings, as a combined effect of extremely high importance and relevant immaturity. This shows that tall buildings are still seen as a vulnerable typology, especially under fire scenarios.

4. Defining appropriate levels of safety performance in tall buildings

A second broad trend in the domain of safety that is apparent from the Roadmap results is the need for research to establish appropriate levels of safety performance in tall buildings. In particular, this is evident from the scores in two fields: *Structural Performance*, *Multi-Hazard Design and Geotechnics* and *Fire and Life Safety* where several topics related to the safety performance of tall buildings are all ranked among the highest priority topics.

5. The embodied energy of tall buildings and their components

When talking about environmental sustainability, current emphasis has shifted to also include the environmental impact of building materials and components. Research has suggested that, due to their greater structural requirements, tall buildings use more embodied energy than low-rise buildings and the results of the Roadmap here highlight that both establishing and reducing embodied energy in tall buildings is considered a priority topic across multiple fields.

Topics connected to the environmental performance of building systems and products can be found among the highest ranking topics in the *Sustainable Design, Construction and Operation*; *Building Materials and Products*; and *Cladding and Skin* fields.

6. Life-cycle sustainability of tall buildings

In a similar manner to the calls for priority research on embodied energy above, the Roadmap shows that more research is needed on tall building life-cycle sustainability issues beyond day-to-day operations. While this broad area includes embodied energy and the specific topics previously mentioned, other highly prioritized topics include material and component durability, the design for easy repair and replacement of materials, disassembly and deconstruction of tall buildings, strategies to extend tall buildings' lifecycles, adaptive reuse and retrofitting, research to determine whole-life-cycle impacts of tall buildings, and the holistic and integrated sustainable performance of tall buildings.

Again, this broader thinking in terms of tall building sustainability is a reflection of current thought in the built environment community as a whole, but also identifies the need for research dedicated to the unique challenges and opportunities of tall building lifecycles specifically.

7. Disassembly/deconstruction/demolition of tall buildings

"Research examining the opportunities and strategies to allow for disassembly/deconstruction at the end of a tall building's life (and as such, re-use of components, materials, etc.)" received the third-highest immaturity score of all Roadmap research topics. This fits well in the overall life-cycle issues of tall buildings noted above, but it reinforces a perceived lack of knowledge regarding the end of the life-cycle of tall buildings which is likely to become a dominant research field for the future of cities' re-development as many tall buildings are now approaching the end of their service lives.

8. The Economic impact of tall buildings

The joint-highest score in the Roadmap, in terms of importance, is "Research on tall buildings' financial relationship with global economic cycles and conditions." Tall buildings are often assessed in terms of their impact on the local real estate market but, in an ever-increasing competition among cities at a global scale, the role of tall buildings (as individual buildings, or their booming construction in a single city) must be carefully assessed to prevent the bursting of real estate bubbles and in relation to larger scale economic conditions.

9. The use and performance of new and innovative materials in tall buildings

A trend in priority research, apparent across multiple fields, is the use and performance of new and innovative materials in tall buildings. The development and application of such materials will have a significant impact on other disciplines as well, as recognized by issues such as the call for studies on the fire behavior of "green" and innovative materials.

10. Highlighted high-scoring research gaps

Only four topics across the whole Roadmap received a score of immaturity higher than 4 (extremely immature), implying that research is still needed to discover new potentialities. These four topics are:

- Research on alternative evacuation systems that allow for evacuation through the façade in emergency scenarios (immaturity 4.2)
- Research on strategies and technologies for energy sharing between tall buildings such that excess energy generated in one, may coincide with a peak demand in another (immaturity 4.1)
- Research examining the opportunities and strategies to allow for disassembly/deconstruction at the end of a tall building's life (immaturity 4.0)
- Research to determine and calculate the maximum sustainable height of tall buildings (immaturity 4.0)

Summary of Findings, Across All Research Fields

The top five priority research subjects across each field embraced in this Roadmap, as determined by their Priority Index scores are indicated below (scores are out of 10):

Urban Design, City Planning and Social Issues

1. Research examining the social sustainability of tall buildings at an urban/city scale (including impact on social behavior, community and lifestyle, societal needs for tall buildings, ghettoization, social impact in different geographical locations, etc.) **7.8**
2. Research to determine optimum height, density and massing of tall buildings to provide appropriate social interaction and communities at an urban/city scale **7.6**
3. Research to examine and improve the pedestrian realm at ground-floor level in and around tall building developments (including public amenities, social spaces, development of regulations, etc.) **7.6**

4. Research on the design and integration of tall buildings in or near historic urban districts (including UNESCO designated areas, regulatory systems, etc.) **7.5**
5. Research on tall building city planning and regulatory policies (including local city plans, planning for changing demographics, political and financial policies, urban design standards, etc.) **7.4**

Architecture and Interior Design

1. Research on the impact living in tall buildings has on families with children, and strategies to make high-rise living more appropriate for families with children **7.9**
2. Research on the experience, happiness and satisfaction of those who live and work in tall buildings **7.6**
3. Research on the needs of the elderly and disabled with respect to high-rise living **7.6**
4. Research to improve the social-communal experience of occupants in tall buildings (including appropriate mix of functions, humanizing tall building environments, strategies to foster community, etc.) **7.5**
5. Research on architectural strategies to improve tall buildings' integration and relationship with the surrounding urban context **7.4**

Economics and Cost

1. Research on tall buildings' financial relationship with global economic cycles and conditions **7.9**
2. Research to determine the holistic economic benefits and costs of tall building construction on the city/surrounding urban area (including direct tax benefits and indirect employment tax/spending benefits, impact of creating recognizable icons on the city, value of surrounding area, externalities, etc.) **7.9**
3. Research to establish cost metrics for key architectural decisions and different building types (including location, height, land-use, footprint, floor-to-floor, structural systems, etc.) **7.9**
4. Research on the life-cycle cost analysis of tall buildings (including development of methodologies, creation of a database of results, etc.) **7.8**
5. Research on strategies to reduce construction costs of tall buildings **7.7**

Structural Performance, Multi-Hazard Design and Geotechnics

1. Research on the development and implementation of real-time structural monitoring of completed tall buildings (including the creation of a database of results, comparison with design assumptions, determining actual performance such as in-situ natural frequency, damping, vertical shortening, acceleration, creep, etc.) **7.9**
2. Research on the validation of modelling assumptions for wind and seismic loading **7.5**
3. Research to improve tall building protection from multi-hazard events such as seismic and wind events, blast, plane impact, tornadoes, etc. (including robustness, structural optimization, etc.) **7.5**

4. The development of design criteria to determine the appropriate level of safety for tall buildings in extreme events (such as seismic and wind events, blast, plane impact, tornadoes, etc.) **7.4**
5. Research on the development of holistic performance-based multi-hazard design and analysis of tall buildings across multiple disciplines **7.4**

Circulation: Vertical Transportation and Evacuation

1. Research on the planning, design and implications of using elevators for evacuation in tall buildings **8.3**
2. Research on appropriate evacuation and egress strategies for the disabled (including emergency planning, the use of safe zones, etc.) **8.0**
3. Research on strategies and technologies to deliver information to occupants in evacuation/emergency scenarios (including dynamic route guidance systems, integrated audio and video technology, wireless systems, occupants' attitude toward such systems and conformance to legislation) **7.8**
4. Research on the use of elevators for evacuation in extreme events, e.g., after an earthquake **7.8**
5. Research on real-time tall building evacuation management strategies and technologies **7.8**

Fire and Life Safety

1. Research to determine credible worst-case design fires for tall buildings **8.3**
2. Research to establish the impact of new sustainable materials, technologies and design strategies in tall buildings on fire and life safety performance **8.2**
3. Research to develop better collaborations between architects, fire-engineers and the fire-fighting community **8.1**
4. Research and development of realistic fire scenarios for the design of tall building structural fire protection **8.0**
5. Research focussing on fire and life safety issues in tall buildings in developing and the least developed countries **8.0**

Cladding and Skin

1. Research on the use of innovative/advanced materials and cladding systems in tall building façades (including composite materials, photochromatic glazing, aerogel, application of aerospace/shipbuilding technologies, etc.) **7.9**
2. Research to develop strategies and products to improve the thermal performance of tall building façades (including development of new products such as vacuum insulation panels, highly insulating but thin cladding products, improved thermal performance of framing components, etc.) **7.8**
3. Research to establish the embodied energy of tall building façades (including the development of reliable, quickly-sourced metrics) **7.8**
4. Research on the design, construction and performance of dynamic/active façade systems in tall buildings (including user control, development of standards and regulations, impact on energy performance and indoor climate, etc.) **7.7**

5. Research on façade-integrated energy generation and collection systems in tall buildings (including building-integrated photovoltaics, wind energy systems, water collection, etc.) **7.7**

Building Materials and Products

1. Research on the use of composite materials and systems in tall buildings **7.5**
2. Research to improve material and component durability in tall buildings **7.5**
3. Research on the responsible procurement of materials and components in tall buildings (e.g., in areas that do not have strict controls on processing-plant emissions and toxic waste disposal) **7.4**
4. Research to determine material and component durability in tall buildings **7.4**
5. Research on the application and performance of fiber-reinforced polymers in tall buildings (e.g., carbon, glass) **7.3**

Sustainable Design, Construction and Operation

1. Research on strategies and technologies to develop carbon-neutral, net-zero-energy, zero-carbon and self-sustaining tall buildings (including evaluations of whether such concepts are technically viable) **7.8**
2. Research on strategies and techniques to reduce embodied energy/carbon in tall buildings **7.8**
3. Research on environmental optimization strategies and methodologies for tall building form **7.7**
4. Research on the integration of passive design strategies and technologies into tall buildings to reduce energy requirements and improve occupant comfort **7.6**
5. Research examining the opportunities and strategies to allow for disassembly/deconstruction at the end of a tall building's life (and, as such, re-use of components, materials, etc.) **7.6**

Construction and Project Management

1. Research on the dissemination of construction logistics best practices and lessons learned from tall building project and team leaders internationally **7.8**
2. Research and development of new construction methods and systems for complex tall building projects **7.6**
3. Research and development of strategies to increase the speed of tall building construction (including Lean Building Principles, etc.) **7.4**
4. Research to develop strategies and practices to reduce waste and waste water during tall building construction **7.3**
5. Research and development of integrated software and tools, such as BIM, and their impact on tall building design, construction and logistics **7.3**

Energy: Performance, Metrics and Generation

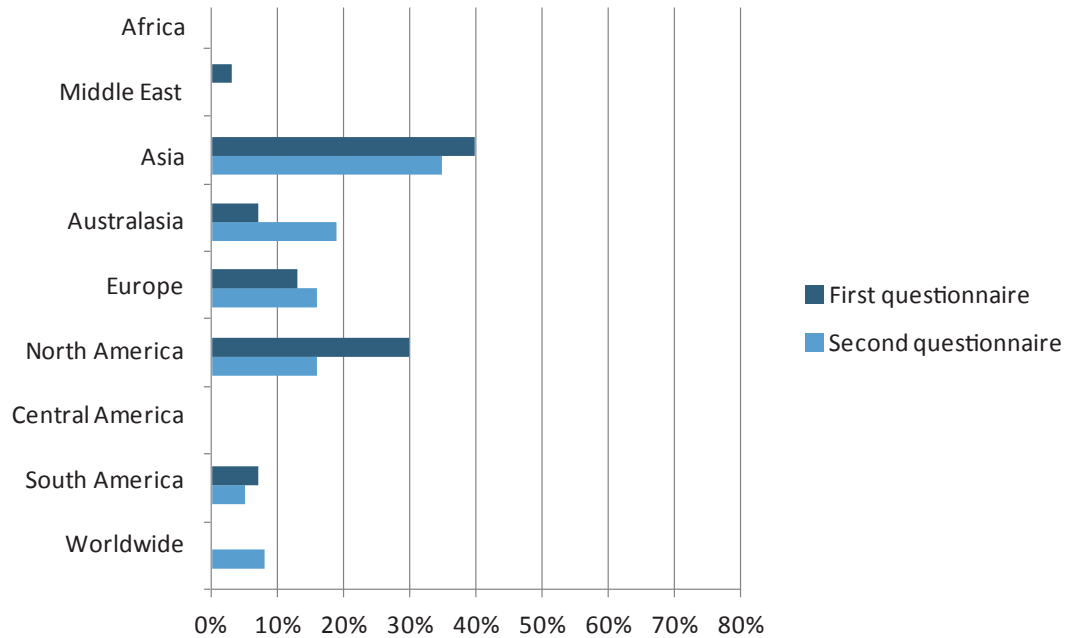
1. Research to determine and calculate the holistic and integrated sustainable performance of tall buildings (including environmental, economic and social sustainability, integrated cost, carbon and energy analyses, etc.) **8.3**

2. Research on strategies and technologies for heat storage and sharing in tall buildings (including waste energy harvesting in mixed-use tall buildings, etc.) **8.0**
3. Research on the post-occupancy evaluation of tall buildings to monitor real energy performance and water requirements in operation (including use of monitoring systems, energy use in different geographical locations, verification of computer simulations, comparison with design loads, creation of an inventory of data, etc.) **7.9**
4. Research to determine and calculate the whole life-cycle environmental impacts of tall buildings (including Life-cycle Assessment, development of methodologies, etc.) **7.8**
5. Research on strategies and technologies for energy sharing between tall buildings such that excess energy generated in one, may coincide with a peak demand in another **7.8**

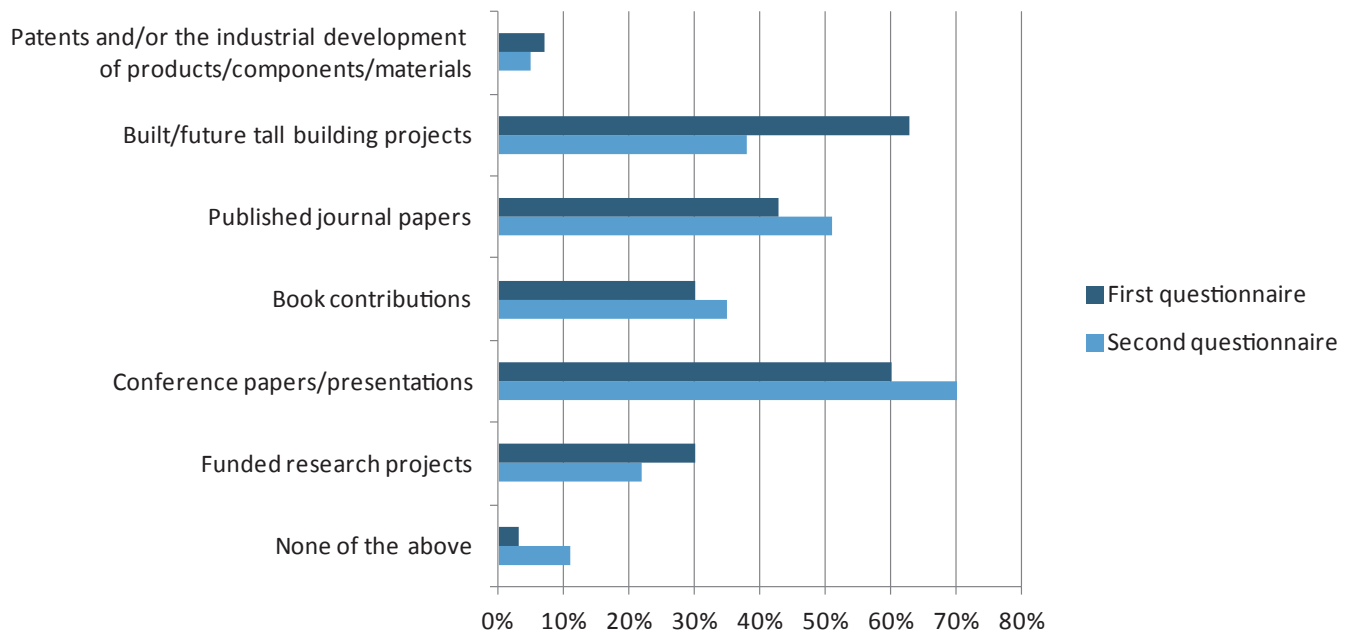
1. Urban Design, City Planning and Social Issues

Questionnaire Sample

In which geographical region is your involvement in the field of *Urban Design, City Planning and Social Issues* mainly located?



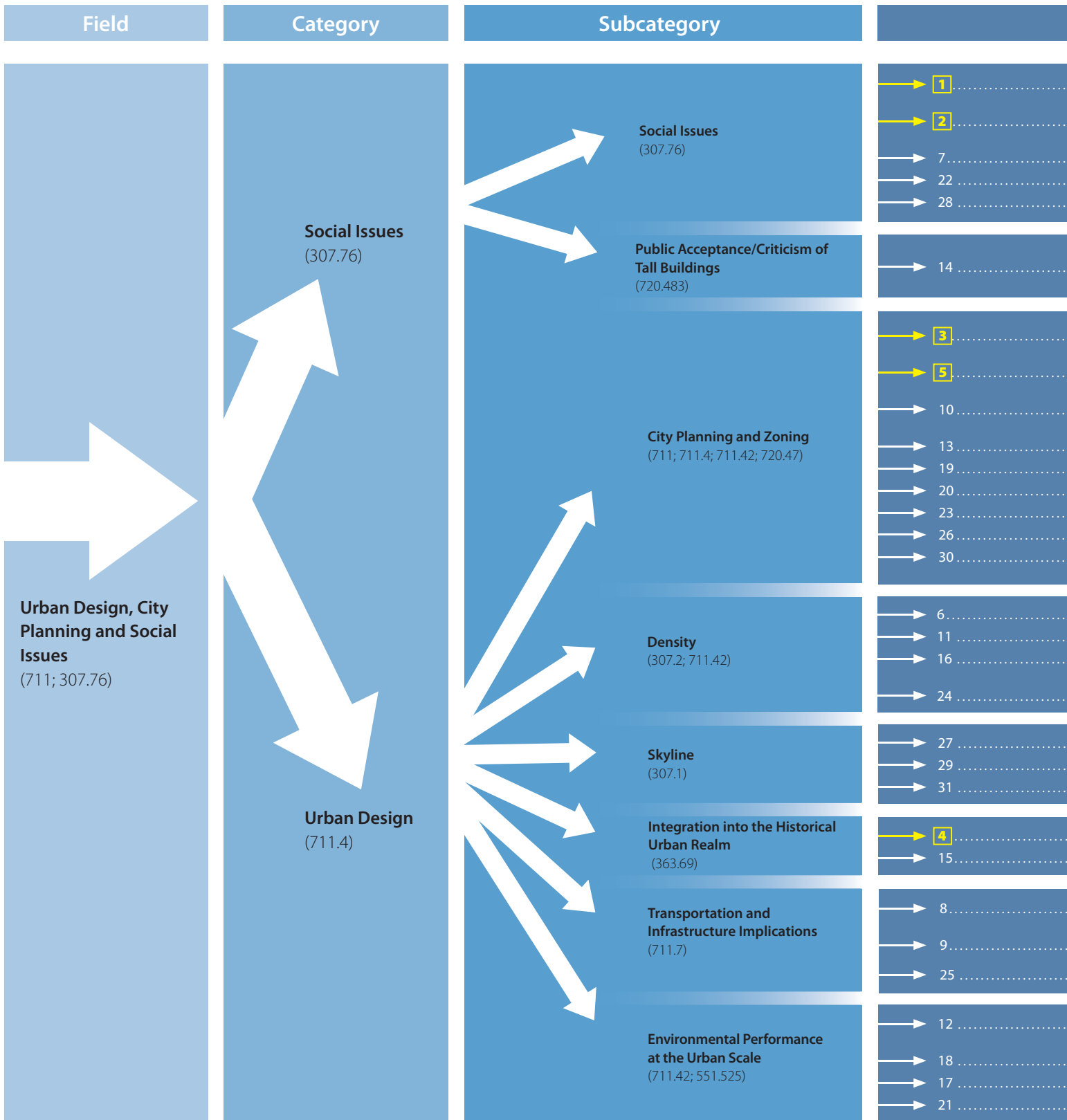
Has your knowledge in the field of *Urban Design, City Planning and Social Issues* been applied to any of the following outputs, specific to tall buildings?



Please note: The percentages above may total greater than 100% due to responders' option to choose multiple answers

Phase 1: Identifying Priority Topics

The “Research Tree” presented here outlines the various topics identified in questionnaire 1 as deserving priority research in the field of *Urban Design, City Planning and Social Issues*. These have been grouped together by commonality, and were later ranked by importance and immaturity in questionnaire 2, to determine the final results (see “Evaluation and Ranking of Topics” on the following page). Here topics are organized by broad categories and subcategories, with the numbers in parentheses denoting each field’s Dewey Decimal Classification, which can be used for further enquiry or research in each area. For a more in-depth explanation of this system, along with a key, please refer to pages 23–25.



Phase 2: Evaluation and Ranking of Topics

* **Priority Index:** Following the identification of priority topics in questionnaire 1, a second questionnaire asked responders to rank and score all topics based on their importance (1 = not at all important, 5 = extremely important) and immaturity (1 = not at all immature, 5 = extremely immature). These scores have been combined to create a “Priority index,” which in turn leads to a “Priority Ranking” (listed on the left). The ranking highlights the topics which are most deserving of priority research in the field in the coming years. The top five scores are highlighted in yellow for easy reference. For a more in-depth explanation of these definitions, please refer to page 18.

Topic	Importance	Immaturity	Priority index *
Research examining the social sustainability of tall buildings at an urban/city scale (including impact on social behavior, community and lifestyle, societal needs for tall buildings, ghettoization, social impact in different geographical locations, etc.)	4.7	3.2	7.8
Research to determine optimum height, density and massing of tall buildings to provide appropriate social interaction and communities at an urban/city scale	4.5	3.1	7.6
Research examining the cultural impact of tall buildings at an urban/city scale	4.2	3.2	7.4
Research examining tall building demographics and living trends	4.0	3.0	7.0
Research exploring the formation of “ghost towns” and their relationship with rapid urban growth and high-density construction	3.5	3.3	6.8
Research exploring public acceptance and pride related to tall buildings (including in different contexts, NIMBYism, etc.)	3.8	3.4	7.2
Research to examine and improve the pedestrian realm at ground-floor level in and around tall building developments (including public amenities, social spaces, development of regulations, etc.)	4.6	3.0	7.6
Research on tall building city planning and regulatory policies (including local city plans, planning for changing demographics, political and financial policies, urban design standards, etc.)	4.5	2.9	7.4
Research on horizontal connectivity and skybridges in tall buildings, and their ability to create alternative layers of public realm at height in the city	3.9	3.4	7.3
Research exploring appropriate tall building heights for urban development (including “how high is too high?“, existing height restriction zones, etc.)	4.3	2.9	7.2
Research examining the appropriate context for tall building zoning/development (including suburban opportunities)	4.1	2.9	7.1
Research on the development of tools and software to model cities and precincts to test the impact of tall buildings	4.1	2.9	7.0
Research examining the impact of tall building development on the surrounding realm (e.g., impact on character, circulation, property values)	4.3	2.7	7.0
Research exploring the possibilities for outdated, vacant high-rise housing developments (e.g., demolish, refurbish, renovate, etc.)	3.8	3.1	6.9
Research examining the safety of land used to construct tall buildings (including impact of former uses, remediation strategies, hazardous operations and substances, etc.)	3.6	3.0	6.6
Research examining the impact of density and the creation of tall buildings on the availability of public open spaces	4.3	3.1	7.4
Research to establish what densities are achievable in tall buildings and cities	4.3	3.0	7.3
Research on the relationship between density, sustainability and tall buildings (including urban versus suburban development, analysis of case studies, etc.)	4.2	2.9	7.1
Research to establish alternative models to high-density urban living	3.9	3.0	6.9
Research on the impact of tall buildings on city skylines (visual impact, public satisfaction, skyline identity, etc.)	4.1	2.8	6.8
Research on the impact of tall buildings on strategic urban views	4.0	2.6	6.6
Research on the role of the tall building as a city/regional icon	3.7	2.8	6.5
Research on the design and integration of tall buildings in or near historic urban districts (including UNESCO designated areas, regulatory systems, etc.)	4.3	3.2	7.5
Research on the integration of tall buildings into the European urban context	3.8	3.4	7.1
Research on tall building integration with mass transit systems (including impact of high-rise on the economics of mass transit, construction implications, capital expenditure needed by public agencies, architectural implications, etc.)	4.5	2.8	7.3
Research on the impact of tall buildings on urban mobility (including impact on existing transportation infrastructure, access to tall building areas, overcrowding, etc.)	4.3	3.0	7.3
Research examining the impact of tall building development on local infrastructure services (water supply, electricity, gas, sewage capacity, etc.)	4.1	2.8	6.9
Research on the environmental impact of tall buildings on the surrounding urban realm (including rights of light, rights of wind, wind downdraft on the pedestrian realm, etc.)	4.3	3.0	7.2
Research on district energy/water systems in tall building zones	3.8	3.3	7.1
Research on ground-level ecology and landscaping in and around tall building developments	4.0	3.1	7.1
Research exploring the impact tall buildings, and tall building clusters, have on the urban heat island effect	3.9	3.0	6.9

Top-Five Priority Index Scores

Topic	Priority Index
1 Research examining the social sustainability of tall buildings at an urban/city scale (including impact on social behavior, community and lifestyle, societal needs for tall buildings, ghettoization, social impact in different geographical locations, etc.)	7.8
2 Research to determine optimum height, density and massing of tall buildings to provide appropriate social interaction and communities at an urban/city scale	7.6
3 Research to examine and improve the pedestrian realm at ground-floor level in and around tall building developments (including public amenities, social spaces, development of regulations, etc.)	7.6
4 Research on the design and integration of tall buildings in or near historic urban districts (including UNESCO designated areas, regulatory systems, etc.)	7.5
5 Research on tall building city planning and regulatory policies (including local city plans, planning for changing demographics, political and financial policies, urban design standards, etc.)	7.4

Highlighted Findings

In the field of *Urban Design, City Planning and Social Issues*, 31 individual topics of relative importance and/or immaturity were recognized. Questionnaire responders in this field gave high importance scores overall, with most topics receiving an average importance score greater than 4 (very important). No topic received a score below 3.5. In addition, the topic “Research examining the social sustainability of tall buildings at an urban/city scale” received the joint-highest average importance score (4.7) in any section of the Roadmap. This underlines the perceived importance of the broad research field as a whole, and suggests that tall buildings may still be widely considered to be disconnected from the urban realm in the physical and social sense.

Immaturity scores in the field ranged from 2.6–3.4, with over 60% of topics receiving a score of 3.0 (moderately immature) or higher. These scores are somewhat lower than other fields, but still suggest knowledge related to *Urban Design, City Planning and Social Issues* is perceived as somewhat underdeveloped.

“I think in headline terms what the results show in the area of *Urban Design, City Planning and Social Issues*, is that the integration of tall buildings within urban systems remain an important and under-researched area in the field. It would seem that the social implications of tall buildings are particularly relevant to the discipline and I think this is the area that would concur with my own view of research gaps.”

Michael Short, University of the West of England, Bristol, UK

Priority Research in the Field

One of the main findings that can be drawn from the results is the need for more research related to the social sustainability of tall buildings at an urban scale, with the two highest scoring topics in the priority index concerned with this. Such findings were also supported by the peer review panel.

“We do need more research on livability in terms of inter-generational living. There is a huge difference between high-rise buildings for seniors or for young single professionals, or for families with children. Are planners thinking about the kind of communities we want in terms of family structure? Otherwise, we could end up without the kind of age diversity (not to mention class diversity) that might not be healthy in the long run.”

Robert Lau, Roosevelt University & Jon DeVries, Marshall Bennett Institute of Real Estate, Chicago, USA

While research has been developing in this area, it is clear that social sustainability is still a significant research gap and priority in the field of tall buildings, with a need for examples of socially-successful vertical communities published as example case studies to educate those unfamiliar to this style of living.

Some of the more specific research statements grouped under the topic “Research examining the social sustainability of tall buildings at an urban-city scale” suggested by responders in the first open-ended questionnaire include:

- How do megatall buildings impact human behavior within and around them?
- Research on the correlation between plot ratio and social behavior in urban habitats.
- Are tall buildings socially sustainable, and do they add significant benefit to cities’ vitality and the lifestyle of people living and working in cities?
- Studies on whether tall buildings are a development for a limited, wealthy elite or whether the typology provides assets for a wider range of social groups within the city. Such studies should include the displacement of residents that may occur to make way for the tall building and could also include public resources (like green spaces or subway access) within the development.
- Studies related to urban density, in particular “vertical density” as a positive factor in the quality of urban life.

Two additional topics received high importance scores from the questionnaire responders. “Research on tall building city planning and regulatory policies” received an importance score of 4.5, although it is suggested by the peer review panel that such research can be “tricky” as some cities may not provide data relating to regulatory policies, and success stories do not necessarily mean that other city governments will follow suit. “Research on tall building integration with mass transit systems” also received an importance score of 4.5, with high-rise communities that prosper from efficient, accessible and affordable transportation considered worthy of significant focus.

Additional Research Gaps

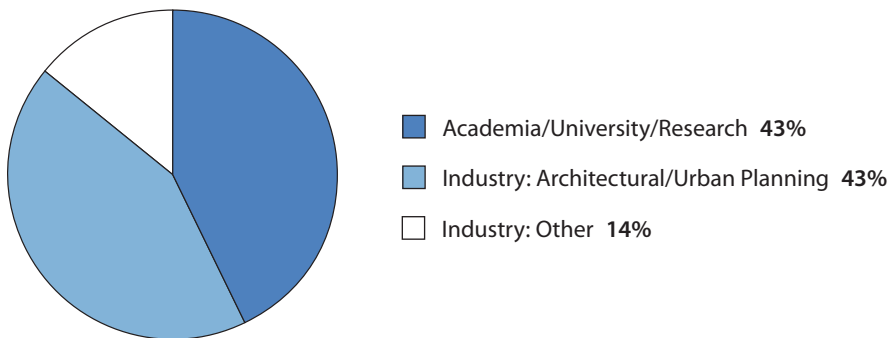
It is interesting to note that the top three research gaps in this field did not rank in the top 5 priority index finding. Three topics received the highest immaturity score of 3.4 (between moderately immature and very immature) and can thus be considered as research gaps in the field. These are:

- Research on horizontal connectivity and skybridges in tall buildings
- Research exploring public acceptance and pride related to tall buildings
- Research on the integration of tall buildings in the European urban context

Some aspects of research related to the impact of tall buildings on the physical urban realm were considered a lower priority by responders, with “Research on the role of the tall building as a city/regional icon”, “Research on the impact of tall buildings on strategic urban views”, “Research on the impact of tall buildings on city skylines” and “Research examining the impact of tall building development on the surrounding realm” all receiving lower scores overall. This may be due to the maturity of such studies, with significant work on zoning and skylines already undertaken. The main exception here is “Research on the design and integration of tall buildings near historic urban districts,” which achieved the fourth-highest priority index score in this section. This is likely due to recent and widely publicized debate regarding the placement of tall buildings in sensitive historic areas, such as controversies with regard to high-rises in UNESCO World Heritage Zones in London and St Petersburg.

Results Broken Down by Questionnaire Responders

Responders who completed the second questionnaire in this section have a professional background in the following disciplines:



Results by Professional Background

Responders in this field were quite evenly distributed between the academic and industrial realm, with most from the latter being in the architecture/urban planning field. Outlined below are the three highest-scoring topics for academic and industrial responders respectively:

Academia/University/Research

- Research examining the social sustainability of tall buildings at an urban/city scale (8.0)
- Research to determine optimum height, density and massing of tall buildings to provide appropriate social interaction and communities at an urban/city scale (7.9)
- Research examining the impact density and the creation of tall buildings has on the availability of public open spaces (7.8)

This Roadmap aims to identify priority research topics and research gaps in the field of tall buildings. In doing so, it acts as a guide to assist all those involved with the typology in the necessary planning of future research and the pursuit of research funding in order to advance tall buildings to their optimum level in the coming years.

The Roadmap has been created as a joint venture between the Council on Tall Buildings and Urban Habitat (CTBUH), the International Council for Research and Innovation in Building and Construction (CIB) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).