CHAPTER 6 – CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Chapter 06 integrates and synthesises various issues raised in Chapter 04 and Chapter 05, whilst reflecting the introductory research problem statement. Chapter 06 provides methodologically developed answers to the thesis research questions, which were raised based on the research objectives. Further, the section identifies the theoretical and policy implications of the study with respect to the overall study area of 'academic research for construction management innovations'. Finally, the chapter highlights the study limitations and provides direction and areas for future research.

6.2 Conclusions

The study was set out to investigate the CSFs of merging academic research with the industry development requirements to cultivate an innovative construction management practice. Therefore, the research has identified; the significance of research as a duty of the academia in leading construction management towards innovative developments, allied of an innovative construction management practice for the construction industry development, barriers to the research interactions between the academia and the construction industry, and CSFs for merging the academic research and the industry development requirements. Finally, a model to demonstrate CSFs to be implemented by the stakeholders in establishing an innovative construction management practice was developed.

The literature findings led to four (04) RQs:

RQ1. Why academic research is significant in cultivating an innovative construction management practice?

RQ2. How innovative management practices assist construction industry development?

RQ3. What are the barriers for merging academic research and industry development requirements?

RQ4. What are the CSFs for the construction stakeholders in developing an innovative management practice?

Next, the concluded answers upon each RQ as presented in an order explaining the achievement of each objective.

In response to the objective 1 to 'identify the significance of research as a duty of the academia in leading an industry towards innovations', the RQ1 was devised and the related findings are explained below.

The field study conducted based on existing knowledge confirm the significance of academic research in cultivating an innovative management practice. Different possible resolutions of the relations among institutional spheres of university, industry, and government can help to generate alternative strategies for economic growth and social transformation. However, the general research practice is deviated much from the requirement at current status leading to poor level research based innovations in construction management.

Reasoning to the gap, poor knowledge dissemination and utilisation efforts are present in local context. Stages suggested by Chain of Knowledge Utilisation (MCKU) and Pipeline Model of Knowledge Dissemination (PMKD) of Alker (2008) helped to identify the construction management academics' success of dissemination of research knowledge in general at the local academia. The results revealed that the dissemination efforts are mostly in line with the theoretically suggested flow in the MCKU of Alker (2008).

The *Reception* and the *Cognition* levels are well within the reach of the academic researchers, therefore, the academics are currently being able to reach the desks of the recipients and people understood the research. However, *Reference*, and *Effort* stages are moderately reached. Hence, half of the researchers only, have been able to change the way people think and to shape action. The dissemination flow is disturbed at the fifth stage**.** Hence, the researchers in general, fail in*; bringing tangible benefits* to the industry, creating *direct influences upon actual policy/practice* and influencing *policy/practice development***.** Therefore, the academic research utilisation by the

industry is at a primitive level, revealing the inefficiency of the academia's dissemination efforts and industry apathy in research informed management practice.

Further, construction industry indicates poor research knowledge utilisation. The industry is 'Aware', and 'Accept' the research conducted by the academia, yet, rarely see research as 'Locally applicable'. Therefore, do not 'Adhere' into research based innovations, disturbing the reach of further stages.

Reasoning the gap between the dissemination and utilisation, the industry collaborations with academia in terms of research are highly underdeveloped. Interactions between the academia and the industry are limited mostly to academics' teaching and consultancy services. Research interactions were limited only to supporting research students in common and rarely construction firms are into the practice of having academics appointed into the director board and reviewing recent academic research solutions in problematic situations.

Hence, the level of 'research informed' decision-making practised in construction organisations is significantly low. The construction firms make decisions along the organisation hierarchy. However, firms are interested in tools developed based on research. Yet, currently, the local academia does not meet such needs of the industry. Besides, some companies promote research within the company, seek the services of consultants. However, frequently, the overall industry decision-making is reactive and understands the importance of proactive decision-making.

Hence, the failure in academia's research dissemination efforts and the industry's apathy of capturing research outcome in general have led the industry's unawareness upon the research outcome and its' capacity for bringing in innovations. Therefore, the challenge was to improve the accessibility of desired knowledge products by those, who are intended to reach. As such, simply initiating the dissemination mechanisms is insufficient; the transfer needs to adopt an end-user perspective. Therefore, researchers should need to have proper knowledge dissemination plans.

However, researchers use many different mechanisms to disseminate research knowledge. The field study revealed that 'publications', as the foremost successful mechanism in disseminating research outcome to the academia. Differently,

collaborations with the industry were suggested as the strongest mechanisms to disseminate research outcome to the industry. Further, delivering the outcome to a company at the end of a research and attaching a research student into a company as a researcher, a product developer, or to the R&D division, were also effective dissemination mechanisms. Obtaining patents create strong chances of disseminating research outcome to the industry, yet patents are difficult to acquire for construction management type social research. However, the uses of industry friendly mechanisms are rare at present, while the publications being the priority.

Hence, in answering RQ1, the study identified the significance of research, as a duty of the academia in leading the industry towards innovations achieving the first objective of the research.

In response to objective 2 to 'critically review the necessity of an innovative construction management practice for the construction industry development', the RQ2 was devised and the related findings are explained below.

The literature comprised of many theories that explain the positive relationship between innovation and development. Thus, knowledge and experience become important intellectual assets; hence the related community need to be updated with the changes happening in the global environment to avoid the industry intellectual drivers' knowledge base getting obsolete, since they are an integral part of the value creation process. However, there is a lack of evidence that construction industry adopt new findings of academic research into their practice.

The situation is explained by Red Ocean Strategy (ROS) and Blue Ocean Strategy (BOS) of Kim and Mauborgne (2005). The construction market is characterised by a typical "Red Ocean" environment, where companies compete on the overhead rather than the ability to reduce production cost and create value. Further, the companies have a reactive practice towards development, where it follows development in the market, rather than shaping an own market.

Hence, the theory concludes that business development represents an important but an unacknowledged practice for innovation of the building industry and suggests that, strategy processes should be facilitated and subjected to more detailed research,

to escape the present unhealthy market practices in the construction industry. Therefore, answering the RQ2 revealed the necessity of an innovative construction management practice for the construction industry development leading to achieve the second objective of the study.

In response to the objective 3 to 'investigate the barriers for research interactions between the academia and the construction industry', the RQ3 was devised and the related findings are explained below.

The research revealed the presence of many deterrents for both the academia and the industry in merging academic research and industry development requirements, which are within the control and beyond the control of the individuals/affiliations.

The highest influencing internal barriers for the academics are; **time pressure, increased workload due to a raised number of universities, colleges, and students,** and **increasing pressure from stakeholder groups upon quality assurance and OBE,** where all three (03) factors are basically related to time management. Time pressure creates negative impact upon research since long period research would most probably affected by the researcher's personal life events. Moreover, the impacts of the time pressure depend on the researcher, supervisor, and the dissemination requirements.

The highest influencing external barriers for academic researchers are; **goals and paradigms of trans-national research driven by the perspectives of economically advanced countries**, **the impact of research taking considerable time to appear** and **inadequate allocation of resources for research**. Aligning global research focus with the local industry requirements is challenging for researchers in general since, testing high end theories using a local sample is quite questionable in terms of the quality of the research output generated. Further, the scale of the industry matters, when moving ahead with the global research focus. However, it is good to bring on new developments in the global context. Yet, following global focus may deviate academics from their subject expertise.

Out of the internal barriers for construction organisations/individual practitioners; **academic research focused on subjects, which are not crucial for the**

construction industry, constantly changing team compositions disturbing the information flow and methods of innovation diffusion, and **no proper structure to accumulate financial capital to invest in research** are the most critical hindrances. Constantly changing team compositions are inevitable by the nature of the construction industry.

Further, the field study confirms; **industry timidity in adapting management innovations** and **construction industry lacking leadership to direct towards research,** as the main external barriers for the construction industry.

The study, therefore, revealed the barriers for the research interactions between the academia and the construction industry, in answering the RQ3, which directed to the achievement of third objective of the study.

In response to the objective 4 to 'determine the CSFs for merging the academic research and the industry development requirements', the RQ4 was devised and the related findings are explained below.

Triple Helix Model (THM) of Etzkowitz and Leydesdorff, (2000) proves the significance of academic research in leading industry innovations. Subsequently, innovations play a vital role in the development of an economic sector. Yet, an industry operating under a ROS of Kim and Mauborgne, (2005), poses heavy threats for innovative development. Hence, the management practices of the construction industry, traditionally operating under a ROS, show a slow development with less interest into academic research based innovations. Complimentary, no academic researchers entertain a considerable level of research dissemination, neither construction industry shows significant utilisation of research and only the basic stages of MCKU and PMKD of Alker (2008) are reached, respectively.

In developing space for innovation, creation of a knowledge space, and a consensus space are precursors, as per to Etzkowitz (2011). Correspond to the argument, Leydesdorff, (2005) identifies three major actors in THM interactions as; novelty producers, legislative controllers and wealth generators creating, knowledge infrastructure, political economy for innovations. Hence, CSFs of merging academic research and construction industry development requirements for an innovative

construction management practice were developed separately for each contender under each of the knowledge, consensus and innovation spaces, respectively.

Knowledge space is the initial foundation for innovations via regional innovation spaces comprising novelty producers, legislative controllers and wealth generators, who would improve local conditions for innovation through providing necessary knowledge infrastructure and the political economy. In construction management context, universities play the role of novelty producers, government/regulatory bodies are the legislative controllers, and construction industry is the wealth generator, respectively.

Hence, CSFs creating a knowledge space developed for three contenders separately. The CSFs for universities are as; **Prioritise research in academic job description, Provide resources for research, Provide administrative assistance to KBH, Include industry impact into research performance measurement criteria,** and **Standardise research via regulations.** Simultaneously, the CSFs for Government/ regulatory bodies are; **Establish development goals for the construction industry, Include R&D benchmarks into contractor grading criteria, Provide R&D accreditations, Practice research informed policy development**, and **Ensure national research bodies functioning.** In response, the CSFs for the construction industry are; **Avoid research paradigm discrimination, Manage change resistance, Switch from survival mode to sustainable development mode, Include research soundness into job descriptions,** and **Use research to avoid re-inventing the wheels at practice.**

Since necessary knowledge infrastructure and political economy are generated within created knowledge space, the prerequisites of creation of a consensus space are available. One indicator of this shift from knowledge space to consensus space is the increased involvement of universities and other knowledge producing and disseminating institutions. Establishment of a Knowledge Brokering Hub (KBH) to intermingle research academia and construction organisations, therefore, creates the consensus space.

Hence, the CSFs, for each of the contenders in the consensus space were revealed. The CSFs for research academia are; **Maintain active relationships with the industry, Develop strong research profiles, Develop time management skills, Network with the research community**, and **Practice dissemination as a habit**. The success of the established KBH will be assured through practicing the CSFs; **Develop academic-industry strategic research partnerships in front of legal and business arrangements, Obtain intellectual property rights on research knowledge, Link international research expertise with local research, Create a linguistic support cloud,** and **Attract resources for research through marketing.** CSFs for industry organisations are identified as; **Maintain active relationships with the academia, Establish goals for innovative development, Establish R&D units, Create space for innovation investments through proper company structure**, and **Develop professional approach to organisation management**.

The operations of the consensus space leads creation of space for innovation in the specific context, majorly through strategic research partnerships in between research academia, and industry organisations, brokered by KBH. Hence, the CSFs for researching and CSFs for industry organisations inside such partnerships were developed separately.

The CSFs of research were identified in three (03) segments, considering the stages of a research as; CSFs of research initiation, execution, and dissemination. The CSFs of research initiation are; **Proactively identify research issues, Localise global research focus, Identify issues for research from industry practice, Include research output dissemination into the initial research proposal**, and **Keep biased toward applied research.** Hence, the successful research initiation should be followed by successive execution of research by performing the CSFs; **Conduct research ethically, Follow a methodologically sound research method, Maintain quality, Use proper samples for research,** and **Balance academic duties to allocate required time for research**. Finally, in disseminating research outcome, the CSFs are: **Use proper dissemination techniques considering the target audience, Develop research outcome into directly applicable tools, Balanced dissemination**

for academia and industry, Deliver high level research output to the broader community, and **Develop high-quality publications**.

In response to the earnest efforts of the academic researchers, industry organisations should be properly oriented themselves for developing strategic partnerships and should be interested in searching opportunities for innovations followed by proper maintenance of adapted innovations. Hence, the CSFs of organisation orientation for innovations are: **Maintain open approach to innovation, Support research with data, Maintain a cooperative dynamic staff, Identify chances for gaining a comparative advantage through innovations**, and **Acquire resources for innovations.** The CSFs of innovation initiations are; **Solve issues in practice with a scientific approach, Conduct post analysis of projects, Maintain accreditations, Aim for awards for the sector**, and **Network and follow successful innovations**. Finally, in maintaining the adapted innovations the CSFs are; **Assure quality of innovations, Train employees following adapted innovations, Conduct feasibility studies prior innovation adoptions, Review innovation investments closely**, and **Evaluate options in selecting innovative solutions**.

In answering the RQ4, the study achieved the research objective of the research by determining the CSFs for merging academic research and the industry development requirements.

In response to the objective 5 to 'develop a model to demonstrate the CSFs for strategic research collaborations in merging academic research and industry development requirements', the answers derived for RQ1-RQ4 were synthesised as follows:

Overall, the study has revealed the CSFs, which need to be implemented to merge academic research and industry development requirements for generating an innovative construction management practice in response to the research problem. A final model was developed in mapping the location and application of the CSFs. Figure 5.19, therefore, presents the developed final model, 'The **M**odel of CSFs for **R**esearch Driven **I**nnovations (MRI) for construction management', achieving the final objective of the study, which ultimately completed the achievement of research

aim ' to investigate the Critical Success Factors (CSFs) of merging academic research with the industry development requirements to cultivate an innovative construction management practice '.

The CSFs identified in the model are applicable to the local context (Sri Lanka) and beyond to different construction contexts, where poor academic research lead management innovations are present. The structure of the model can be applicable to any construction industry along with the timeline, yet the CSF may need to be refined through external validation of the data. In addition, the basic theories integrated into the model (pre-requisite spaces and stakeholder roles) could be genaralised irrespective of the industry, yet in applying to a particular industry it would require to identify the relevant parties to play each stake holder role.

Importantly, the application of the discussed model would enable THM operation, developing an innovative construction management practice guided by the academic research, as discussed in the next section, which presents the contributions of this research.

6.3 Contribution to Knowledge - Theoretical Implications

The research presents the major contribution to theory via the developed model, 'The **M**odel of CSFs for **R**esearch Driven **I**nnovations (MRI) (refer Figure 5.19) embodying CSFs for merging academic research and industry development requirements for an innovative management practice. In the process of determining CSFs, the study has identified the significance of academic research in cultivating an innovative management practice in the construction industry in line with the THM of Etzkowitz and Leydesdorff (2000). Further, the study has identified ROS (Kim and Mauborgne, 2005) operation in the construction industry, and poor industry orientation of academic research, as the major reasons behind the slow progress through PMKD, and MCKU of Alker (2008) in construction management context.

Therefore, CSFs in creating knowledge, consensus and innovation were identified separately, with reference to the actionable contenders of each space, which are essential in enabling a THM operation in construction management context. Hence, the study concludes, the necessity of universities, government/regulatory bodies, and

construction industry, playing the roles as; novelty producers, legislative controllers, and wealth generators in creating the knowledge space for enabling THM operations. Therefore, the interactions between the academia and government/regulatory bodies will generate the knowledge infrastructure, while interactions between the construction industry and government/regulatory bodies will generate the political economy leading to creation of consensus space for construction management innovations. Resultantly, KBHs was demanded to be established for the operation of consensus space in linking research academia and industry organisations. Innovation space will be created through KBHs generating strategic research partnerships, in between academic researchers and industry organisations.

6.4 Contribution to Knowledge - Practical Implications

In contribution to the practice, the developed model 'The **M**odel of CSFs for **R**esearch Driven **I**nnovations (MRI) for construction management' (refer Figure 5.19) presents CSFs, which should be followed by the stakeholders in construction management, in cultivating an innovative management practice. Therefore, the study revealed CSFs for universities, government/regulatory bodies, and construction industry in creating the initial knowledge space. Further, in creating the consensus space, CSFs, were developed to be practised by academic researchers, the resultant KBH from knowledge space operations, and the willing construction organisations. Finally, in the innovation space, strategic research partnerships will be developed and CSFs for researching and CSFs for industry partners under such partnerships are revealed. The CSFs of research initiation, execution, and dissemination were developed separately in conducting research inside an innovation space. Finally, CSFs for the industry partners for innovations were revealed in three (03) segments as; CSFs for organisation orientation for research based innovations, CSFs for innovation initiations, and CSFs for maintaining adapted innovations.

In conclusion of the contribution to knowledge, the ultimate results of the application of the model are shown in Figure 6.1.

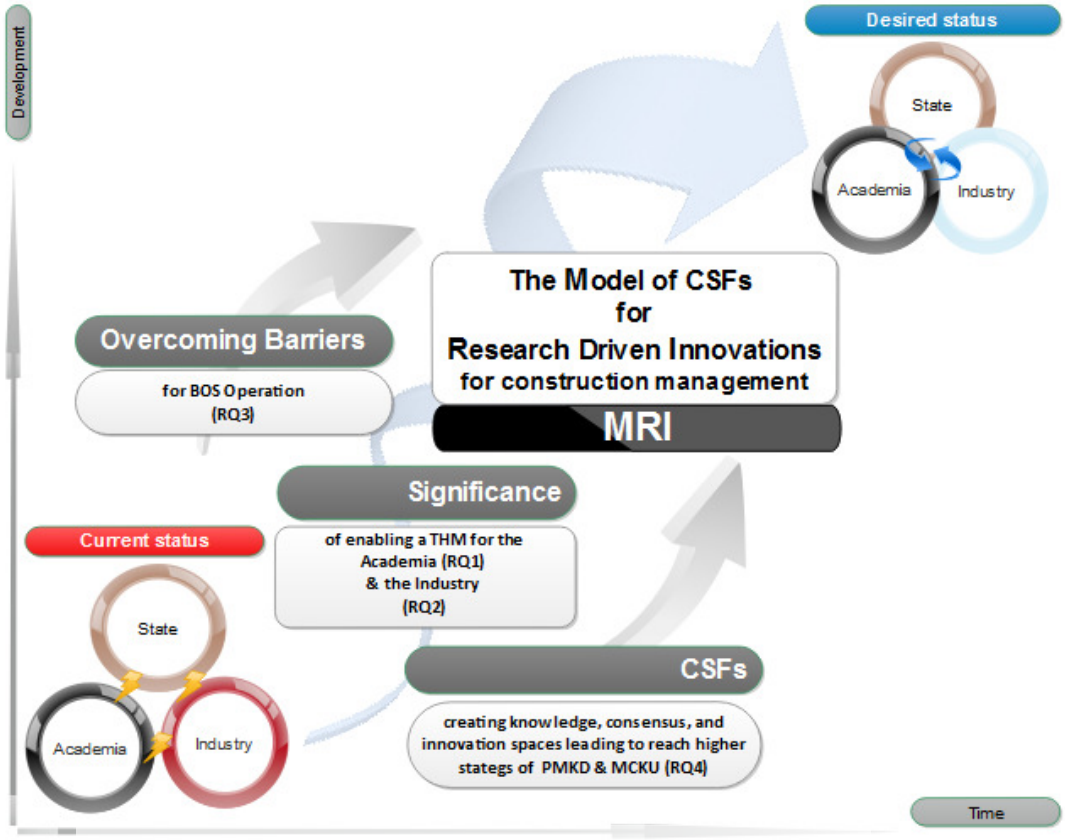

Figure 6.1: Impact of the Application of the Model - SRC

Since the model – MRI (refer Figure 5.19) will guide industry in following a BOS of Kim and Mauborgne, (2005) from the current ROS. Eventually the higher stages of MCKU and PMKD of Alker (2008) will be reached by the academia and the industry. Accordingly, the sector will reach development as suggested by THM of Etzkowitz and Leydesdorff (2000). Hence, the model – MRI fill in the blanks of the conceptual framework presented in Chapter 02. Finally, the changed operational behaviour of stakeholders via the CSFs will enable an innovative construction management practice, which complements the construction industry's development.

6.5 Recommendations for future research

The scale of this debate is, therefore, extensive and multifaceted, even at the local level. To generate achievable policy strategies and development targets with regard to research based innovative construction management; there is a need for more case studies at the local level to allow further assessment of local dimensions of the

subject. Exploring the following as future research areas, can facilitate the attainment of this goal.

- Policy changes required for developing knowledge infrastructure and political economy in assisting construction management innovations
- Sustainability of KBHs in the built environment context
- Necessities of shifting paradigms in management research for industry research collaborations
- Mechanisms of converting construction organisations from survival mode to a sustainable development mode to avoid 're-inventing the wheel' at practice
- Requirements of developing hybrid professionals to avoid paradigm discrimination in construction management arena

6.6 Limitations of the study

The study offered an evaluative perspective on an important economic sector's development requirements, and was conducted in a developing country environment through sampling construction management academics and construction organisations/individual practitioners. As a direct consequence of this method, the study encountered several limitations that need to be considered.

- The findings rely on cross-sectional data rather than longitudinal data. This may not reflect the changing situations and deep relationship that would develop between the academia and industry over time. The cross-sectional data may affected by the respondent's predisposition of any events that have happened in the past or by the mental position at the period of providing data.
- The data were collected from a single country. This facilitated data collection and controlling diversity, but limited the generalisability of the findings.
- The data upon organisation perspective were collected only from the contractor organisations rather than consultancy and client organisations. Yet, the individual practitioners were not limited to a particular section. This might not represent the construction industry organisations in proportion. Nevertheless, the contracting organisations' view was considered as highly

important since they process both the qualities of prevailing long- term in the industry and with capacity for funding and benefiting from research.

- The data were collected with respect to a respondent's most significant contribution towards an innovative management practice, where necessary, which might not reflect the overall life experience of the researcher/practitioner/organisation.
- The data were collected only from the academic and industry perspectives due to the absence of a proper population to collect data upon the government/regulatory body's perspective. However, to integrate the agreement of latter perspective, the experts for data validation were selected, who are extensively engaged in industry regulatory activities.

6.7 Final Note

The research study, therefore, concluded the CSFs for research based innovations in construction management practice via the developed model in answering the RQs methodologically with a pragmatist philosophical stance. The application of the model – MRI (refer Figure 5.19) will enable the operation of THM spirals via academic and industry practitioners reaching the higher levels of PMKD, and MCKU of Alker (2008) respectively, through the creation of necessary knowledge, consensus, and innovation spaces, converting the ROS of current construction practice into a desired BOS of Kim and Mauborgne, (2005).

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APPENDICES

Appendix - A: Linkages of Variables to the Literature Review

Appendix - A1: Significance of disseminating research knowledge – Academia's perspective

Significance	References
Internal Significance	
Research being a major responsibility, academics should carry out research that serves educational needs	Postlethwaite (2005)
As it benefits to the human, financial and intellectual resources of the university	Houston (2008)
To improve employment skills of the next generation of professionals	Fielden (2008); OECD (2010)
To attract new research students	Cullen (2003)
As an integral part of the career development of academia	Postlethwaite (2005)
To become a research-led university	Boyer Commission (1998)
Linking Research to improve Teaching	Boyer Commission (1998)
As communicating research outcomes lies at the heart of academic endeavour and to guide further research	Sparrow*et al.,* (2009)
To support individual professional development	Virolainen (2007)
For the advancement of the academic careers of the research graduates	Hays (2007)
External Significance	
Research being a major responsibility academics should carry out research that serves the development of the region and its economy	Postlethwaite(2005); Virolainen (2007)
Add new knowledge in order to serve the wider society	Houston (2008)
To bringing in innovation to the particular industry the academia involved with	OECD (2010)
Responsibility in shaping the culture, paradigms and practices of the related professions	Fielden (2008)
To accommodate and respond to key external parties in reaching their expectations	Houston (2008)
Dissemination of knowledge to the existing industry becomes a duty to the academics	Brown (2005)
Research institutions being a source of new ideas and collaborating with industry to maximising the use of these ideas	European Commission (2007)
For the advancement of research in a particular field of interest	Hays (2007)

Appendix – A2: Significance of research knowledge utilisation – Industry perspective

Significance	References
Internal Significance	
To address the economic, environmental and resource constraints	Kulatunga et al. (2005)
Community need to be updated with the global environment	Brown (2005)
Trends polarize the financial and technical superiority of the developed countries	Steele & Murray (2004)
Address the economic, resource and environmental constraints	Kulatunga, Amaratunga & Haigh (2005)
To survive and proliferate through innovation	Hughes & O'Rourke (2009)
Develop new products, materials, advanced construction processes	Kulatunga et al. (2005)
To avoid the Industry intellectual drivers' knowledge base getting obsolete	Brown (2005)
Requirement of commitment to improve the delivery of projects	Egan (1998)
Deliver better value for money	Fairclough (2002)
Less innovation adaptation as a possible reason for lack of productivity improvement of	Sabol (2007)
construction labour forces compared to the other industries	
Increase construction industry productivity, design and performance quality	Maqsood & Walker (2007); Le & Bronn (2007)
Finding solutions to the challenges faced by the construction industry	Barrett (2007)
Making it highly valued by its customers	Barrett (2007)
External Significance	
In order to sustain long-term competitive advantage of organisations	Sparrow *et al*., (2009)
Guide on effective management of human resources	Jones & Robinson (1997)
'Knowledge economy' is an emergent reality for many organisations	Laszlo & Laszlo (2002)
For continuous performance improvement	Hughes & O'Rourke (2009
To become more profitable	Fairclough (2002)
To be competitive through technological advances	Kulatunga, Amaratunga & Haigh (2009)
Cost efficiency improvements	Le & Bronn (2007)
Enhances the effectiveness of construction organisations	Kulatunga, Amaratunga & Haigh (2005)
Managerial developments	Kulatunga, Amaratunga & Haigh (2005)
Lead project team deliver high quality projects at lower costs in shorter times	Oyedele (2010); Sexton *et al*,.(2007)

Appendix – A3: Barriers for research dissemination – Academia's perspective

Barriers	References
Internal Barriers	
Demand to involve in both pure and applied research	William *et al*. (2004); Kassel (2009)
Maintaining traditional role in public science while partnering with a commercial entity with a tradition of proprietary science	William *et al*. (2004)
Increased work load due to raised number of universities and colleges and the number of students	Brezis & Crouzet (2004)
Increasing pressure from stakeholder groups to demonstrate relevant, quality-oriented processes and outcomes related to teaching	Payne (1996)
Tensions arise among academics due to the funding mechanisms and the iniquity of rewards for research and for teaching	McLernon & Hughes (2003)
"Think global, act local" challenge	Kassel (2009)
Time pressure	Havnes & Stensaker(2006)
Highly qualified disciplinary specialists might feel incompetent when they enter the challenges of the pedagogical discipline	Havnes & Stensaker(2006)
Poor planning and the absence of a proper dissemination strategy	Ordoñez & Serrat (2009)
Low success in getting a substantial share of research funds from abroad	Meek et al. (2009)
Poor use of communication mechanisms	Pheng & Hua (2002)
External Barriers	
Continuing financial demands arising out of diminishing financial support from public sources of finance together with the high requirement of funds for developing activities	OECD (2010); Abbott, Aouad & Madubuko (2008)
Passive and low dissemination	Brown (2005); RD Direct (2009)
Separation of quality assurance mechanisms for teaching and research has created critical problems with regard to choosing a mission and also allocation of resources as R&T requires different type of resources	Senaratne et al. (2005);
Distributed autonomy in higher education is a barrier to open communication, debate and critique	Havnes & Stensaker (2006)
Popularity of fashionable management concept which is virtually ignored by practitioners discouraging the applied research in a way	Hambrick (1994)
Changes brought by research will be seen over a long period of time rather than immediately at some points	Marsh (2010)
Increased global competition in higher education and research	Meek et al. (2009)

Barriers Cont.	References
External Barriers Cont.	
Commercialization of university research is the threat it poses to "open science" and academic freedom	Meek et al. (2009)
Related information systems on "World-Class Universities" and indicators of "cutting-edge" research are more likely to underscore gaps than to motivate the less privileged to 'catch up'	Meek et al. (2009)
Trans-national education provided or assisted by economically advanced countries might be low in quality, and might exploit those paying for it in many cases; the low- and middle- income countries have limited capacity for reviewing the quality of programmes and preventing the obvious low-quality programmes from spreading on their territory	Meek et al. (2009)
Resource pools for research in many low- and middle-income countries, even if financially sufficient, might be too small to compete with the larger pools of other countries	Meek et al. (2009)
Changes in funding mechanisms	Senaratne et al, (2005)
Programme goals of trans-national education programmes and the paradigms of research so driven by the perspectives of economically advanced countries that the needs of low- and middle-income countries are neglected or even suppressed	Meek et al. (2009)
Practitioners often do not entertain innovative research ideas	Azhar (2007)

Appendix – A4: Barriers for research knowledge utilisation – Industry perspective

Barriers	References
External Barriers	
Difficulties with moving away from the traditions and going ahead with current development trends	William et al. (2004)
Not considering themselves being in a position to make the necessary investments	Meek et al. (2009)
Ignorance about good quality academic research	Pheng & Hua (2002)
Although educational research provides useful information, insights, and ideas for improvement, it does not often lead directly to practical advances	Burkhardt & Schoenfeld (2003)
Poor definition of construction product quality attributes	Toakley & Marosszesky (2003)
Not very influential and useful, especially when less-funded and consulted	BERR (2008)
Very unique nature of its own	Steele & Murray (2004)
Ignorance of the knowledge worker and their skills and slow to recognize the importance of skills agenda	O'Donnell (2008)
More fragmented than many other industries	Pathirage, *et al,*. (2007)
Nature of the way in which the construction services are purchased	NZCIC (2006)
Product complexity	Toakley & Marosszesky (2003)
"One off" nature of many projects	Toakley & Marosszesky (2003)
Clients who insist on a dominance of lowest-price criteria to award contracts	Latham (1994)
Pace of developments are integrated and implemented in the sector is slow	Hughes & O'Rourke (2009)
Low responsiveness to the changes	Bettelle (2010); Sabol (2007);
Lack of investment on R&D by the industry	Bettelle (2010); NZCIC (2006)
Impractical to use in real- life construction projects	Azhar (2007)
Culture of conservatism, Lack of appropriate leadership and Timidity in leading the adaptation of new technologies	Jones &Saad (2003 cited Maqsood & Walker, 2007)
Driven by technology push rather than demand pull	Barrett & Barrett (2003)
Industry's short-term focus on achieving project goals	Dubois & Gadde (2002)
Industry as a whole is featured as a loosely coupled system	Dubois & Gadde (2002)
Structure of the industry is seen to inhibit innovation	Sexton et al, (2007)
Limited resources and reduced opportunities for supply chain driven innovation	Sexton et al, (2007)
Risk averse	Sexton et al, (2007)
Industry mind-set that academic research is not directly usable and valid	Pheng & Hua (2002)
Industry lacking direction and resources to test and implement new research outcomes	Pheng & Hua (2002)

Barriers Cont.	References
Internal Barriers	
Lack of skilled people in construction organisations	Kulatunga et al. (2005)
Less adoption of new findings of R&D activities	Pheng &Hua (2002)
Services offered by the professional organisations are highly tacit knowledge intensive in nature	Løwendahl (2000)
Low profit levels	Latham (1994)
R&D expenditure as a proportion of turnover	Fairclough (2002)
Unawareness	Hughes & O'Rourke (2009)
Less knowledge	Hughes & O'Rourke (2009)
Competences among construction companies	Hughes & O'Rourke (2009)
Less incentives	Hughes & O'Rourke (2009)
Out-dated skills of professionals	O'Donnell (2008)
Increasing costs to train employees in today's high technology environment	Wall & Ahmed (2008)
Constantly changing team compositions and lack of team-mate to team-mate familiarity	Sabol (2007)
Academic research is more focused on subjects and issues which are not crucial for the industry	Azhar (2007)
Academic research results are sometimes inapplicable	Azhar (2007)
Poor learning organisational orientation, Lack of investment in people and Lack of training for professionals	Jones & Saad (2003 cited Maqsood & Walker, 2007)
People have to adapt to a number of changes at a personal and professional level at rapid pace	Reissner (2005)
More mature workers already active in the workforce	Hall & Sandelands (2009)
Findings of research are published in research journals that are difficult for practitioners to access	NCTM (2010)
Construction organisations providing services are not properly structured to accumulate sufficient financial capital to invest in research, nor do they have R&D infrastructure	NZCIC (2006)
Reported in an academic style that makes them difficult to interpret	NCTM (2010)

Appendix – A5: Success factors for academia in research knowledge dissemination

Success Factors for Academia	References
Research Initiation	
Partnerships amongst governments, the economic sector and research universities to make new knowledge linked to development goals	Kassel (2009); Teichler & Keanrney (2009)
Research conducted in higher education should be more biased towards applied sciences	Virolainen (2007)
There should be conceptual research undertaken by researchers, as they will ultimately develop to be relevant and useful research outcomes for practice. In fact, such research though may not be immediately usable, will in the long run gradually penetrate to the industry	Barrett & Barrett (2003)
Balance the need to be seen as research institutions contributing new knowledge to society with the need to be seen as effective teaching institutions which are engaged with the community	Haughton et al (2003)
Prioritise	Havnes & Stensaker (2006)
More pedagogical research need to be carried out in order to address the issues of teaching and community engagement relationship	Postlethwaite (2005)
More 'research' and for re-shaping of research culture in order to align with the changing nature of industry behaviour	Brown (2005)
Need to play a more active role in relationship with industry	European Commission (2007)
Focus not only to overcome global challenges, but also to improve individual industries	Marsh, (2010)
Establishing networks of expertise on research	Abbott *et al*,(2008)
Transfer needs to adopt an end-user perspective therefore researchers should need to have a proper knowledge dissemination plan	Davenport & Prusak (1998 cited Senaratne et al, 2005)
Dissemination plan into initial academic research proposals	Ordoñez & Serrat (2009)
Practical relevance	Dean & Bowen (1994)
Dissemination exercises have milestones that must be identified and set early	Ordoñez & Serrat (2009)
Academic research could be made more useful if its structure and organisation were better linked to the practical needs of the industry	EN (2011)
Clarifying objectives; and how they are translated into the supported activities, while maintaining flexibility to respond to emerging policy needs	EN (2011)

Success Factors for Academia Cont.	References
Research Execution	
Quality researching	OECD (2010)
Need to play a more active role in relationship with industry	European Commission (2007)
Re-shape in academic research culture with better compatibility with the industry	Virolainen (2007)
Establishing networks of expertise on research	Abbott *et al*., (2008)
Research with high dissemination capacity	Alker (2008)
Balance the characteristics such as teach-ability, complexity and specificity of research	Bogers (2011)
Improve trust upon research findings	Bogers (2011)
Include summary documents	Ordoñez & Serrat (2009)
Letters of thanks to study participants	Ordoñez & Serrat (2009)
Newsletters to study participants	Ordoñez & Serrat (2009)
Quality control to ensure the information content is accurate, relevant, representative, and timely	Ordoñez & Serrat (2009)
Value creation process	Le &Bronn (2007)
Academic research could be made more useful if its structure and organisation were better linked to the practical needs of the industry	EN (2011)
Reduce complexities of research funding: Research and innovation funding should provide more added values, increase its leverage effect on other public and private resources and be used more effectively to support the strategic alignment and pooling of national and regional funds to avoid duplication. Further, administrative burdens should be lowered by timely grants	EN (2011)
Academic research development centres	Havnes & Stensaker (2006)
Research Dissemination	
Packaging dissemination techniques	Meek (2009)
Specialist staff to identify and manage knowledge resources with business potential, i.e. how to take a new idea to market, resources to make it happen, and to obtain adequate buy-in by all stakeholders	European Commission (2007)
Establishing networks of expertise on research	Abbott *et al*., (2008)
Ensuring physical availability of the product to as large a proportion of the target audience	Ordoñez and Serrat (2009)

Enablers for academia	References
Research Dissemination cont.	
Bigger the project and the higher the level of the degree, the more likely it is that research outcomes that would be worth communicating beyond the basic requirements to the broader research community	Hays (2007)
Transfer needs to adopt an end-user perspective therefore researchers should need to have a proper knowledge dissemination plan	Davenport & Prusak (1998 cited Senaratne et al, 2005)
Interactive dissemination process, allowing feedback from audiences according to a cyclical model of communications flow	Alker (2008)
Active dissemination by tailoring research findings to a target audience with a dynamic flow of information from the source to increase the uptake of research in policy making	RD Direct (2009)
Shared vision and common understanding of what one wants to disseminate together with a way of describing that to those who stand to benefit from it	Ordoñez & Serrat (2009)
Clearly identify the target audience and to map it to one of the categories in the awareness, understanding, and action to be taken	Ordoñez & Serrat (2009)
Presented as a benefit and solution to users	Ordoñez & Serrat (2009)
Communicating the results of research to a wider community beyond immediate research reports, theses and research products	Hays (2007)
Effective communication channels	Alker (2008)

Appendix – A6: Success factors for industry in research knowledge utilisation

Success Factors for Industry	References
Success Factors to be implemented as an Industry	
Develop open innovation approaches to R&D	European Commission, (2007)
Use public research as a strategic resource	European Commission, (2007)
Capacity building to access and use research	Alker, (2008)
Development of procurement	Hall &Sandelands (2009)
Industry investments out of self-interest or to respond to the demands of clients and government policy	Koebel et al, (2004)
Move beyond the traditional practices to adopt new practices	Kulatunga et al. (2005)
Research use included in job-descriptions	Alker (2008)
Skills agenda - the ability to attract, retain and develop skilled people is a required core competence	Hall &Sandelands (2009)
A network through which members could collaborate with each other	Egan (1998)
Updating knowledge of the workers comparatively with the new knowledge generation	Amaratunga*et al*.,(2010)
Development of strategic and professional leadership	Hall &Sandelands (2009)
Success Factors to be implemented as Organisational/Individuals	
Change internal dynamics of construction organisations to be able to respond to change	Steele & Murray (2004)
Use as criterion for staff appraisal	Alker, (2008)
Combining in-house and external resources	European Commission, (2007)
Aim to maximize economic value through intellectual property rights	European Commission, (2007)
Asking project managers to identify and report on innovation opportunities	Ward (2003)
Increase senior management awareness on benefits of external knowledge can bring to the organisation budgets	Ward (2003)
Rewarding research-informed decision-making	Alker, (2008)
Organise events with employees returning from a conference to share knowledge to other employees	Ward (2003)
Develop a mechanism to identify important innovative management practices from research	Ward (2003)
Offer chances to attend conferences as a reward for deserved employees	Ward (2003)
Publish, how new knowledge has contributed to improved performance at the personal and/or organisational level so that there is an explicit cause-and-effect link between being open to knowledge-pull and adopting an innovation	Ward (2003)
Knowledge workers	Green, Newcombe, Fernie& Weller (2004)

Appendix – A7: Success factors for academic - industry research collaborations

Success Factors to be implemented Collaboratively	References
Collaboration where the interests and values of each partner were articulated in advance and conflict of interest issues are resolved before legal and business arrangements are established in a contract would be essential	Azhar (2007)
Incentives in the system that motivates staff and institutional leaders to participate in, or initiate, development	Havnes & Stensaker (2006)
Undergraduate research more into actual issues in the industry	Blackman & Kennedy (2009)
Communication between researchers, research funders and research users in a number of different ways	Alker (2008)
Review how research can be more effectively connected to real-world activity and policy setting	Marsh (2010)
Research programs should be judged not just by the quality and quantity of science produced, but by the industry impact and tangible benefit resulting from the research	Marsh (2010)
Joint publications between university researchers and those based in industry and government	Meek (2009)
Knowledge broker	Alker, (2008)
Embedding researchers within companies as part of existing research activity	Aouad *et al*., (2010)
Strategic partnerships	Meek (2009)
Collaborations and partnerships amongst governments, the economic sector and research universities to make sure that new knowledge becomes linked to development goals	Meek (2009); Kassel (2009)
Enhance the researcher-practitioner collaboration to conduct research on problems which are vital for the construction industry and to find out adoptable solutions	Meek (2009); Azhar (2007)
Broadening participation in programmes: The ultimate users of innovations should be involved much earlier in the process to accelerate and broaden the exploitation of results and to encourage greater public acceptance	EN (2011)
Increasing the competitiveness and societal impact: This would require better uptake and use of results by companies, investors, public authorities, other researchers and policy makers	EN (2011)
Understanding the process and of building systems for innovation	Meek (2009)

Appendix - B: Research Directions from Academic Research for Sustainable Construction Practice

Research Drivers for Construction Sustainability	
Procurement	Whole life value, Best practices, Supply chain integration (Vadera et al., 2008)
Design	Build-ability, Purposive, Resource efficient, Sustainable, Resilient, Adaptable, Attractive, Quality assessment tools (Vadera et al., 2008)
Innovation	Enhancing industry's capacity to innovate (Vadera et al., 2008)
Work force	Skills pledges, Training plans, Invest in people or other business support tools, Continuous professional development, Lifelong learning (Vadera et al., 2008); Productivity enhancing mechanization, Modernization, Technology upgrading, Changes in financing and management practices, Labour intensive practices, Wages and welfare, Quality consciousness, Motivation, Awareness, Concern on sustainability issues, Living habits, Economic pursuits, Global-local interdependence, Attitude and actions of an individuals, Consciousness building (Shah, 2002)
Better regulation	Reduction in the administrative burdens (Vadera et al., 2008)
Climate change	Adaptation, Reducing carbon dioxide emissions (Vadera et al., 2008)
Biodiversity	Conservation, Enhancement (Vadera et al., 2008)
Automation, industrialisation and new technologies	New systems and processes, Modern methods, Up skill industry, Change out-dated perceptions, Emerging technologies, Appropriate BIM standards (Vadera et al., 2008)
Building better cities and communities	Standards and conformance review, Building Act/Code (Vadera et al., 2008); Meeting aspirations of residents, Affordable, Liveable, Vibrant city environments, Integrating urban planning requirements with individual property rights, Cities and towns for future needs (Crisp et al., 2012); Land conservation, Optimal and creative use, Equitable distribution and reuse of brown field areas, Creative land ownership and use policy(Shah, 2002)
Meeting the housing needs	Population change, Ageing population, Diverse population, Vulnerable groups, Tenure, Affordability (Vadera et al., 2008)
Productivity	Industry structure, Productivity measures, Industry processes, Skills, Technology, Client value, Regulatory environment (Vadera et al., 2008)
Water	Reduce per capita consumption (Vadera et al., 2008)
Sustainability	Measuring sustainability, Awareness for industry including benchmarking sector performance from a whole of life perspective, New technologies(Crisp et al.,2012)

Research Drivers for Construction Sustainability (Cont.)	
Waste	Reduction (Vadera et al., 2008)
Better buildings	Retrofit solutions, Building condition(Flint et al. 2008); Resilient buildings, Indoor air quality and moisture control, Insulation and air tightness, Ventilation, Dependably in fire situations(Crisp et al., 2012); Extending the working life of buildings(Shah, 2002)
Materials performance	Improvement of traditional materials, viability and applicability of new and innovative building materials, Best use of existing materials, Reuse, Indigenous materials, Low environmental and social impact materials, Performance Assurance (Vadera et al., 2008)
Informal housing	Settlements in the urban landscape, Recognizing role of the peoples' processes in producing them (Shah, 2002)
Disaster mitigation	Protection, Disaster preparedness, Disaster resistant designs Detailing, technology and construction(Shah, 2002)
Gender equality	Women status as owners, Recognizing their role as users, Respecting their contribution as producers(Shah, 2002)

Appendix - C: Survey Questionnaires Samples

Appendix - C1: Questionnaire devised to collect data from academic researchers under Phase I of data collection

Appendix - C2: Questionnaire devised to collect data from industry organisations under Phase I of data collection

Appendix - C3: Questionnaire devised to collect data from industry practitioners under Phase I of data collection

Appendix - D: Survey with Academics– Demographic Data Analysis

Appendix - D1: Analysis of academic sample in terms of positions held by the respondents

Position Held	Code	Frequency	Percentage
Head of the Department	AD1-1	4	13.33%
Professor	AD1-2	1	3.33%
Senior Lecturer	AD1-3	25	83.33%

Appendix - D2: Analysis of academic sample in terms of field of specialisation of the respondents

Field of Study	Code	Frequency	Percentage
Architecture/Town and Country Planning	AD2-1	8	26.67%
Building Economics	AD2-2	11	36.67%
Civil/ Technology/ Environmental/ Infrastructure Engineering	AD2-3	11	36.67%

Appendix - D3: Analysis of academic sample in terms of publication efforts

Publication Number Category	Code	Frequency	Percentage
< 40	AD3-1	20	66.67%
40 - 60	AD3-2	7	23.33%
>60	AD3-3	3	10.00%

Appendix - E: Survey with Industry Organisations – Demographic Data Analysis

Appendix - E1: Analysis of industry organisation sample in terms of positions held by the respondents

Position Held	Code	Frequency	Percentage
General Manager	OD1-1	10	32.26%
Deputy General Manager	OD1-2	12	38.71%
Other (Section Head, Chief Engineer, Chief Quantity Surveyor)	OD1-3	09	29.03%

Appendix - E2: Analysis of industry organisation sample in terms of CIDA grade of the organisation

CIDA Grade	Code	Frequency	Percentage
C1	OD2-1	19	61.29%
C2	OD2-2	7	22.58%
C3	OD2-3	5	16.13%

Appendix - E3: Analysis of industry organisation sample in terms of years of experience of the respondents

Years of Experience category	Code	Frequency	Percentage
0-10 years	OD3-1	14	45.16%
11-15 years	OD3-2	5	16.13%
16-20 years	OD3-3	8	25.81%
Beyond 20 years	OD3-4	3	9.68%

Appendix - F: Survey with Industry Practitioners – Demographic Data Analysis

Appendix - F1: Analysis of industry practitioner sample in terms of positions held by the respondents

Position Held	Code	Frequency	Percentage
Quantity Surveyor	ID1-1	30	33.33%
Engineer	ID1-2	30	33.33%
Architect	ID1-3	30	33.33%

Appendix - F2: Analysis of industry practitioner sample in terms of organisation stakeholder group

Organisation Stakeholder Group	Code	Frequency	Percentage
Contractor	ID2-1	45	50.00%
Consultant	ID2-2	24	26.67%
Client	ID2-3	21	23.33%

Appendix - F3: Analysis of industry practitioner sample in terms of years of experience of the respondents

Years of Experience Category	Code	Frequency	Percentage
0-10 years	ID3-1	59	65.56%
11-15 years	ID3-2	13	14.44%
16-20 years	ID3-3	9	10.00%
Beyond 20 years	ID3-4	9	10.00%

Appendix - G: Analysis of Model - Chain of Knowledge Utilisation

Appendix - G1: Weightings (values as per expanded scale) of stages of Model - Chain of Knowledge Utilisation

Stage Number	Stage of Research Utilisation	Code	Weighting (Based on Stage and Ranking)				
			1	2	3	4	5
1	Reception	DE1	-14	-7	0	1	8
2	Cognition	DE2	-13	-6	0	2	9
3	Reference	DE3	-12	-5	0	3	10
4	Effort	DE4	-11	-4	0	4	11
5	Adoption	DE5	-10	-3	0	5	12
6	Implementation	DE6	-9	-2	0	6	13
7	Impact	DE7	-8	-1	0	7	14

Appendix - G2: Median and Percentile statistics of Model - Chain of Knowledge Utilisation as per the results of academic survey data analysis

Statistics								
		DE1	DE2	DE3	DE4	DE5	DE6	DE7
N	Valid	30	30	30	30	30	30	30
	Missing	0	0	0	0	0	0	0
Median		4.00	4.00	3.00	3.00	2.50	2.50	3.00
Percentiles	25	3.00	3.00	2.00	2.00	2.00	2.00	2.00
	50	4.00	4.00	3.00	3.00	2.50	2.50	3.00
	75	4.00	4.00	4.25	4.00	3.25	4.00	4.00

Reliability Statistics	
Cronbach's Alpha	N of Items
0.613	7

Appendix - H: Analysis of Pipeline Model of Knowledge Dissemination

Appendix - H1: Weightings (values as per expanded scale) of stages of Pipeline Model of Knowledge Dissemination

Stage Number	Stage of Research Utilisation	Code	Weighting (Based on Stage and Ranking)				
			1	2	3	4	5
1	Aware	U1	-14	-7	0	1	8
2	Accept	U2	-13	-6	0	2	9
3	Locally Applicable	U3	-12	-5	0	3	10
4	Doable	U4	-11	-4	0	4	11
5	Act	U5	-10	-3	0	5	12
6	Adopt	U6	-9	-2	0	6	13
7	Adhere	U7	-8	-1	0	7	14

Appendix - H2: Median and Percentile statistics of Pipeline Model of Knowledge Dissemination as per the results of industry organisation survey data analysis

Statistics								
		U1	U2	U3	U4	U5	U6	U7
N	Valid	31	31	31	31	31	31	31
	Missing	0	0	0	0	0	0	0
Median		3.00	3.00	2.00	3.00	2.00	3.00	2.00
Percentiles	25	2.00	2.00	1.00	2.00	2.00	1.00	1.00
	50	3.00	3.00	2.00	3.00	2.00	3.00	2.00
	75	4.00	4.00	4.00	4.00	4.00	4.00	4.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.859	7

Appendix - H3: Median and Percentile statistics of Pipeline Model of Knowledge Dissemination as per the results of industry practitioner survey data analysis

Statistics								
		U1	U2	U3	U4	U5	U6	U7
N	Valid	90	90	90	90	90	90	90
	Missing	0	0	0	0	0	0	0
Median		3.00	3.00	2.00	2.00	3.00	3.00	2.00
Percentiles	25	2.00	2.00	2.00	1.75	1.00	2.00	1.00
	50	3.00	3.00	2.00	2.00	3.00	3.00	2.00
	75	4.00	4.00	3.00	4.00	4.00	4.00	4.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.871	7

Appendix - I: Analysis of Internal Barriers for Academics in Dissemination of Research Knowledge

Appendix - I1: Internal barriers for academics in dissemination of research knowledge, with assigned codes

Internal Barrier	Code
Research culture of the affiliation demanding to involve in either pure or applied research	IB1
Maintaining traditional research culture while partnering with a commercial industry	IB2
Increased work load due to raised number of universities, colleges and students	IB3
Increasing pressure from stakeholder groups upon quality assurance and outcome based education	IB4
Tension due to funding mechanisms	IB5
Iniquity of rewards for research and teaching	IB6
"Think global, act local" challenge	IB7
Time pressure	IB8
Poor planning and absence of a proper outcome dissemination strategy	IB9
Low success in getting research funds	IB10

Appendix - I2: Median and Percentile statistics of internal barriers for academics, in dissemination of research knowledge as per the results of academic survey data analysis

Statistics

		IB1	IB2	IB3	IB4	IB5	IB6	IB7	IB8	IB9	IB10
N	Valid	30	30	30	30	30	30	30	30	30	30
	Missing	0	0	0	0	0	0	0	0	0	0
Median		3.00	3.00	4.00	4.00	4.00	3.00	3.00	4.00	3.00	3.00
Percentiles	25	2.00	3.00	4.00	3.00	3.00	2.00	2.75	3.00	2.00	2.00
	50	3.00	3.00	4.00	4.00	4.00	3.00	3.00	4.00	3.00	3.00
	75	4.00	4.00	5.00	4.25	5.00	4.00	4.00	5.00	4.00	4.25

Reliability Statistics

Cronbach's Alpha	N of Items
0.774	10

Appendix - I3: Ordinal Regression analysis parameter estimates of internal barriers for academics, in dissemination of research knowledge as per the results of academic survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	IB1W	.243	.361	.452	1	.502	-.465	.950
	IB2W	-.242	.486	.247	1	.619	-1.195	.712
	IB3W	.795	.735	1.171	1	.279	-.645	2.236
	IB4W	.086	.513	.028	1	.867	-.920	1.092
	IB5W	-1.094	.443	6.104	1	.013	-1.962	-.226
	IB6W	-.385	.506	.581	1	.446	-1.376	.606
	IB7W	-1.751	.539	10.565	1	.001	-2.807	-.695
	IB8W	.848	.805	1.111	1	.292	-.729	2.426
	IB9W	1.424	.497	8.224	1	.004	.451	2.397
	IB10W	.188	.343	.300	1	.584	-.485	.862

Appendix - J: Analysis of External Barriers for Academics in Dissemination of Research Knowledge

Appendix - J1: External barriers for academics in dissemination of research knowledge, with assigned codes

External Barrier	Code
Diminishing financial support from public sources for research	EB1
Passive and low opportunity for actual research outcome dissemination	EB2
Inadequate quality assurance mechanisms for research	EB3
Inadequate allocation of resources for research	EB4
Lack of autonomy in higher education	EB5
Ignorance of fashionable management concepts by practitioners	EB6
Effects of research takes long time to get appear even if adopted	EB7
Low- and middle- income countries inability in reviewing and preventing low quality of research programmes	EB8
Increased global competition in higher education and research	EB9
Indicators of "world-class universities" and "cutting-edge" research reduces the chances for less privileged universities	EB10
Commercialization of university research	EB11
Goals and paradigms of trans-national research driven by the perspectives of economically advanced countries	EB12

Appendix - J2: Median and Percentile statistics of external barriers for academics in dissemination of research knowledge as per the results of academic survey data analysis

Statistics												
		EB 1	EB 2	EB 3	EB 4	EB 5	EB 6	EB 7	EB 8	EB 9	EB 10	EB 11	EB 12
N	Valid	30	30	30	30	30	30	30	30	30	30	30	30
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median		4.0	4.0	4.0	4.0	3.0	3.00	4.0	3.00	3.50	3.50	3.00	4.00
Percentiles	25	3.0	3.0	3.0	3.0	1.0	2.00	3.0	2.00	2.00	2.00	2.00	3.00
	50	4.0	4.0	4.0	4.0	3.0	3.00	4.0	3.00	3.50	3.50	3.00	4.00
	75	4.0	4.0	5.0	5.0	4.0	4.25	5.0	4.25	4.25	4.00	4.00	5.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.793	12

Appendix - J3: Ordinal Regression analysis parameter estimates of external barriers for academics, in dissemination of research knowledge as per the results of academic survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	EB1W	-.265	.566	.219	1	.640	-1.375	.845
	EB2W	.316	.478	.438	1	.508	-.621	1.254
	EB3W	-1.414	.581	5.922	1	.015	-2.553	-.275
	EB4W	.044	.397	.012	1	.912	-.734	.821
	EB5W	.570	.466	1.498	1	.221	-.343	1.484
	EB6W	.115	.486	.056	1	.813	-.837	1.067
	EB7W	.084	.458	.034	1	.855	-.814	.982
	EB8W	-.762	.388	3.844	1	.050	-1.523	.000
	EB9W	1.835	.739	6.162	1	.013	.386	3.284
	EB10W	-2.495	.731	11.651	1	.001	-3.927	-1.062
	EB11W	-.750	.475	2.493	1	.114	-1.681	.181
	EB12W	2.260	.556	16.502	1	.000	1.170	3.351

Appendix - K: Analysis of Internal Barriers for Construction Industry in Utilisation of Research Knowledge

Appendix - K1: Internal barriers for construction industry in utilisation of research knowledge, with assigned codes

Internal Barrier	Code
Lack of skilled people to promote innovations	BW1
Research outcome capturing is difficult as it is tacit knowledge intensive	BW2
Link between research & development and profit levels is not visible	BW3
Unawareness due to research outcome not reaching the industry	BW4
Competition among construction companies being highly price based	BW6
Less incentives for interest on research & development activities	BW7
Out-dated skills of professionals failing to match with requirements of innovations	BW8
High cost of training employees to match with requirements of innovations	BW9
Constantly changing team compositions disturbs information flow and methods of innovation diffusion	BW10
Academic research more focused on subjects which are not crucial for the construction industry	BW11
Poor organisational learning orientation	BW12
Challenging requirement of adapting to a number of personal and professional changes at a rapid pace	BW13
No proper structure to accumulate financial capital to invest in research	BW14
Research reported in an academic style making difficult to interpret	BW15

Appendix - K2: Median and Percentile statistics of internal barriers for construction industry, in utilisation of research knowledge as per the results of industry organisation survey data analysis

Statistics															
		BW1	BW2	BW3	BW4	BW5	BW6	BW7	BW8	BW9	BW10	BW11	BW12	BW13	BW14	BW15
N	Valid	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median		4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Percentiles	25	2.0	2.0	2.0	3.0	2.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0
	50	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	75	5.0	4.0	4.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0	5.0

Reliability Statistics

Cronbach's Alpha	N of Items
0.819	15

Appendix - K3: Median and Percentile statistics of internal barriers for construction industry, in utilisation of research knowledge as per the results of industry practitioner survey data analysis

Statistics															
		BW1	**BW2**	**BW3**	**BW4**	**BW5**	**BW6**	**BW7**	**BW8**	**BW9**	**BW10**	**BW11**	**BW12**	**BW13**	**BW14**	**BW15**
N	Valid	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median		4.00	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.00	3.0
Percentiles	25	2.75	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	3.0	2.0	2.00	2.0
	50	4.00	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.00	3.0
	75	5.00	4.0	4.0	5.0	5.0	5.0	5.0	4.0	4.0	4.0	5.0	4.0	4.0	4.25	4.0

Reliability Statistics

Cronbach's Alpha	N of Items
0.868	15

Appendix - K4: Ordinal Regression analysis parameter estimates of internal barriers for construction industry, in utilisation of research knowledge as per the results of industry organisation survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	**Std. Error**	**Wald**	**df**	**Sig.**	**Lower Bound**	**Upper Bound**
Location	BW1W	-.179	.386	.214	1	.644	-.935	.578
	BW2W	.352	.466	.573	1	.449	-.560	1.265
	BW3W	.341	.475	.516	1	.473	-.590	1.272
	BW4W	1.227	.622	3.894	1	.048	.008	2.445
	BW5W	-1.857	.496	14.031	1	.000	-2.829	-.886
	BW6W	-1.658	.495	11.206	1	.001	-2.628	-.687
	BW7W	1.684	.502	11.251	1	.001	.700	2.668
	BW8W	-.599	.427	1.970	1	.160	-1.437	.238
	BW9W	-.486	.384	1.601	1	.206	-1.239	.267
	BW10W	.430	.349	1.519	1	.218	-.254	1.115
	BW11W	1.622	.451	12.910	1	.000	.737	2.506
	BW12W	.532	.353	2.275	1	.131	-.159	1.223
	BW13W	-1.655	.472	12.274	1	.000	-2.580	-.729
	BW14W	1.076	.436	6.100	1	.014	.222	1.930
	BW15W	.490	.405	1.465	1	.226	-.304	1.284

Appendix - K5: Ordinal Regression analysis parameter estimates of internal barriers for construction industry, in utilisation of research knowledge as per the results of industry practitioner survey data analysis

Parameter Estimates								
			Std.				95% Confidence Interval	
		Estimate	Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	BW1W	-.100	.196	.262	1	.609	-.484	.284
	BW2W	.341	.210	2.650	1	.104	-.070	.753
	BW3W	.012	.184	.004	1	.948	-.349	.373
	BW4W	-.214	.232	.851	1	.356	-.669	.241
	BW5W	-.097	.232	.175	1	.676	-.551	.358
	BW6W	-.042	.187	.050	1	.823	-.408	.324
	BW7W	-.181	.205	.774	1	.379	-.583	.222
	BW8W	.189	.285	.441	1	.506	-.369	.747
	BW9W	-.309	.180	2.950	1	.086	-.661	.044
	BW10W	.624	.214	8.530	1	.003	.205	1.043
	BW11W	.109	.168	.424	1	.515	-.220	.438
	BW12W	-.294	.201	2.145	1	.143	-.687	.099
	BW13W	.173	.197	.775	1	.379	-.213	.559
	BW14W	.121	.226	.287	1	.592	-.321	.563
	BW15W	.050	.183	.074	1	.786	-.308	.408

Appendix - L: Analysis of External Barriers for Construction Industry in Utilisation of Research Knowledge

Appendix - L1: External barriers for construction industry in utilisation of research knowledge, with assigned codes

External Barriers	Code
Difficulties in going ahead with current construction industry development trends	BB1
Reluctance to invest on research	BB2
Ignorance of good quality academic research	BB3
Educational research does not often lead directly to practical advances	BB4
Low attention given to construction product quality	BB5
Less funded/consulted research being low influential/useful	BB6
Very unique nature of construction industry	BB7
Ignorance of the knowledge worker and importance of skills agenda	BB8
Highly fragmented nature of construction industry	BB9
Complexity of construction industry production process	BB10
"One off" nature of many construction projects	BB11
Clients interest of 'lowest-price criteria' to award contracts	BB12
Slow pace of development in construction sector	BB13
Low responsiveness to change	BB14
Lack of investment on R&D by the industry	BB15
Research outcomes are impractical to use in real- life construction projects	BB16
Industry lacks leadership to direct towards research and development	BB17
Industry is timid in adapting management innovations	BB18
Industry is driven by the technology push over the demand pull	BB19
Industry's short-term focus on achieving project goals	BB20
Limited resources and opportunities for supply chain driven innovation	BB21
Risk averse nature of the construction industry	BB22
Industry mind-set that academic research is not directly usable and valid	BB23

Appendix - L2: Median and Percentile statistics of external barriers for construction industry, in utilisation of research knowledge as per the results of industry organisation survey data analysis

Statistics																								
		BB 1	**BB 2**	**BB 3**	**BB 4**	**BB 5**	**BB 6**	**BB 7**	**BB 8**	**BB 9**	**BB 10**	**BB 11**	**BB 12**	**BB 13**	**BB 14**	**BB 15**	**BB 16**	**BB 17**	**BB 18**	**BB 19**	**BB 20**	**BB 21**	**BB 22**	**BB 23**
N	Valid	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median		4.0	4.0	4.0	3.0	2.0	2.0	3.0	4.0	3.0	3.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Percentiles	25	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0	2.0	2.0	3.0	2.0	2.0
	50	4.0	4.0	4.0	3.0	2.0	2.0	3.0	4.0	3.0	3.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	75	4.0	5.0	5.0	5.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	5.0	4.0	5.0	4.0	4.0	4.0	4.0	4.0

Reliability Statistics

Cronbach's Alpha	N of Items
0.733	23

Appendix - L3: Median and Percentile statistics of external barriers for construction industry, in utilisation of research knowledge as per the results of industry practitioner survey data analysis

Statistics																								
		BB 1	**BB 2**	**BB 3**	**BB 4**	**BB 5**	**BB 6**	**BB 7**	**BB 8**	**BB 9**	**BB 10**	**BB 11**	**BB 12**	**BB 13**	**BB 14**	**BB 15**	**BB 16**	**BB 17**	**BB 18**	**BB 19**	**BB 20**	**BB 21**	**BB 22**	**BB 23**
N	Valid	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median		3.0	4.0	4.0	4.0	3.0	3.0	4.0	3.0	4.0	3.0	3.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0
Percentiles	25	2.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	2.0
	50	3.0	4.0	4.0	4.0	3.0	3.0	4.0	3.0	4.0	3.0	3.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0
	75	4.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0	4.0	4.0	4.0	4.0	5.0	4.0	4.0	4.0

Reliability Statistics

Cronbach's Alpha	N of Items
0.869	23

Appendix - L4: Ordinal Regression analysis parameter estimates of external barriers for construction industry, in utilisation of research knowledge as per the results of industry organisation survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	BB1W	-7.336	2.003	13.414	1	.000	-11.261	-3.410
	BB2W	2.649	.792	11.194	1	.001	1.097	4.201
	BB3W	3.326	1.411	5.555	1	.018	.560	6.092
	BB4W	5.501	1.976	7.746	1	.005	1.627	9.374
	BB5W	.781	1.588	.242	1	.623	-2.331	3.893
	BB6W	-6.503	2.130	9.323	1	.002	-10.677	-2.329
	BB7W	-2.763	1.177	5.506	1	.019	-5.071	-.455
	BB8W	2.306	1.906	1.465	1	.226	-1.429	6.042
	BB9W	-8.485	3.680	5.318	1	.021	-15.697	-1.274
	BB10W	9.561	2.935	10.609	1	.001	3.808	15.315
	BB11W	-4.850	1.871	6.719	1	.010	-8.517	-1.183
	BB12W	13.083	3.865	11.460	1	.001	5.508	20.658
	BB13W	-3.384	1.123	9.084	1	.003	-5.585	-1.184
	BB14W	.055	.578	.009	1	.924	-1.078	1.189
	BB15W	-1.807	1.353	1.783	1	.182	-4.459	.845
	BB16W	-9.215	2.532	13.243	1	.000	-14.178	-4.252
	BB17W	5.103	1.549	10.848	1	.001	2.066	8.139
	BB18W	13.375	3.903	11.636	1	.001	5.666	21.085
	BB19W	8.420	2.523	11.140	1	.001	3.476	13.365
	BB20W	2.103	1.536	1.875	1	.171	-.907	5.113
	BB21W	-5.394	2.050	6.924	1	.009	-9.411	-1.376
	BB22W	-5.667	2.745	4.262	1	.039	-11.047	-.287
	BB23W	-.603	.915	.434	1	.510	-2.397	1.191

Appendix - L5: Ordinal Regression analysis parameter estimates of external barriers for construction industry, in utilisation of research knowledge as per the results of industry practitioner survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	BB1W	.288	.179	2.599	1	.107	-.062	.638
	BB2W	-.125	.208	.364	1	.547	-.532	.282
	BB3W	-.509	.237	4.604	1	.032	-.973	-.044
	BB4W	-.014	.194	.006	1	.941	-.395	.366
	BB5W	.058	.175	.109	1	.741	-.285	.400
	BB6W	-.222	.196	1.281	1	.258	-.606	.162
	BB7W	-.190	.227	.702	1	.402	-.635	.255
	BB8W	.119	.240	.245	1	.621	-.351	.589
	BB9W	.438	.249	3.083	1	.079	-.051	.926
	BB10W	.056	.178	.098	1	.754	-.293	.404
	BB11W	-.039	.229	.029	1	.865	-.487	.409
	BB12W	-.014	.175	.006	1	.936	-.357	.329
	BB13W	.513	.222	5.318	1	.021	.077	.948
	BB14W	-.646	.253	6.545	1	.011	-1.142	-.151
	BB15W	.370	.248	2.223	1	.136	-.116	.856
	BB16W	-.203	.211	.925	1	.336	-.618	.211
	BB17W	.023	.202	.013	1	.908	-.373	.420
	BB18W	.319	.192	2.758	1	.097	-.058	.697
	BB19W	.243	.222	1.204	1	.273	-.191	.678
	BB20W	-.014	.211	.004	1	.947	-.428	.400
	BB21W	.179	.227	.620	1	.431	-.266	.623
	BB22W	.042	.233	.032	1	.857	-.414	.498
	BB23W	-.018	.227	.006	1	.936	-.463	.427

Appendix - M: Analysis of Success Factors of Research Initiation for Academia, in Dissemination of Research Knowledge

Appendix - M1: Success factors of research initiation for academia, in dissemination of research knowledge, with assigned codes

Success Factors of Research Initiation	Code
Create new knowledge linked to development goals	WI1
Select research more biased towards applied sciences	WI2
Undertake conceptual research with the ability to gradually penetrate to the industry	WI3
Give the correct priority to the research	WI4
Select research more related to the teaching discipline of the academic	WI5
Focus not only on global challenges, but also on individual industries	WI8
Establish networks of expertise on research	WI9
Consider end-user perspective in planning knowledge dissemination	WI10
Add a dissemination plan into initial academic research proposals	WI11

Appendix - M2: Median and Percentile statistics of success factors of research initiation for academia, in dissemination of research knowledge as per the results of academic survey data analysis

Statistics

		WI1	WI2	WI3	WI4	WI5	WI6	WI7	WI8	WI9	WI10	WI11
N	Valid	30	30	30	30	30	30	30	30	30	30	30
	Missing	0	0	0	0	0	0	0	0	0	0	0
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.50	4.00	4.00	4.00	4.00
Percentiles	25	3.00	3.75	3.00	3.00	3.00	4.00	4.00	3.00	4.00	3.00	3.75
	50	4.00	4.00	4.00	4.00	4.00	4.00	4.50	4.00	4.00	4.00	4.00
	75	5.00	5.00	5.00	5.00	4.25	5.00	5.00	5.00	5.00	5.00	5.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.060	11

Appendix - M3: Ordinal Regression analysis parameter estimates of success factors of research initiation for academia, in dissemination of research knowledge as per the results of academic survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	WI1W	.274	.483	.322	1	.570	-.672	1.220
	WI2W	.237	.498	.227	1	.634	-.738	1.213
	WI3W	-.312	.339	.845	1	.358	-.976	.353
	WI4W	-.856	.440	3.780	1	.052	-1.719	.007
	WI5W	-.827	.513	2.592	1	.107	-1.833	.180
	WI6W	-.850	.581	2.144	1	.143	-1.988	.288
	WI7W	-1.331	.609	4.775	1	.029	-2.525	-.137
	WI8W	-.572	.487	1.379	1	.240	-1.527	.383
	WI9W	3.742	1.210	9.558	1	.002	1.370	6.114
	WI10W	-.246	.496	.246	1	.620	-1.219	.726
	WI11W	1.585	.573	7.658	1	.006	.462	2.708

Appendix - N: Analysis of Success Factors of Research Execution for Academia, in Dissemination of Research Knowledge

Appendix - N1: Success factors of research execution for academia, in dissemination of research knowledge, with assigned codes

Success Factors of Research Execution	Code
Maintain required quality of research	WP1
Balance teach-ability, complexity and specificity of research	WP2
Follow a clear method based on research methodology	WP3
Include summary documents	WP4
Send affiliation authorized thanking letters to study participants	WP5
Send newsletters to study participants	WP6
Treat research as a value creation process by being ethical	WP7
Reduce complications and administrative burdens of research funding	WP8
Establish academic research development centres	WP9

Appendix - N2: Median and Percentile statistics of success factors of research execution for academia, in dissemination of research knowledge as per the results of academic survey data analysis

Statistics										
		WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9
N	Valid	30	30	30	30	30	30	30	30	30
	Missing	0	0	0	0	0	0	0	0	0
Median		4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00
Percentiles	25	4.00	4.00	4.00	3.00	3.75	3.00	4.00	4.00	4.00
	50	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00
	75	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.597	9

Appendix - N3: Ordinal Regression analysis parameter estimates of success factors of research execution for academia, in dissemination of research knowledge as per the results of academic survey data analysis

Parameter Estimates								
			Std.				95% Confidence Interval	
		Estimate	Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	WP1W	.057	.461	.015	1	.902	-.848	.961
	WP2W	.088	.456	.037	1	.846	-.805	.982
	WP3W	.585	.571	1.049	1	.306	-.534	1.704
	WP4W	.238	.414	.329	1	.566	-.574	1.049
	WP5W	.182	.423	.185	1	.667	-.647	1.011
	WP6W	-.114	.409	.078	1	.780	-.916	.688
	WP7W	.316	.728	.188	1	.664	-1.110	1.742
	WP8W	-.780	.815	.915	1	.339	-2.378	.818
	WP9W	-.107	.552	.037	1	.847	-1.189	.975

Appendix - O: Analysis of Success Factors of Research Dissemination for Academia

Appendix - O1: Success factors of research dissemination for academia, with assigned codes

Success factors of Research Dissemination	Code
Use multiple dissemination techniques	WD1
Recruit specialist staff with business potential to manage knowledge resources	WD2
Put stronger efforts to communicate outcomes of higher level research to a broader community	WD3
Ensure availability of the product to the target audience	WD4
Allow for feedback from audiences	WD5
In dissemination, tailor research findings to a target audience to increase use of research in policy making	WD6
Present research outcome as a benefit or a solution to a problem	WD7

Appendix - O2: Median and Percentile statistics of success factors of research dissemination for academia as per the results of academic survey data analysis

Statistics								
		WD1	WD2	WD3	WD4	WD5	WD6	WD7
N	Valid	30	29	30	30	30	30	30
	Missing	0	1	0	0	0	0	0
Median		4.00	4.00	4.00	5.00	4.00	4.00	4.00
Percentiles	25	3.75	3.00	4.00	4.00	4.00	4.00	3.00
	50	4.00	4.00	4.00	5.00	4.00	4.00	4.00
	75	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.647	7

Appendix - O3: Ordinal Regression analysis parameter estimates of success factors of research execution for academia, in dissemination of research knowledge as per the results of academic survey data analysis

Parameter Estimates								
			Std.				95% Confidence Interval	
		Estimate	Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	WD1W	-.159	.548	.085	1	.771	-1.235	.916
	WD2W	.134	.411	.106	1	.745	-.672	.939
	WD3W	.706	.503	1.969	1	.161	-.280	1.693
	WD4W	.527	.559	.889	1	.346	-.569	1.622
	WD5W	-1.312	.726	3.262	1	.071	-2.736	.112
	WD6W	1.108	.535	4.288	1	.038	.059	2.157
	WD7W	.131	.371	.125	1	.724	-.596	.857

Appendix - P: Analysis of Success Factors of Research Utilisation, to be Implemented Internally by Construction Industry

Appendix - P1: Success factors of research utilisation, to be implemented internally by construction industry, with assigned codes

Success Factors to be implemented Internally	Code
Change internal dynamics of construction organisations to be able to respond to change	WW1
Use research literacy as a criterion for staff appraisal	WW2
Combine in-house and external resources	WW3
Aim to maximize economic value through intellectual property	WW4
Ask project managers to identify and report on innovation opportunities	WW5
Increase senior management's awareness on benefits of external knowledge can bring to organisation budgets	WW6
Reward research-informed decision-making	WW7
Organise events with employees returning from a conference to share knowledge to other employees	WW8
Develop a mechanism to identify important innovative management practices from research	WW9
Offer chances to attend conferences as a reward for deserved employees	WW10
Share how new knowledge has contributed to improved performance to create an explicit cause-and-effect link within the organisation	WW11
Promote the concept of 'knowledge worker'	WW12

Appendix - P2: Median and Percentile statistics of success factors of research utilisation, to be implemented internally by construction industry as per the results of industry organisation survey data analysis

Statistics													
		WW1	WW2	WW3	WW4	WW5	WW6	WW7	WW8	WW9	WW10	WW11	WW12
N	Valid	31	31	31	31	31	31	31	31	31	31	31	31
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median		4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Percentiles	25	3.0	2.0	2.0	2.0	4.0	3.0	4.0	2.0	3.0	3.0	2.0	4.0
	50	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	75	5.0	4.0	4.0	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0

Reliability Statistics

Cronbach's Alpha	N of Items
0.877	12

Appendix - P3: Median and Percentile statistics of success factors of research utilisation, to be implemented internally by construction industry as per the results of industry practitioner survey data analysis

Statistics												
		WW1	WW2	WW3	WW4	WW5	WW6	WW7	WW8	WW9	WW10	WW11	WW12
N	Valid	90	90	90	90	90	90	90	90	90	90	90	90
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median		4.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Percentiles	25	3.00	2.00	*2.75*	3.00	3.00	2.00	3.00	2.00	3.00	3.00	3.00	3.00
	50	4.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
	75	4.00	4.00	4.00	4.00	4.00	5.00	4.00	5.00	4.25	4.00	4.00	5.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.885	12

Appendix - P4: Ordinal Regression analysis parameter estimates of success factors of research utilisation, to be implemented internally by construction industry as per the results of industry organisation survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	WW1W	-.760	.427	3.162	1	.075	-1.598	.078
	WW2W	.187	.310	.366	1	.545	-.420	.794
	WW3W	.659	.352	3.515	1	.061	-.030	1.348
	WW4W	.658	.408	2.599	1	.107	-.142	1.457
	WW5W	-.286	.524	.298	1	.585	-1.312	.740
	WW6W	.713	.401	3.163	1	.075	-.073	1.499
	WW7W	-.321	.497	.418	1	.518	-1.296	.653
	WW8W	-.574	.361	2.529	1	.112	-1.281	.133
	WW9W	.435	.406	1.146	1	.284	-.361	1.231
	WW10W	.107	.451	.057	1	.812	-.777	.992
	WW11W	-.048	.345	.020	1	.889	-.724	.628
	WW12W	-.548	.453	1.466	1	.226	-1.435	.339

Appendix - P5: Ordinal Regression analysis parameter estimates of success factors of research utilisation, to be implemented internally by construction industry as per the results of industry practitioner survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	WW1W	.354	.214	2.719	1	.099	-.067	.774
	WW2W	.095	.189	.256	1	.613	-.274	.465
	WW3W	-.329	.232	2.008	1	.156	-.783	.126
	WW4W	-.193	.240	.642	1	.423	-.664	.279
	WW5W	.019	.261	.005	1	.941	-.492	.530
	WW6W	.063	.221	.082	1	.774	-.370	.497
	WW7W	.261	.238	1.196	1	.274	-.206	.727
	WW8W	-.504	.361	2.529	1	.112	-.281	.133
	WW9W	.058	.212	.075	1	.784	-.357	.473
	WW10W	.018	.204	.008	1	.930	-.383	.419
	WW11W	.079	.245	.103	1	.748	-.402	.559
	WW12W	-.087	.222	.152	1	.697	-.522	.349

Appendix - Q: Analysis of Success Factors of Research Utilisation for Construction Industry, to be Implemented Externally

Appendix - Q1: Success factors of research utilisation for construction industry, to be implemented externally, with assigned codes

Success Factors to be Implemented Externally	Code
Develop approaches to promote Research and Development	WB1
Encourage industry to use research as a strategic resource	WB2
Direct industry in capacity building to access research	WB3
Encourage industry investments on research	WB4
Develop more innovative management friendly procurement methods	WB5
Move beyond the traditional practices to adopt new practices	WB6
Include research soundness into job-descriptions	WB7
Increase the ability to attract, retain and develop skilled people	WB8
Create networks with other/foreign industries to collaborate in developing construction management skills	WB9
Update knowledge of the workers in line with the new knowledge generation	WB10
Develop strategic and professional leadership for research and development through industry professional bodies	WB11

Appendix - Q2: Median and Percentile statistics of success factors of research utilisation for construction industry, to be implemented externally as per the results of industry organisation survey data analysis

Statistics

		WB 1	WB 2	WB 3	WB 4	WB 5	WB 6	WB 7	WB 8	WB 9	WB 10	WB 11
N	Valid	31	31	31	31	31	31	31	31	31	31	31
	Missing	0	0	0	0	0	0	0	0	0	0	0
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Percentiles	25	3.00	2.00	3.00	3.00	3.00	2.00	2.00	2.00	4.00	2.00	3.00
	50	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
	75	5.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.781	11

Appendix - Q3: Median and Percentile statistics of success factors of research utilisation for construction industry, to be implemented externally as per the results of industry practitioner survey data analysis

Statistics											
		WB 1	WB 2	WB 3	WB 4	WB 5	WB 6	WB 7	WB 8	WB 9	WB 10	WB 11
N	Valid	90	90	90	90	90	90	90	90	90	90	90
	Missing	0	0	0	0	0	0	0	0	0	0	0
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Percentiles	25	3.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00
	50	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
	75	4.25	4.00	5.00	5.00	5.00	4.00	4.00	5.00	5.00	4.00	4.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.899	11

Appendix - Q4: Ordinal Regression analysis parameter estimates of success factors of research utilisation for construction industry, to be implemented externally as per the results of industry organisation survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	WB1W	.186	.323	.334	1	.564	-.446	.819
	WB2W	.780	.439	3.156	1	.076	-.081	1.642
	WB3W	-.027	.438	.004	1	.950	-.887	.832
	WB4W	-.257	.393	.427	1	.514	-1.027	.514
	WB5W	.564	.362	2.434	1	.119	-.145	1.273
	WB6W	-.370	.298	1.535	1	.215	-.954	.215
	WB7W	.210	.419	.252	1	.616	-.611	1.031
	WB8W	-.465	.451	1.061	1	.303	-1.349	.419
	WB9W	.240	.468	.263	1	.608	-.678	1.157
	WB10W	.022	.318	.005	1	.944	-.602	.646
	WB11W	-.399	.323	1.521	1	.218	-1.032	.235

Appendix - Q5: Ordinal Regression analysis parameter estimates of success factors of research utilisation for construction industry, to be implemented externally as per the results of industry practitioner survey data analysis

Parameter estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	WB1W	.195	.228	.738	1	.390	-.251	.641
	WB2W	-.283	.234	1.453	1	.228	-.742	.177
	WB3W	-.101	.219	.213	1	.644	-.531	.329
	WB4W	-.128	.225	.323	1	.570	-.570	.314
	WB5W	-.331	.237	1.955	1	.162	-.795	.133
	WB6W	-.303	.231	1.712	1	.191	-.756	.151
	WB7W	.399	.183	4.753	1	.029	.040	.758
	WB8W	.474	.220	4.647	1	.031	.043	.904
	WB9W	.127	.232	.300	1	.584	-.327	.581
	WB10W	-.113	.247	.210	1	.646	-.597	.371
	WB11W	.111	.218	.258	1	.612	-.316	.538

Appendix - R: Analysis of Success Factors to be Implemented by Academia and Construction Industry together for Research Collaborations

Appendix - R1: Success factors to be implemented by academia and construction industry together for research collaborations, with assigned codes

Success Factors to be Implemented together	Code
Resolve conflict of interest issues before legal and business arrangements	WT1
Introduce incentives to motivates staff and institutional leaders to participate in, or initiate, research collaborations	WT2
Direct student research more into actual issues in the industry	WT3
Increase communication between researchers, research funders and research users	WT4
Review how research can be more effectively connected to real-world activity and policy setting	WT5
Judge research programmes by industry impact and tangible benefit	WT6
Promote joint publications between university researchers and practitioners in industry and governing bodies	WT7
Practice the concept of knowledge brokering : an intermediary to develop relationships between producers and users of knowledge	WT8
Embed researchers within companies as part of existing research activity	WT9
Create strategic partnerships - formal alliance to help each other in achieving aims which cannot be achieved alone	WT10
Promote collaborations amongst governments, economic sector and research universities to link knowledge to development goals	WT11
Enhance researcher-practitioner collaboration to conduct research on vital problems to find adoptable solutions	WT12

Appendix - R2: Median and Percentile statistics of success factors to be implemented by academia and construction industry together for research collaborations as per the results of academic survey data analysis

Statistics												
		WT 1	WT 2	WT 3	WT 4	WT 5	WT 6	WT 7	WT 8	WT 9	WT 10	WT 11	WT 12
N	Valid	30	30	29	30	30	30	30	30	29	30	30	30
	Missing	0	0	1	0	0	0	0	0	1	0	0	0
Median		4.00	5.00	4.00	5.00	4.00	4.00	4.00	4.00	3.00	5.00	5.00	5.00
Percentiles	25	3.00	4.00	4.00	4.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00
	50	4.00	5.00	4.00	5.00	4.00	4.00	4.00	4.00	3.00	5.00	5.00	5.00
	75	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00

Reliability Statistics

Cronbach's Alpha	N of Items
0.664	12

Appendix - R3: Median and Percentile statistics of success factors to be implemented by academia and construction industry together for research collaborations as per the results of industry organisation survey data analysis

Statistics													
		WT 1	**WT 2**	**WT 3**	**WT 4**	**WT 5**	**WT 6**	**WT 7**	**WT 8**	**WT 9**	**WT 10**	**WT 11**	**WT 12**
N	Valid	31	31	31	31	31	31	31	31	31	31	31	31
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Percentiles	25	3.0	2.0	2.0	3.0	3.0	2.0	3.0	2.0	2.0	2.0	3.0	2.0
	50	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	75	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Reliability Statistics

Cronbach's Alpha	**N of Items**
0.930	12

Appendix - R4: Median and Percentile statistics of success factors to be implemented by academia and construction industry together for research collaborations as per the results of industry practitioner survey data analysis

Statistics													
		WT 1	**WT 2**	**WT 3**	**WT 4**	**WT 5**	**WT 6**	**WT 7**	**WT 8**	**WT 9**	**WT 10**	**WT 11**	**WT 12**
N	Valid	90	90	90	90	90	90	90	90	90	90	90	90
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median		4.00	4.00	4.00	4.00	3.50	4.00	4.00	3.00	4.00	4.00	4.00	4.00
Perce	25	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00
ntiles	50	4.00	4.00	4.00	4.00	3.50	4.00	4.00	3.00	4.00	4.00	4.00	4.00
	75	4.00	5.00	5.00	4.00	5.00	5.00	5.00	4.00	4.00	4.00	5.00	4.00

Reliability Statistics

Cronbach's Alpha	**N of Items**
0.918	12

Appendix - R5: Ordinal Regression analysis parameter estimates of success factors to be implemented by academia and construction industry together for research collaborations as per the results of academic survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	WT1W	.085	.468	.033	1	.856	-.832	1.001
	WT2W	-.289	.493	.344	1	.558	-1.254	.677
	WT3W	-.219	.594	.136	1	.712	-1.382	.944
	WT4W	-.559	.638	.768	1	.381	-1.808	.691
	WT5W	-1.657	.702	5.571	1	.018	-3.032	-.281
	WT6W	1.341	.895	2.246	1	.134	-.413	3.095
	WT7W	.592	.470	1.587	1	.208	-.329	1.513
	WT8W	1.333	.422	10.004	1	.002	.507	2.160
	WT9W	-.218	.525	.172	1	.678	-1.247	.811
	WT10W	-1.371	.697	3.875	1	.049	-2.737	-.006
	WT11W	.775	.807	.923	1	.337	-.806	2.357
	WT12W	-.550	.480	1.310	1	.252	-1.492	.392

Appendix - R6: Ordinal Regression analysis parameter estimates of success factors to be implemented by academia and construction industry together for research collaborations as per the results of industry organisation survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	WT1W	2.027	.497	16.605	1	.000	1.052	3.001
	WT2W	-1.207	.459	6.924	1	.009	-2.106	-.308
	WT3W	-.987	.592	2.782	1	.095	-2.148	.173
	WT4W	1.634	.944	2.995	1	.084	-.216	3.485
	WT5W	-1.630	.570	8.167	1	.004	-2.748	-.512
	WT6W	-1.392	.573	5.900	1	.015	-2.516	-.269
	WT7W	1.294	.703	3.390	1	.066	-.084	2.671
	WT8W	.502	.849	.349	1	.555	-1.163	2.166
	WT9W	-2.541	.633	16.098	1	.000	-3.782	-1.300
	WT10W	1.231	.690	3.179	1	.075	-.122	2.584
	WT11W	1.904	.877	4.714	1	.030	.185	3.623
	WT12W	-.202	.620	.106	1	.745	-1.417	1.014

Appendix - R7: Ordinal Regression analysis parameter estimates of success factors to be implemented by academia and construction industry together for research collaborations as per the results of industry practitioner survey data analysis

Parameter Estimates								
							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Location	WT1W	-.234	.249	.885	1	.347	-.722	.254
	WT2W	.631	.247	6.545	1	.011	.148	1.115
	WT3W	-.194	.253	.583	1	.445	-.690	.303
	WT4W	.018	.260	.005	1	.946	-.492	.527
	WT5W	.182	.255	.508	1	.476	-.318	.682
	WT6W	-.077	.262	.088	1	.767	-.590	.435
	WT7W	-.397	.258	2.379	1	.123	-.902	.108
	WT8W	.228	.258	.786	1	.375	-.277	.734
	WT9W	-.400	.276	2.102	1	.147	-.940	.141
	WT10W	.267	.261	1.052	1	.305	-.243	.778
	WT11W	.450	.308	2.132	1	.144	-.154	1.055
	WT12W	-.294	.298	.973	1	.324	-.878	.290

Appendix - S: Samples of Interview Guidelines

Appendix - S1: Interview guideline devised to collect data from academic experts under Phase II of data collection

Appendix - S2: Interview guideline devised to collect data from innovative industry organisations under Phase II of data collection