

MEGAPROJECTS

Introduction

Megaprojects is a term used to refer to projects and events that encompass large scale projects in size, cost, space, time, energy and influence. Megaprojects are synonymous with large engineering projects, complex projects, large transport or energy projects and large infrastructure projects. Megaprojects are often composed of multilayered discrete projects forming a larger scale complex project. Some of these projects are highly complex and relate to science research, engineering infrastructure or private and public construction of buildings and/or other venues.

Megaprojects have an impact on a number of areas both locally and globally. This includes extending notions of urban planning to accommodate for large scale constructions. These projects can be significant in terms of social and/or economic factors in a positive or negative sense. There have been debates and criticism on the need and function of megaprojects and whether they are beneficial constructs or detrimental to society.

GENERAL OVERVIEW

Typology of Megaprojects –

Megaprojects most frequently emerge from social, economic or policy driven needs and manifest in the following manner: Infrastructure and societal needs in the categories of water and energy, information technology; and industrial processing plants, mining, supply chains, enterprise systems, government administrative systems, defence, intelligence, air and space exploration, urban regeneration, and major events (Flyvberg 2014).

Megaprojects span many industries and sectors taking form as:

High-speed rail lines, airports, seaports, motorways, hospitals, national health or pension ICT systems, national broadband, the Olympics, large-scale signature architecture, dams, wind farms, offshore oil and gas extraction, aluminium smelters, the development of new aircrafts, the largest container and cruise ships, high-energy particle accelerators, and the logistics systems used to run large supply-chain-based companies like Amazon and Maersk. (Flyvberg 2014)

As related to various fields of study, megaprojects have crossed many disciplines due to their pervasive characteristics. Fields of study includes some of the following; Business, Management, Engineering, Science, Information Technology, Urban Studies, Environmental Studies, Geography, Economics, Architecture and Public Administration.

Characteristics

Megaprojects contain a number of specific features. When conceptualizing what the significant aspects are the following characteristics are seen:

Size is one consideration, this is in terms of the project physical size or its impact.

Cost is also a specific value included in many technical definitions. Flyvbjerg links cost ranging from Mega, Giga to Terra. The cost is sometimes linked to scheduled and contractual milestones with suggested or specific timelines for project completion. The scope of the megaproject is also considered in terms of time, content and delivery. Complexity and risk are also usually deemed to be characteristics of a megaproject.

Stakeholders are also an inherent part of the Megaproject with many complex relationship related to the stakeholder interest in the megaproject. These include social, financial, environmental, community and other more implicit and hidden stakeholders. One could argue that 'Optimism bias' and 'Strategic misrepresentation' was also a feature of megaprojects with budget and cost blow outs, time over runs (Flyvbjerg, Skamris, Buhl 2002).

Flyvbjerg, Bent, (ed). 2017. *The Oxford handbook of megaproject management*. Oxford. Oxford University Press

This handbook presents the most up to date research in Megaproject Management including a global perspective. The book is comprehensive covering all aspects of megaprojects in four parts including challenges, causes and cures. There are a number of case studies included highlighting fundamental issues in megaprojects. The book is interdisciplinary and explores management, planning, engineering and geography, psychology and political science.

Flyvbjerg, Bent. "What You Should Know about Megaprojects and Why: An Overview." *Project Management Journal* 45, no. 2 (April 2014): 6–19. doi:10.1002/pmj.21409.

This paper looks at a number of issues around megaprojects. The paper explores how global megaproject spending denotes the biggest spending boom in human history. Aspects such as political, technological, economic, and aesthetics are identified as "four sublimes" and explored to shed light on the increased size and frequency of megaprojects.

Flyvbjerg, Bent , Holm, Mette Skamris and Buhl, Soren. 2002 Underestimating Costs in Public Works Projects: Error or Lie?, *Journal of the American Planning Association*, 68:3, 279-295, doi: 10.1080/01944360208976273

Presents research on significant study on transportation infrastructure projects and cost over runs across 258 transport projects. The paper takes into account different types of projects, over historical periods and geographical areas. The study found that estimates around costs for these projects (and in turn viability for proceeding with the project) were misleading.

Flyvbjerg, Bent, Nils Bruzelius, and Werner Rothengatter. 2003. *Megaprojects and risk: An anatomy of ambition*. Cambridge University Press.

This book provides a detailed examination of the megaprojects and their underlying problems from a risk management perspective. The book explores case studies of road and rail projects in Europe. A number of other issues are explored such as better institutional arrangements in decision making. The author also proposes transparency is used as a tool to manage and enforce accountability of decision-makers.

Morris, Peter WG, and George H. Hough. 1987. *The anatomy of major projects: A study of the reality of project management*. John Wiley and Sons, New York

This book is considered an influential work and presents research from studies on a number of major projects predominantly in the U.K. The book focuses on the 'practicalities of implementation' and presents itself as a "study of the reality of project management".

Merrow, E.W., 2011. *Industrial megaprojects. Concepts, Strategies and Practices for Success* Hoboken, NJ: Wiley.

This book focusses on decision making, with business decisions and project decisions being of prime importance to megaprojects. Careful consideration of decision making is seen as critical before committing to a Megaproject. The book covers critical mistakes that can cause problems in megaprojects related to strategy, money and people.

Flyvbjerg, B., 2017. Introduction: The iron law of megaproject management. *Bent Flyvbjerg*, pp.1-18 in Flyvbjerg, B. ed., 2017. *The Oxford handbook of megaproject management*. Oxford University Press.

This chapter is an introduction to megaprojects, and to The Oxford Handbook of Megaproject Management. The chapter outlines ten details about megaprojects that are often overlooked. The result is cost overruns, delays, and benefit shortfalls that undermine project viability during project delivery and operation.

Pollack, Julien, Christopher Biesenthal, Shankar Sankaran, and Stewart Clegg. 2018. "Classics in megaproject management: A structured analysis of three major works." *International Journal of Project Management* 36, no. 2 (2018): 372-384.

The paper explores three texts in the field of megaproject management that may be considered 'classics'. The works examined are *Megaprojects and Risk: An Anatomy of Ambition* by Flyvbjerg,

Bruzelius and Rothengatter; (2003) *The Anatomy of Major Projects* by Morris and Hough (1987) and *Industrial Megaprojects* by Merrow (2011).

Journals

Megaprojects has no dedicated journals that deal with the specific topic of Megaprojects in an exclusive manner. There are cluster of articles relating to Megaprojects in Engineering and Project Management journals as well as other areas. The journals listed below contain articles on Megaprojects that have been significant in developing the field or have covered the topic in a significant manner in a peer reviewed journal.

Journal of Management in Engineering.1985-

The Journal of Management in Engineering offers researchers and practitioners of civil engineering the opportunity to present contemporary issues associated with management and leadership. The journal is published usually bimonthly. This journal did a Special Collection Issue in 2016, on Supply Chain Management in Megaprojects.

Journal of Construction Engineering and Management -1983?

The Journal of Construction Engineering and Management is published monthly. It contains papers that aim to advance the science of construction engineering and harmonize construction practices. This includes an approach encompassing design theories and further education and research in construction engineering and management.

Journal of the American Planning Association. 1935 -

This quarterly journal publishes content that is useful to practitioners, policy makers as well as academics. The journal publishes a variety of articles around research and commentaries.

International Journal of Urban and Regional Research. 1977-

IJURR is published bi-monthly and has a focus on urban and regional research with a multidisciplinary approach. IJURR includes material from a range of critical, comparative and geographic perspectives.

International Journal of Project Management. 1983 -

The International Journal of Project Management is published eight times a year and focusses on the field of project management and organization studies.

Project Management Journal. 1984-

The Project Management Journal is published six times a year and its mission is to publish cutting edge research and advance theory and evidence based practice. This includes reflective practitioners, researchers and organizations from project, program, and portfolio management fields.

International Journal of Managing Projects in Business. 2008 -

The International Journal of Managing Projects in Business is published quarterly and aims to promote a better understanding of project management and seeks to advance theoretical, research and practice based aspects of project management. The journal encourages novel project management perspectives and multidisciplinary approaches based in social sciences.

Habitat International. 1976 -

Habitat International focusses on urbanisation in the developing world. It explores the study of urban and rural human settlements and includes research on urban issues dealing with policy and implementation, the links between planning, building and land, finance and management. The journal also focusses on urban design and the interaction between the natural environment and urban areas.

Utilities Policy Governance, Performance, Analysis. 1999-

Published six times a year the journal is interdisciplinary, international and intersectoral with a focus on utility changes and concerns occurring in developing and developed economic environments. Particular emphasis is given to the provision of electricity, natural gas, waste water and water services, public transport, internet broadband delivery and communications.

Book Series

Research in Urban Sociology

This book series addresses themes in urban sociology. Topics include ethnicity, minority groups within the city, urban residents and social networks, activities within the metropolitan complex and suburban lifestyles. Volume 13 is published on *Urban Megaprojects: A Worldwide View*. This book in the series explores the phenomena of 'new scales and forms of territorial restructuring' in a globalizing context with a focus on urban megaproject development.

Resources

Omega Centre

The Omega Centre is based within the Bartlett School of Planning (BSP), University College London (UCL). The OMEGA Centre for Mega Projects in Transport and Development is made up of a team of researchers supported by an international network of partner academics, and professionals engaged in mega transport projects (MTPs).

<http://www.omegacentre.bartlett.ucl.ac.uk/about-omega/>

Megaproject COST Action

The European Cooperation in Science and Technology (COST) is an organization that provides funding for research networks (COST Actions). These networks aim to provide a space for collaborative work among scientists mainly in Europe. Megaprojects COST Action aims to shed light on how megaproject design and delivery can be more effective in the European Union. The Megaprojects COST Action is a network of over 80 researchers from different backgrounds and from 24 EEU countries. COST has developed a database of case studies with sector, county, budget and other parameters to provide and share information on megaprojects.

<http://www.mega-project.eu/portfolio>

History of Megaprojects

In the past, historical megaprojects have left many famous landmarks: the Pyramids, the Great Wall of China, the Suez Canal, and so on. Contemporary megaprojects can range from major defence contracts, the creation of huge theme parks, IT projects and major civil engineering and construction projects. Megaprojects are the impetus for large-scale physical urban transformation and financial expenditure. What makes a megaproject is matters of scale: they are large-scale, complex, costly, highly contentious, highly risky for the parties concerned, lengthy in duration, have multiple public and private stakeholders and create a significant impact, often one that their stakeholders find highly disappointing.

Historically megaprojects have dominated their communities: the cathedrals built to soar to the heavens in medieval Europe; the Large Hadron Collider (the world's largest and most powerful particle accelerator), an icon of inestimable significance for the global community of physicists, the Opera Houses of Sydney, Copenhagen and Oslo, in their commanding waterfront positions. Each of these megaprojects served as global magnets for travel, migration and learning. Megaprojects function as action nets, trawling in prodigious resources, talent and opportunities.

Megaprojects exist because they encapsulate symbolic value, pose challenges for professionals, generate economic activity and because they have influential sponsors able to make them happen. Professional and personal satisfaction flows from mastering the innovations needed to materialize megaprojects. Jobs and careers are generated. Reputations are made and lost. Various capitals are materialized: social, symbolic, economic and intellectual. Waves of innovation, from the canals, through the railways and steamships, the global telegraph cables, the automobiles and highways, the Internet and the web, have all been powered by associated megaprojects, their endeavours and innovations. In terms of intellectual capital, the analysis of megaprojects is now a sub-sphere of project management, in which considerable recent investments have been made. Every megaproject is a site of many stories and these constitute a contested historical terrain – the Sydney Opera House being a particularly apt

case in point seen simultaneously as a failure and as the most successful construction megaproject of the 20th century. Megaprojects increasingly extend across institutional fields constituted by key suppliers, resource and product consumers, regulatory agencies and professional knowledges. In part, their innovations arise from these overlaps, interlays and intersections of diverse practices and interests.

Bernstein, P. L. (2005) *Wedding the waters: The Erie canal and the making of a great nation*. New York: W. W. Norton & Co.

Koeppel, G. (2009) *Bond of Union: Building the Erie Canal and the American Empire*, Cambridge, MA: Da Capo Press.

Accounts of an early 19th century megaproject that led to the opening up of a great north east canal network, vital to the early development of the American economy.

van Marrewijk, A., Ybema S., Smits, K., Clegg, S. R., and Pitsis, T. S. (2016) Clash of the Titans: Temporal organizing and collaborative dynamics in the Panama Canal megaproject, *Organization Studies*, (Special Issue on Temporary Organizations), 37 (12), 1745-1769.

Canal megaprojects does not just belong to history. This is an account of the 21st century Panama Canal megaproject and the role that relations of project organization and cultural differences played in its execution.

Flyvbjerg, B. (Ed.). (2017). *The Oxford handbook of megaproject management*. Oxford. Oxford University Press.

The definitive handbook collection of everything you ever wanted to know about megaprojects

Rego, M. L., Reis Irigaray, H. A., & Chaves, R. L. P. (2017). Symbolic megaprojects: historical evidence of a forgotten dimension. *Project Management Journal*, 48(6), 17-28.

Combining historical analysis of three megaprojects with organizational theory the paper looks at how symbols are constructed, communicated, translated and captured in megaprojects.

Söderlund, J., Sankaran, S., Biesenthal, C. The past and Present of Megaprojects (2017) *Project Management Journal*, 48 (6), pp. 5-16.

A comprehensive overview of current approaches to megaproject analysis and a review of the literature.

Globalization

Megaprojects can take on a global character in several ways. A megaproject in one country may have foreign players involved in some activities. For example, Metro Rail projects in India are financed by Japan International Corporation Agency (JICA) which finances overseas projects. Megaprojects can also be carried out across countries where multiple agencies across the borders may be involved in the projects. An example is the Øresund Bridge that connects Malmö in Sweden to Copenhagen in Denmark or the Channel Tunnel across the English Channel. Megaprojects can also be international collaborations exploring new technologies for global benefit such as the NASA's International Space Station or the Square Kilometer Array telescope being simultaneously built in Australia and South Africa. In such megaprojects several institutional issues could arise that can be explored using institutional theory (Scott 2012)

Davies, A., MacAulay, S. C., & Brady, T. (2019). Delivery model innovation: Insights from infrastructure projects. *Project Management Journal*, 50(2): 119-127. <https://doi.org/10.1177/8756972819831145>

This paper outlines how links can lead to the diffusion of delivery models across institutional settings and that this diffusion is an important source of delivery model innovation.

Scott, W.R. (2014) *Institutions and Organizations: Ideas, Interest and Identities*, 4th edn , Thousand Oaks, CA: Sage Publications

A seminal book that discusses institutional theory from a perspective that can be applied to managing global projects

Scott, W.R. (2012). The institutional environment of global project organizations, *The Engineering Project Organization Journal*, 2(1-2): 27-35.

Explains the relevance of institutional theory to global infrastructure construction projects. Institutions are conceptualised using three interdependent elements – regulative, normative and cultural-cognitive. Also provides the concept of an organizational field to discuss global construction projects.

Scott, W.R. (2011). Introduction: studying global projects: In W.R. Scott, R.E., Levitt, R.E. & Orr, R.J. (Eds.) *Global Projects: Institutional and Political Challenges*, Cambridge, Cambridge University Press, pp. 1-11.

An edited book based on papers presented at the Engineering and Project Organization conference held at Stanford University which helps understand the institutional and political issues in global infrastructure projects due to political, economic and cultural differences.

Mahalingam, A. and Levitt, R.E. (2007). Institutional theory as a framework for analyzing conflicts on global projects, *Journal of Construction Engineering and Management*, 133(7): 517- 528.

Provides a framework for analysing conflicts in global projects using an institutional theory perspective using a case study in India where foreign agencies were involved.

Ilke Kardes , Ayse Ozturk, S. Tamer Cavusgil, Erin Cavusgil (2013) Managing global megaprojects: Complexity and risk management , *International Business Review*, 22(6): 905-917

Examines the key characteristics of global megaprojects, factors contributing and provides a risk management framework and advice on how to manage global megaprojects for success.

Douglass, M. (2005) Globalization, Mega-projects and the Environment: Urban Form and Water in Jakarta, Globalization Research Centre and Department of Urban and Regional Planning University of Hawaii, International Dialogic Conference on Global Cities: Water, Infrastructure and Environment, The UCLA Globalization Research Center – Africa May 16-19.

Discusses ecological issues created by a megaproject boom created by an intercity competition driven by finance capital entering very large city regions in Asia Pacific using the city of Jakarta in Indonesia as an example.

Kirsi Aaltonen, (2013) The establishment of legitimacy: the case of international projects, *International Journal of Managing Projects in Business*, 6(1):13-35, <https://doi.org/10.1108/17538371311291008>

Discusses legitimization strategies and the factors that affect legitimacy in international projects. The lack of legitimacy can upset local stakeholders.

Löfgren, O. (2015). Catwalking a bridge: A longitudinal study of a transnational project and its ritual life, in A. van Marrewijk (Ed.) *Inside megaprojects: Understanding cultural practices in project management*, Copenhagen, CBS Press, pp. 33-68.

Explores how the Øresund Bridge that spans Malmo in Sweden and Copenhagen in Denmark does symbolic and ritual work through its project life cycle and afterwards contributing to the making of a transnational metropolis.

Project management and value management of urban megaprojects

Megaprojects are the wild beast in the world of project management. They are hard to tame, known for their complexity, their vast size and high costs. To begin with, this bibliography covers some key articles that discuss project success through the project management lens of project design and culture, stakeholders management and commitment, risk management and decision-making. Second, we looked at value management. Traditionally, project management discusses value through the concept of Earned

Value Management. More recently, other ways of seeing value management appear, especially through the process of value creation and stakeholder management.

van Marrewijk, A., Clegg, S.R., Pitsis, T.S., Veenswijk, M. (2008) Managing public–private megaprojects: Paradoxes, complexity, and project design, *International Journal of Project Management*, Volume 26, Issue 6, ,Pages 591–600,ISSN 0263–7863, <https://doi.org/10.1016/j.ijproman.2007.09.007>.

This paper presents a more benign and theoretically-grounded view on what goes wrong by comparing the project designs, daily practices, project cultures and management approaches of two recent megaprojects in The Netherlands and Australia, showing how these projects made sense of uncertainty, ambiguity and risk. The authors conclude that project design and project cultures play a role in determining how managers and partners cooperate to achieve project objectives to a greater or lesser extent.

Leung, M. Y., Chong, A., Ng, S. T., & Cheung, M. C. (2004). Demystifying stakeholders' commitment and its impacts on construction projects. *Construction Management & Economics*, 22(7), 701-715. DOI: [10.1080/0144619042000300736](https://doi.org/10.1080/0144619042000300736)

This research study aims to investigate the impacts of commitment amongst major project stakeholders in construction projects. The results show that high affective commitment induces high performance and satisfaction, while the continuous commitment provokes intention to quit.

Kardes, I., Ozturk, A., Cavusgil, S. T., & Cavusgil, E. (2013). Managing global megaprojects: Complexity and risk management. *International Business Review*, 22(6), 905–917.ISSN 0969–5931, <https://doi.org/10.1016/j.ibusrev.2013.01.003>

This paper takes an exploratory approach to identify key characteristics of global megaprojects, factors contributing to disappointing outcomes, and offers a risk management framework and managerial prescriptions for enhancing success. Building on the prospect theory, self-justification theory, and sunk cost effect, this paper examines the behavior of decision making under risk in megaprojects.

Siemiatycki, M. (2013). Riding the wave: explaining cycles in urban mega-project development. *Journal of Economic Policy Reform*, 16(2), 160-178.DOI: [10.1080/17487870.2013.797904](https://doi.org/10.1080/17487870.2013.797904)

This research concludes that the global diffusion of mega-project innovations are driven by the political and policy lure of achieving major tangible benefits, as well as the potential to convey a powerful set of symbolic messages. The paper examines the complex mix of technological innovation, economics, social networks, ideologies and interest groups that spur the diffusion of certain new mega-project approaches at punctuated moments in time.

Salet, W. (2008). Rethinking Urban Projects: Experiences in Europe. *Urban Studies*, 45(11), 2343–2363. <https://doi.org/10.1177/0042098008095871>

This article investigates how decision-making processes relating to strategic urban projects are framed in order to achieve innovative urban developments. Three dimensions of framing are analyzed: the cognitive framing, the framing of alliances in the metropolitan action space and the framing of the democratic process.

Dimitriou, H. T., Ward, E. J., & Wright, P. G. (2013). Mega transport projects—Beyond the ‘iron triangle’: Findings from the OMEGA research programme. *Progress in planning, 86*, 1-43. ISSN 0305-9006, <https://doi.org/10.1016/j.progress.2013.03.001>

The main focus of the findings is on the proclaimed, emergent and actual roles of Mega transport projects (MTPs) and the provision of insights into how these evolved, materialised and *ultimately* were judged by different project stakeholders and commentators. The authors argue that there is a need for the employment of more holistic approaches to decision making in *all* stages of the project lifecycle. They state that a ‘successful’ MTP is dependent on how well risks, uncertainties and complexities in decision-making are addressed, and how context-sensitive its decision-making is *throughout* the project lifecycle.

Davies, A., Gann, D., & Douglas, T. (2009). Innovation in Megaprojects: Systems Integration at London Heathrow Terminal 5. *California Management Review. 51*. 101-125. 10.2307/41166482

This article presents the findings of research on design and production of London's Heathrow Airport Terminal 5 (T5). The findings were used to develop a conceptual framework—which we call the systems integration model—to identify the project and operational processes that contribute to success in delivering megaprojects. Innovations based on the "recombination" and "replication" of processes can be introduced to improve megaproject performance.

Value management of urban megaprojects

Value management can be defined as a process of delivering benefit to a client from the successful implementation of a given project. When the project delivers some specifically defined value that can be qualified in business terms then it is worth delivering. These terms of value should include both customer benefits and the project organization's profit. The value of a project might be that a customer, say a developer contracted by a road transport authority, receives the utility of better traffic flow as well as receipts from the tolling system that users of the road network have to pay. The project delivery organization, to realize value, should make profit from the tolls over the period that their operating contract extends, while for the road transport authority and the motorists that it serves, the value should be faster and better traffic flow; for motorists it should mean less time in their cars as they travel from point to point served by the road network.

Besner, C., & Hobbs, B. (2006). The Perceived Value and Potential Contribution of Project Management Practices to Project Success. *Project Management Journal*, 37(3), 37–48.

<https://doi.org/10.1177/875697280603700305>

This investigation is based on a large-scale survey of 753 project management practitioners. By identifying the most valued practices, practitioners and organizations can identify their priorities when developing their project management competencies. When choosing priorities to develop and implement, organizations can look to the tools that practitioners identify as most valuable, as having the most potential for increased contribution to project performance.

Chang, A., Chih, Y. Y., Chew, E., & Pisarski, A. (2013). Reconceptualising mega project success in Australian Defence: Recognising the importance of value co-creation. *International Journal of Project Management*, 31(8), 1139-1153. ISSN 0263-7863, <https://doi.org/10.1016/j.ijproman.2012.12.005>

The paper argues that value created and captured during and post projects are the key to true success. The study presents interview data from three Australian defence mega projects to demonstrate that senior executives have a more complex understanding of project success than traditional iron triangle measures. In these mega defence projects, customers and other stakeholders actively engage in the value creation process, and over time both content and process value are created to increase defence and national capability.

Zhai, L., Xin, Y., & Cheng, C. (2009). Understanding the Value of Project Management from a Stakeholder's Perspective: Case Study of Mega-Project Management. *Project Management Journal*, 40(1), 99–109. <https://doi.org/10.1002/pmj.20099>

Focusing on mega-projects, this study explores the value of project management from the stakeholders' perspective, thereby creating a value framework. In the case of SHRBC Company, it analyzes the company's project management practice and the value of project management, and consequently certifies the applicability of this value framework through empirical study.

Eweje, J., Turner, R., & Müller, R. (2012). Maximizing strategic value from megaprojects: The influence of information-feed on decision-making by the project manager. *International Journal of Project Management*, 30(6), 639-651. ISSN 0263-7863, <https://doi.org/10.1016/j.ijproman.2012.01.004>

This study argues that information feed to project manager significantly influences strategic value creation on mega-projects. It uses theories of organizational behavior, decision-making and program management to investigate the impact of information feed used by project managers on the strategic value delivered by mega projects in the oil and gas industry.

O Oliomogbe, G. & J Smith, N. (2012). Value in Megaprojects. *Organization, technology & management in construction*, 4 (Special Issue), 0-0. Retrieved from <https://hrcak.srce.hr/96765>

This paper explores how stakeholders engage with the megaproject delivery process and value creation. It was proposed that internal stakeholders are concerned with the value from 'project management deployment' while external stakeholders are primarily concerned with the 'value from project outcome'. Hence, a Value framework that can be used to determine what value needs to be generated for internal and external stakeholders is proposed.

Ma, H., Zeng, S., Lin, H., Chen, H., & Shi, J. J. (2017). The societal governance of megaproject social responsibility. *International Journal of Project Management*, 35(7), 1365-1377. ISSN 0263-7863, <https://doi.org/10.1016/j.ijproman.2017.01.012>

This study has elaborated on a conceptual governance framework to answer such crucial question: How to govern megaproject social responsibility? The research concludes that an integrative mechanism of corporations, the government, and the public is essentially required to facilitate and maintain efficient and effective societal governance, thus creating shared and sustainable value for all stakeholders throughout the megaproject lifecycle.

Giezen, M., Salet, W., & Bertolini, L. (2015). Adding value to the decision-making process of mega projects: Fostering strategic ambiguity, redundancy, and resilience. *Transport Policy*, 44, 169-178. ISSN 0967-070X, <https://doi.org/10.1016/j.tranpol.2015.08.006>

Current practice in decision-making about mega projects seems to be aimed at reducing complexity by simplification, but it is often detrimental to the resilience and added value of these projects. This article uses the concept of strategic capacity for analyzing the decision-making process on mega projects. Two transport mega projects in the Netherlands are analyzed. The analysis demonstrates that creative solutions and added value are to be found in the recombination of policy options made possible by enhancing strategic capacity.

Fahri, J., Biesenthal, C., Pollack, J., & Sankaran, S. (2015). Understanding megaproject success beyond the project close-out stage. Available at SSRN: <https://ssrn.com/abstract=2889833>

In this paper the authors review success factors and criteria that are applicable to projects in general and megaprojects in particular, thus creating value. They identify the significance of evaluating outcomes and impact and propose an ex-post project evaluation (EPPE) framework for megaprojects, since they attract a high level of public attention and political interest, and have both direct and indirect impacts on the community, environment, and national budgets.

Mancini, M., & Derakhshanlavijeh, R. (2017, April). Uncertainty in megaprojects: Opportunities for the future. In *Proceedings of the International Conference on Industrial Engineering and Operations Management, Rabat, Morocco* (pp. 11-13).

This paper investigates the understanding of megaproject success from the point of view of value management, defining best and proven practices to maximize added value in megaproject value, and so

limiting the predominant "iron triangle" perspective (that refer to project management success and not to the project success).

Bowman, C. and Ambrosini, V. (2000), Value Creation Versus Value Capture: Towards a Coherent Definition of Value in Strategy. *British Journal of Management*, 11: 1-15. doi:10.1111/1467-8551.00147

Resource-based theory has tended to focus on the development and protection of valuable resources. What determines a valuable resource has received less attention. This paper addresses three related issues concerning value and valuable resources: what is value? How is it created? and who captures it?

Ang, K., Sankaran, S. & Killen, C. 2016. Value for whom, by whom: investigating value constructs in nonprofit project portfolios. *Project Management Research and Practice*, 3, 5038. <http://dx.doi.org/10.5130/pmrp.v3i0.5038>

This paper explores how value constructs are identified in a non-profit project portfolio. The study sheds light on the question of 'value for whom, value by whom?' by investigating the broad range of value constructs beyond financial value to better support portfolio decision making in multi-stakeholder environments. The findings illustrate the complexity of multiple stakeholders' value perspectives in a non-profit project portfolio, and reveal how value understanding is built from many 'micro-constructs' of value emanating from a variety of stakeholders.

Riis, E., Hellström, M. M., & Wikström, K. (2019). Governance of Projects: Generating value by linking projects with their permanent organisation. *International Journal of Project Management*. ISSN 0263-7863. <https://doi.org/10.1016/j.ijproman.2019.01.005>

The results in this paper illuminate the complex interplay of links that are imperative if the permanent organization is to derive value from its projects, and shows that these links are context-dependent and vary between organizations. The paper demonstrates the advantages of adopting an organizational perspective in order to properly understand how Governance of Projects generates value within a permanent organization.

Megaproject - budgetary factors, control, procurement, contractual matters

Usually commissioned by governments, megaprojects are delivered by private enterprises under a variety of contract conditions. A few examples are the Channel Tunnel (private), the Metro of Copenhagen (public) and the High Speed Train between Stockholm and Arlanda (public-private partnership). Unfortunately, megaprojects are too often over budget, over time and over costs. Megaprojects present unique challenges when it comes to estimating and managing costs.

Flyvbjerg, B. (February 2007). Megaproject Policy and Planning: Problems, Causes, Cures Summary of Dissertation for Higher Doctorate in Science, (Dr. Scient.), Aalborg: Aalborg University, 62 pp.. Available at SSRN: <https://ssrn.com/abstract=2278265>

This paper focuses on problems in megaproject policy and planning and their causes and possible cures. The paper first identifies as a main problem in megaproject development pervasive misinformation about the costs, benefits, and risks involved. A consequence of misinformation is cost overruns, benefit shortfalls, and waste.

Chang, C. Y. (2013). Understanding the hold-up problem in the management of megaprojects: The case of the Channel Tunnel Rail Link project. *International Journal of Project Management*, 31(4), 628-637. ISSN 0263-7863, <https://doi.org/10.1016/j.ijproman.2012.10.012>

This research examines the outcome of renegotiations that happened between the UK government and private investors in the Channel Tunnel Rail Link project and develops a model to formalize the evolution of bargaining power of these two parties in the contracting period.

Cantarelli, C. C., Flyvbjerg, B., Molin, E.J.E., and van Wee, B. (2010). "Cost Overruns in Large-Scale Transportation Infrastructure Projects: Explanations and Their Theoretical Embeddedness". *European Journal of Transport and Infrastructure Research*, 10 (1): 5-18. : http://www.ejtir.tbm.tudelft.nl/issues/2010_01

Managing large-scale transportation infrastructure projects is difficult due to frequent misinformation about the costs which results in large cost overruns that often threaten the overall project viability. This paper investigates the explanations for cost overruns that are given in the literature. Overall, four categories of explanations can be distinguished: technical, economic, psychological, and political.

Kay, Michael A. (2009) Transportation megaproject procurement : benefits and challenges for PPPs and alternative delivery strategies, and the resulting implications for Crossrail. *Massachusetts Institute of Technology*. <http://hdl.handle.net/1721.1/53328>

This thesis evaluates the applicability of public-private partnerships (PPPs) and alternative delivery strategies to transportation megaprojects. The thesis introduces the various stages of megaproject development and the way public and private sector strengths may be packaged together throughout these stages to form alternative delivery strategies. It also provides an assessment of the many issues surrounding the business case, risk, management, and contracts.

Anderson Jr, L. L., Douglass, R. D., & Kaub, B. C. (2006). Anatomy of a successful partnering program on a megaproject. *Leadership and Management in Engineering*, 6(3), 110-116. [https://doi.org/10.1061/\(ASCE\)1532-6748\(2006\)6:3\(110\)](https://doi.org/10.1061/(ASCE)1532-6748(2006)6:3(110))

This article describes how partnering works on the Woodrow Wilson Bridge (WWB) project. At the 50-percent point in construction, this \$2.4 billion megaproject is on schedule and on budget. One of the key factors contributing to this achievement has been the partnering system used, which recognizes common interests, provides for disciplined communication, and measures team effectiveness.

Little, R. G. (2011). The Emerging Role of Public-Private Partnerships in Megaproject Delivery. *Public Works Management & Policy*, 16(3), 240–249. <https://doi.org/10.1177/1087724X11409244>

What distinguishes the modern megaproject is its unfortunate association with huge delays in delivery time and large cost overruns. This article examines some of the reasons why megaprojects have become synonymous with poor cost and schedule performance and suggests that innovative project delivery methods, broadly termed public—private partnerships (PPP or P3), have the potential to improve project performance.

Sinnette, J. (2004). Accounting for megaproject dollars. *Public roads*, 68, 40-47.
http://www.micdot.com/news_room/clips/07-04%20Public%20Roads%20-%20Accounting%20for%20Megaproject%20Dollars.pdf

Megaprojects present unique challenges when it comes to estimating and managing costs. With these huge projects, which may span decades, the challenges can begin as soon as the project is conceived and often do not end until the books are closed.

Van Marrewijk, A. (2005). Strategies of Cooperation: Control and Commitment in Mega-Projects. *Management*, vol. 8(4), 89-104. doi:10.3917/mana.084.0089.

The author discusses the dilemma of control versus commitment in mega-projects, with Public private partnerships. It presents the example of the Environ Mega-Project.

Stakeholder engagement

Power and megaprojects

Megaproject stakeholder engagement involves power and sensemaking, often focusing on the ways in which diverse contractual relations shape the 'norms of competitive contracting' across the various institutional fields involved. Specific project power relations, seek to ensure contractual expectations of profit and schedule. Megaprojects often experiences an 'escalation' of commitment, of costs, of complexity, of conflict. Megaprojects routinely exceed estimates of their risk in terms of costs, completion, and other performance indicators because those associated with their commissioning and implementation will sometimes use deceptive indicators and misleading projections resulting in the misallocation of scarce resources in order to launch and continue the projects

Megaproject decision-makers rarely have sufficient information to be entirely rational – forearmed and forewarned against uncertainties. Instead, they aim to create the most satisfactory outcomes that they can, given what they know, are able to access and process. Limited search, imperfect knowledge and finite time characterize project processes. Megaproject sponsors, financiers and managers are operating under the stresses of the situation, processing what is at hand and what they know, to try

and work out what they will do. Decisions are made when solutions, problems, participants, and choices coincide at a certain point.

In projects there is usually no singular centre of calculation and control but many stakeholders; each project, by definition, is unique; projects are characterized by an identity that is ambiguous, has fuzzy limits and a duality between objects and those actors willing them into being. Projects are complex: different stakeholders will be talking past each other, using different terms, concepts and presuppositions.

Megaprojects require hypocrisy. If stakeholders such as government and finance demand risk analysis and hard figures for project proposals then, even if they know that the figures are highly imprecise and speculative, they will receive them. Otherwise, no project would ever get talked into being. Facing a demand for certainty while confronting much that is unknowable and undecidable makes hypocrisy the norm.

An intricate web of shifting relationships and divergent interests between stakeholders in large-scale global projects gives rise to disagreement, discord and power struggles between them. Power relations in projects as temporary organizational entities constructed from and constituting relations of power bring differential capacities to bear on achieving variably weighted desiderata. Stakeholders in projects have variable capabilities and capacities to exploit the ambiguity that characterizes collaboration in temporary projects. As projects embrace more external stakeholders they increasingly do so through norms of governmentality.

Brunsson, N. (1989) *The Organization of Hypocrisy: Talk, Decisions and Actions in Organizations* Chichester: Wiley.

The classic analysis of why hypocrisy may be normal in organizations, especially public ones.

Clegg, S. R., Pitsis, T., Rura-Polley, T., and Marosszeky, M. (2002) 'Governmentality Matters: Designing an Alliance Culture of Inter-organizational Collaboration for Managing Projects', *Organization Studies*, 23:3, 317-337.

Applies governmentality perspectives to analysis of a designer culture that was created for a specific megaproject conducted as an alliance project.

Clegg, S.R., and Kreiner, K. (2014) Fixing concrete: inquiries, responsibility, power and innovation. *Construction Management & Economics*. 32(3): 262-278.

An analysis of how power relations and responsibility enter into learning in association with projects.

Clegg, S. R., Sankaran, S., Biesenthal, C., and Pollack, J. (2017) Power and Sensemaking in Megaprojects, in B. Flyvbjerg (Eds.), *The Oxford Handbook of Megaproject Management*. Oxford: Oxford University Press.

Combines an analysis of power relations with sensemaking and applies it to the analysis of megaprojects

Dille, T., Soderlund, J., Clegg, S. R. (2018) Temporal Conditioning and Institutional Pluralism: Exploring the Nature and Dynamics of Inter-institutional Temporary Organizations *International Journal of Project Management*, 36: 673–686.

Looks at trans-institutional field project and the how it introduced institutional pluralism through differentially embedded temporal reckoning systems in the fields in question.

Eskerod.P. & Ang. K. (2017) Stakeholder value constructs in megaprojects: A long-term assessment case study, *Project Management Journal*, 48(6): 60–75

Investigating how is value perceived from a highway bridge in the US fifty years after it was built by different generations?

Nihan, J., Mahalingam, A., and Clegg, S. R. (2018) External stakeholder management strategies and resources in megaprojects – an organizational power perspective, *International Journal of Project Management*, 37 (2019) 59– 72.

Applies a governmentality perspective to project branding as a way of securing compliance of external stakeholders.

Governance

The concept of corporate governance is the system of rules, practices, and processes by which a firm is legitimately directed and controlled. The term governance, used relationally, signifies influencing networks to create innovation, reciprocity, trust, and self-organization for organizations that require collective action. Project governance is more complex than the corporate governance of a single firm or organization. No necessary alignment occurs between the many corporate governance doctrines that might be involved. Projects sometimes have an overall code of governance separate from those of the firms involved. Stakeholders not directly involved as project partners in the governance of the project may still require legitimate governance.

Subtle strategies can be used in megaprojects to engage with stakeholders in the project community that are not represented through the legitimate mechanisms of project governance. In the past, community liaison communications specialists have been used for this task (Pitsis et al, 2003). In projects

with adventurous KPIs, such as the Olympic infrastructure project that Pitsis et al (2003) researched, a measure of 'building social capital' was developed to ensure that the project actively managed expectations through engagement.

Most important today is the use of social media to engage with stakeholders. In megaproject organizations, this will be oriented toward specific stakeholders whose potential impact on the progress of the megaproject can be significant and are not otherwise legitimately represented in governance. Social media strategies to promote projects and give progress updates, appealing to and targeting sections of the community, seeking to create community advocates, have been researched in an Indian megaproject (see Nihan et al, 2018).

Social media strategies of stakeholder engagement can be used to try and minimize fractious relationships with communities whose stakeholders have interests in the project's accomplishment; however, their use can be double-edged. A good example of this is the WestConnex Action Group in Sydney, Australia, that ran a sophisticated social media and web-based campaign (<http://www.westconnexactiongroup.org.au/>) against a major road project, leading to major community mobilizations against the project and much adverse publicity which, however, failed to stop the project.

Stakeholder engagement with megaproject opponents that are implacably opposed to developments underway or announced is not easy; however, the costs of not engaging with stakeholders can make projects even more difficult to complete successfully (Lehtinen et al, 2018). These authors draw a number of lessons for such engagement in a processual model of stakeholder management. The practical implications of these include the following useful tips, drawn from their recommendations. First, adopt flexible and balanced approaches to stakeholder management that can be applied ambidextrously as engagement or disengagement with specific stakeholders as circumstances change. Second, develop dis/engagement rationales at an overall project level. Third, joint stakeholder and megaproject inter-organizational bodies and working groups can establish round table discussions and collaborative meeting routines as well as developing joint planning tools and principles among stakeholders. These, together with social media, as suggested earlier, can be used to receive feedback about engagement practices which, if nothing else, have a symbolic function as a 'cooling out' mechanism applied to a collective rather than an individual subject (Goffman, 1952).

Clegg, S. (2019) Governmentality, *Project Management Journal*, 50(3) 1–4.

Explores how soft power through what is called 'governmentality' (the government of specific groups of people through the creation of specific forms of subject mentality) through social media in can be used in projects to incorporate the interests of stakeholders without direct involvement in a project.

Clegg, S. R., Pitsis, T., Rura-Polley, T., and Marosszeky, M. (2002) 'Governmentality Matters: Designing an Alliance Culture of Inter-organizational Collaboration for Managing Projects', *Organization Studies*, 23:3, 317-337.

An analysis of how a project creating and delivering a key piece of infrastructure for the Sydney 2000 Olympics formulated a code of practice for non-litigious and collaborative project delivery, which functioned as a form of governmentality for all contractors and sub-contractors involved in the project, and which also incorporated non-formal project stakeholders, such as the local communities that the project disturbed. This piece should be read in conjunction with the next two references.

Clegg, S. R., Pitsis, T. S., Marosszeky, M., and Rura-Polley, T. (2006) Making the Future Perfect? Constructing the Olympic Dream, pp. 265-293 in D. Hodgson and S. Cicmil (Eds.) *Making Projects Critical*. Palgrave: London.

Pitsis, T., Clegg, S. R., Marosszeky, M., and Rura-Polley, T. (2003) 'Constructing the Olympic Dream: Managing Innovation through the Future Perfect', *Organization Science*, 14:5, 574-590.

Both of these pieces are based upon the empirical work done by the team shadowing the Sydney Olympic infrastructure project. The infrastructure was a twenty-kilometre tunnel designed to catch stormwater and street detritus that otherwise would have ended up polluting the harbour. The focus is on the unique approach to 'Alliancing' developed within the project which brought the job in on time, on budget and meeting an number of other highly innovative key performance indicators based upon a scheme of 'Risk & Reward'. Governance was agreed in the project by the project partners and was key to the delivery.

Sanderson, J. Risk, uncertainty and governance in megaprojects: A critical discussion of alternative explanations (2012) *International Journal of Project Management*, 30 (4), pp. 432-443

This paper proposes a three-fold typology based on looking at the underlying assumptions about the author's worldview about decision-maker cognition and their views of how the future will unfold. It identifies three distinct explanations to explain performance problems that plague many megaprojects. It argues that all these explanations are based on actor far sightedness suggesting preparing for the future. It suggests that studying spontaneous governing within projects in practice could develop a richer understanding of another level of analysis of studying governance in megaprojects that is based on what is happening here and now.

Sovacool, B.K., Cooper, C.J. The governance of energy megaprojects: Politics, hubris and energy security (2013) *The Governance of Energy Megaprojects: Politics, Hubris and Energy Security*, Cheltenham, Edward Elgar.

This book looks at forces driving investment in mega energy projects and focuses on the relationship between energy megaprojects and their governance in the context of national energy and climate change planning and community resilience. It includes five case studies of mega energy project around the world to understand why these failed.

Miller, R., Lessard, D.R., 2000. *The Strategic Management of Large Engineering Projects: Shaping Institutions, Risks, and Governance*. MIT Press, Cambridge, MA (SS)

This book is based on a (International Program in the Management of Engineering and Construction (IMEC) study of sixty large engineering projects and suggests that the 'front-end' engineering of institutional arrangements and strategic systems is a better predictor of project success rather than project engineering and management. Their research shows a considerable gap between espoused views on how to manage large projects and the real practice of managing these. The book discusses several key aspects such as the effects of turbulence, project shaping, risk management and governability that are of practical value to improve management of mega engineering projects.

Zheng, Xian, Yujie Lu, and Ruidong Chang. (2019). *Governing Behavioral Relationships in Megaprojects: Examining Effect of Three Governance Mechanisms under Project Uncertainties*. *Journal of Management in Engineering* 35(5) 04019016.

This paper suggests that the relational behaviour between participants of a megaproject can influence the success of the projects. It investigates the impact of three governance mechanisms – contract, trust and institutional support – in facilitating relational behaviour and proposes ways to cultivate beneficial relational behaviours.

Xue, Jinjie, Hongping Yuan, and Benshan Shi. (2016). "Impact of contextual variables on effectiveness of partnership governance mechanisms in megaprojects: Case of Guanxi". *Journal of Management in Engineering* 33(1): 04016034.

This paper investigates contractual and relational mechanisms to minimise opportunism and maximise cooperation in a megaproject. It uses a Chinese Joint Venture Megaprojects on how *guanxi* affects different governance mechanisms. The authors propose ways of promoting the effectiveness of partnership governance in Chinese megaprojects.

Brunet, M & Aubry, M. (2018) *The governance of major public infrastructure projects: the process of translation*, *International Journal of Managing Projects in Business*, 11(1): 80-103, <https://doi.org/10.1108/IJMPB-08-2017-0095>

How do actors in translate the governance framework established in a megaproject into action using structural, normative and facilitative means?

Innovation

Davies, Gann, and Douglas 2015 outlined that in isolated instances unique components of innovation can be pinpointed within projects but the methodical integration of innovation or processes to foster innovation within individual megaprojects is less common. As Davies and Douglas 2009 conveyed all megaprojects can benefit from drawing on learned experiences derived from comparable or disparate projects and industries, with regard to feasible creative approaches. Van Loon-Steensma and Vellinga 2019 underscored the value in learning from past inventiveness as they explored the reintroduction of an historic invention in the Netherlands of wide green dikes to prevent the problem of flooding. Bjorgo and Røiseland 2018 also reiterated the value of innovation in the context of local governments in Norway who the authors suggested needed to heighten their preparation for situations warranting inventive strategies. In the same vein Sergeeva and Zanello 2018 investigated the role of innovation champions within megaprojects. Shaw and Montana 2016 however drew attention to the absence in Melbourne Australia of statutory controls or equivocal planning mechanisms to intercede against the influence of developers in determining the nature of a megaprojects contribution to the surrounding environment. Any place-making aims espoused by planning bodies are only attained by way of an interchange of unsystematic judgement calls at the behest of a developer. A lack of legal rules or prescriptive processes in Melbourne can be juxtaposed against the work by Van Marrewijk and Veenswijk and Clegg 2014 where corrupt practices in the Dutch construction industry forced the introduction of protocols for the conduct of public-private ventures.

Bjorgo, F., Røiseland, A. Taming wickedness: industrial megaprojects and local governance strategies (2018) *Urban Research & Practice*, 11 (1), pp. 37-52, DOI: 10.1080/17535069.2017.1291717 <https://doi.org/10.1080/17535069.2017.1291717>

Multifaceted problems faced by numerous local governments concerning megaprojects have compelled municipalities to find innovative solutions and alternative modes of collective governance. This study explored the methods employed by two Norwegian local governments facing tribulations with megaprojects involving natural resource mining and excise monies. The appreciably different strategies applied by the two municipalities are detailed with the authors concluding that local governments need to cultivate their readiness for innovative approaches.

Davies, A., Gann, D., Douglas, T. Innovation in megaprojects: Systems integration at London Heathrow terminal 5 (2009) *California Management Review*, 51 (2), pp. 101-125.

The authors counsel that successful management of megaprojects requires deviating from a notion that each megaproject is a wholly incomparable undertaking. Productivity, safety and quality enhancements can be achieved by adopting effective processes formerly applied in different contexts or derived from other innovative projects. These processes can be consolidated into a system to facilitate improvements in the value and efficacy of new projects.

Davies, A., Macaulay, S., Debarro, T., Thurston, M. Making innovation happen in a megaproject: London's crossrail suburban railway system (2015) *Project Management Journal*, 45 (6), pp. 25-37.

Four categories are used as a new heuristic for classifying and organizing innovation in megaprojects: the bridging window, the engaging window, the leveraging window and the exchanging window. The windows summarize the necessary constituents to embed innovation. These include cultivating opportunities for critical stakeholders to offer solutions and availing of prior learning gauged from other projects and industries. The aspiration is to initiate innovation plus process, structure and governance enhancements.

Sergeeva, N., Zanello, C. Championing and promoting innovation in UK megaprojects (2018) *International Journal of Project Management*, 36 (8), pp. 1068-1081.

Five projects in the United Kingdom are utilized to explore the function of innovation champions, an area that has to-date been under-explored.

Thirty interviews were conducted encapsulating the perceptions of innovation champions on how innovation can be inspired and fostered in megaprojects and the expertise that is required to facilitate originality in participant approaches to projects. The significant differences and analogous components between the five projects are detailed.

Shaw, K., Montana, G. Place-Making in Megaprojects in Melbourne (2016) *Urban Policy and Research*, 34 (2), pp. 166-189, DOI: 10.1080/08111146.2014.967392
<https://doi.org/10.1080/08111146.2014.967392>

This article scrutinizes whether government led planning approaches to megaprojects, as vehicles for imparting a sense of coherence and significance to locations, are actually realized. After analyzing two megaprojects with mixed-use functions the authors conclude that the nobler intents of aesthetic place making and urban renewal are neither embedded in legal edicts or in planning systems. The attainment of principled intents is incidental and at the behest of the developer.

Van Loon-Steensma, J., Vellinga, Pier. How "wide green dikes" were reintroduced in the Netherlands: a case study of the uptake of an innovative measure in long-term strategic delta planning (2019) *Journal of Environmental Planning and Management*, pp. 1-20, DOI:10.1080/09640568.2018.1557039
<https://doi.org/10.1080/09640568.2018.1557039>

Using the Hourglass Framework the article details the strategic actions undertaken in the Delta Program to reinstate an historic innovation of wide green dikes as a defence against flooding. Whilst the article focuses on one case example the study offers discernments with wider applicability. Some of the broader critical forces at work in the midst of instituting innovation are uncovered.

Van Marrewijk, Alfons., Veenswijk, M., Clegg, S. Changing collaborative practices through cultural interventions (2014) *Building Research & Information*, 42 (3), pp.330-342. DOI: 10.1080/09613218.2014.867619.

As a result of a parliamentary enquiry into the Dutch construction industry revealing corrupt practices, a process was initiated to instigate change in the conduct of public-private ventures. The transformations were applied to the organization of personal networks amongst contractors and clients and through the introduction of competitive dialogue protocols. An additional measure was the introduction of the right of withdrawal. The article explores the efficacy of the enacted processes.

Megaproject Economics imperatives (financial benefits)

Infrastructure megaprojects are crucial to the future of cities, states, and individual livelihoods. The problem is that these projects often go off the rails, either with regard to budget or time or both. Building and maintaining infrastructure is a critical and sometimes even lifesaving undertaking. Sewage and water-supply systems, for example, keep diseases such as cholera at bay. Big infrastructure projects can also be economically transformative. Consider the Panama Canal. It accounts for a significant share of the country's GDP.

Jones, H., Moura, F., & Domingos, T. (2014). Transport infrastructure project evaluation using cost-benefit analysis. *Procedia-Social and Behavioral Sciences*, 111, 400-409. ISSN 1877-0428. <https://doi.org/10.1016/j.sbspro.2014.01.073>.

This paper addresses CBA as an evaluation tool and its major weaknesses. Authors conclude that the treatment of residual value (RV) is inadequate and needs further research. RV represents the value of the infrastructure at the end of its project lifetime and the value that the asset generates over time. The current methods for calculating RV do not properly reflect the true value.

Chih, Y. Y., & Zwikael, O. (2015). Project benefit management: A conceptual framework of target benefit formulation. *International Journal of Project Management*, 33(2), 352-362. ISSN 0263-7863. <https://doi.org/10.1016/j.ijproman.2014.06.002>.

This paper highlighted the important role of project target benefits in funding decision-making and suggest seven criteria for their appraisal (strategic fit, target value, measurability, realism, target date, accountability and comprehensiveness) and four constructs which improve the formulated target benefits (a formal benefit formulation process, senior executive leadership, senior executive supports, and public service motivation). A holistic view on how project target benefits should be formulated and appraised is proposed.

Sturup, S. (2009). Mega Projects and Governmentality. World Academy of Science, Engineering and Technology. *International Journal of Humanities and Social Sciences* Vol:3, No:6. <http://waset.org/publications/8231>

This paper provides a detailed examination of some of the problems facing mega projects (over estimation of economic benefits and persistent cost over runs). It then examines Foucault's theory of 'governmentality' as a possible frame of analysis which might shed light on the intractability of the problems that have been identified, through an identification of the art of government in which Mega urban transport projects (MUTPs) occur.

Yzer, J. R., Walker, W. E., Marchau, V. A. W. J., & Kwakkel, J. H. (2014). Dynamic Adaptive Policies: A Way to Improve the Cost—Benefit Performance of Megaprojects? *Environment and Planning B: Planning and Design*, 41(4), 594–612. <https://doi.org/10.1068/b39088>

The authors focus on answering two research questions: How can cost—benefit analysis be applied to dynamic adaptive policy? How good is the cost—benefit performance of megaprojects when using DAP compared with the cost—benefit performance when using the static policy-making approach? For this case, the cost—benefit performance of the megaproject under the DAP approach turns out to be better compared with its performance under the static policy. This result provides a first indication that adaptive policies might be able to improve the cost—benefit performance of megaprojects.

Irimia-Dieguez, A. I., Medina-Lopez, C., & Alfalla-Luque, R. (2015). Financial management of large projects: A research gap. *Procedia economics and finance*, 23, 652–657.

ISSN 2212-5671. [https://doi.org/10.1016/S2212-5671\(15\)00495-5](https://doi.org/10.1016/S2212-5671(15)00495-5).

This paper analyses the research published in high-impact journals on Financial Management in large projects. The findings show that performance is the most intensely studied aspect although no agreement in performance measurement has yet been reached.

Korytárová, J., & Hromádka, V. (2014) The Economic Evaluation of Megaprojects – Social and Economic Impacts. *Procedia - Social and Behavioral Sciences*. Volume 119, Pages 495-502, ISSN 1877-0428. <https://doi.org/10.1016/j.sbspro.2014.03.055>.

The paper discusses which of possible social-economic impacts could be taken in evaluation of particular megaprojects into account and which it is useful or not useful to begin to project into economic evaluation. The HDM-4 model developed by University of Birmingham takes into account impact of transport infrastructure projects in the form of changes in the time consumption, changes in operation costs for vehicles, social costs connected with car accidents and newly impacts on environment. But it is possible to calculate also with other impacts, e. g. impact on economy of related areas, barrier effect caused by highways and motorways, sprawling connected with better availability of urban area.

Whitson, D., & Horne, J. (2006). Underestimated Costs and Overestimated Benefits? Comparing the Outcomes of Sports Mega-Events in Canada and Japan. *The Sociological Review*, 54 (2_suppl), 73–89. <https://doi.org/10.1111/j.1467-954X.2006.00654.x>

The authors highlight a number of parallel developments in the pursuit of hosting major international sports events in Canada and Japan. In both countries, Olympic hosting has been the project of political and corporate elites, and in both countries large claims were made for the economic and social benefits that would follow from hosting Olympics and other mega-events (in Japan, such as the football World Cup). The outcomes, however, have been that public and private investments in the 'infrastructure of play' have created expensive sporting infrastructure and other consumer spaces, but with few social benefits for those unable (or dis-inclined) to present themselves as consumers.

Turner, R.J., & Xue, Y (2018). On the success of megaprojects, *International Journal of Managing Projects in Business*, Vol. 11 Issue: 3, pp.783-805, <https://doi.org/10.1108/IJMPB-06-2017-0062>

The authors identify four dimensions of megaproject success: they produce an output at a time and cost that makes it valuable; they achieve the desired outcome and benefit at a time and cost that makes them valuable; they deliver positive net present value; and they deliver a business or public need at a time and cost which makes it valuable. Megaprojects often produce benefits to society over and above the financial benefits. Often an economic benefit cannot be paced on these social benefits, which makes it problematic to assess the value of the project.

Vickerman, R. (2007). Cost — Benefit Analysis and Large-Scale Infrastructure Projects: State of the Art and Challenges. *Environment and Planning B: Planning and Design*, 34(4), 598–610. <https://doi.org/10.1068/b32112>

The author reviews the problems surrounding the use of cost-benefit analysis (CBA) in the appraisal of large-scale infrastructure projects. He defines the requirements of a best-practice transport CBA and show the difficulties in achieving these for large-scale projects. The main difficulties discussed are those of forecasting over long time periods, dealing with imperfect competition in transport-using sectors to obtain estimations of wider transport benefits, introducing private finance and appraising network effects.

Locatelli, G., Mariani, G., Sainati, T., & Greco, M. (2017). Corruption in public projects and megaprojects: There is an elephant in the room!. *International Journal of Project Management*, 35(3), 252-268. ISSN 0263-7863, <https://doi.org/10.1016/j.ijproman.2016.09.010>.

This paper sets the background to foster the discussion concerning how to select, plan and deliver infrastructure in corrupt project contexts. Corruption worsens both cost and time performance, and the benefits delivered.

Flyvbjerg, B. (2005) Machiavellian megaprojects. *Antipode*. 37.1, 18–22. <https://doi.org/10.1111/j.0066-4812.2005.00471.x>

The author argues that costs and benefits are being deliberately manipulated to help projects get approved. Undoubtedly, many project proponents believe their projects will benefit society and that, consequently, they are justified in “cooking” up costs and benefits to get projects built. The ends justify the means, or so the players reason. Moreover, the whole structure of incentives for large construction projects is geared towards underestimating costs and overestimating benefits.

Molle, F., & Floch, P. (2008). Megaprojects and Social and Environmental Changes: The Case of the Thai “Water Grid. *AMBIO: A Journal of the Human Environment* 37(3). [https://doi.org/10.1579/0044-7447\(2008\)37\[199:MASAEC\]2.0.CO;2](https://doi.org/10.1579/0044-7447(2008)37[199:MASAEC]2.0.CO;2)

This paper analyzes the emergence of the megaproject of the water grid of the Isaan region (2003), its governance, and its economic and environmental soundness.

Megaprojects – complexity, decision making, risk management

A megaproject’s value at its completion may vary from the assessment of the worth of a project as it was anticipated at its inception. Eweje, Turner, and Müller 2012 attribute this loss in value to the quality and nature of the data sources utilized by project managers to inform their decision making. Project manager’s application of their perceptions of senior management’s expectations in their decisions rather than the reality of what their leaders would require also has a detrimental effect on a projects outcomes. Unrealistic cost estimates relating to project expenditure is another negative consequence relating to megaprojects. The paper presented by Molenaar 2005 investigates a Cost Estimating Validation Process developed by the Washington State Department of Transportation (WSDOT) in the context of nine megaproject case studies. The frequency of global collaborations in the megaproject space and the concomitant complexity created as a consequence has also necessitated further scrutiny as to other features that influence the successful outcome of megaprojects Molenaar 2006. Kardes, Ozturk, Cavusgil and Cavusgil 2013 identify that the combination of an efficient plan covering risk management together with the observance of best practice assists with increasing the success of international projects. The focus by Sankaran 2018 is on the study of four megaproject leaders and the analysis elicits information on the successful leadership strategies that were mutually applied by these leaders and those that were divergent.

Eweje, J., Turner, R., Müller, R. Maximizing strategic value from megaprojects: The influence of information-feed on decision-making by the project manager (2012) *International Journal of Project Management*, 30 (6), pp. 639-651

Discussion centers on the cause of the lessening of a megaprojects value as it proceeds. Vital to a projects worth upon delivery is the interplay between information sources that are accessible and data that project managers apply in their decision making. Project manager’s judgements were also found to be shaped by their discernments concerning Senior Management perspectives. Theoretical analysis derived from organizational behavior, program management and decision making is applied.

Kardes, I., Ozturk, A., Cavusgil, S.T., Cavusgil, E. Managing global megaprojects: Complexity and risk management (2013) *International Business Review*, 22 (6), pp. 905-917

An examination of the essential components that influence the realisation of megaprojects is provided. A framework for the assessment of risk management is outlined in combination with suggestions for prescriptive management options to heighten the likelihood of achieving a successful megaproject. Blending an effective risk management strategy with an adherence to best practice is deemed a blueprint to increase the success and efficiency of joint international projects.

Molenaar, K.R. Programmatic cost risk analysis for highway megaprojects (2005) *Journal of Construction Engineering and Management*, 131 (3), pp. 343-353

A Cost Estimating Validation Process system advanced by the State Department of Transportation in Washington is analyzed in the context of nine megaproject case studies averaging collectively in excess of \$22 billion dollars. Cost risks that are measured include economic, environmental, engineering, process design, construction, program management together with items of lesser risk. The system employed by the Department of Transportation has resulted in more realistic cost estimates being proposed.

Sankaran, S. Megaproject management and leadership: a narrative analysis of life stories-past and present (2018) *International Journal of Managing Projects in Business*, 11 (1), pp. 53-79

A descriptive account of the life stories of four megaproject managers that applies narrative analysis to reflect on the mutual and different strategies employed by four managers in their leadership roles. Common strategies included the choice of the best possible megaproject team members, developing trust with stakeholders, navigating the political and power components associated with the projects and venturing to innovate.

Megaprojects – common problems

Merrow 2011 portrays that in excess of fifty percent of projects suffer from the peril of lengthier construction schedules and higher expenditures than were anticipated. Caldas and Gupta 2016 present a method to moderate such type of vulnerabilities associated with a megaproject. Their study worked on identifying high level risk factors associated with megaproject failures. They used their analysis to develop a tool to evaluate an organizations readiness to pursue a megaproject. van Marrewijk, Clegg, Pitsis and Veenswijk 2008 also investigated risk factors in tandem with uncertainty and ambiguity. This study revealed that the preliminary design of megaprojects and the organizational culture associated with a project had an impact on the degree of collaboration between the stakeholders to achieve the completion of a project. Mangioni 2017 has raised another important consideration that influences the long term analysis by stakeholders of the outcome of a megaproject. Megaprojects in urban areas invariably involve the compulsory acquisition by government of private properties. This has become an increasingly litigious space due to the lack of appropriate negotiation between governments and the impacted home owners.

Caldas, C., Gupta, A. Critical factors impacting the performance of mega-projects (2016) *Engineering Construction and Architectural Management*, 24 (6), pp.920-934.

This is a research study that includes a combination of a broad literature review in addition to interviews with megaproject experts. Over a hundred projects were explored to identify elements that influence megaproject success and failure. Thirty four factors with repeated occurrences and deleterious effects on megaprojects were classified into five categories that were applied to create a megaproject readiness appraisal process.

Mangioni, V. Evaluating the impact of the land acquisition phase on property owners in megaprojects (2017) *International Journal of Managing Projects in Business*, 11 (1), pp.158-173.

A discussion that details that land acquisition emanating from Megaprojects offers constricted opportunities for the property owners to relocate in the same or adjacent locality. As a consequence the number of owners contesting the acquisition of their properties has surged and the propensity within NSW towards compulsory acquisitions has increased. The article advocates property acquisition by agreement in order to enhance the timeliness of acquisitions and public perceptions of projects.

Merrow, E.W. (2011), *Industrial Megaprojects: Concepts, Strategies and Practices for Success*, John Wiley & Sons, Hoboken, NJ.

Merrow outlines that over fifty percent of major projects experience time and budget overruns and safety concerns as a direct consequence of inadequate project management, damaging conduct by team members, insufficient answerability by key players, an irrational emphasis on short range objectives and an aversion to paying for any necessary technical expertise. Where possible companies will avoid negative exposure but some project debacles are unable to be kept secret.

van Marrewijk, A., Clegg, S.R., Pitsis, T.S., Veenswijk, M. Managing public-private megaprojects: Paradoxes, complexity, and project design (2008) *International Journal of Project Management*, 26 (6), pp. 591-600.

This paper takes a theoretically grounded perspective to failings within megaprojects through a comparison of the The Environ Megaproject in the Netherlands and the North Side Tunnel Project (NSTP) in Australia. After analyzing uncertainty, ambiguity and risk factors the authors determined that the design of a project and the associated project cultures influence the extent of collaboration levels between managers and partners to accomplish the goals of a project.

Sustainability and Megaprojects

Kumaraswamy and Wong 2017 make a case for individual megaprojects to be considered in context with the development of other megaprojects in local, regional and national areas to foster a symbiotic relationship between them. This perspective would expand short to mid-range planning goals of specific megaprojects to long-lasting ones encompassing a connectedness between disparate

megaprojects. Such aspirations would convey a more socially sustainable vision concerning the collective impact of megaprojects to individual urban areas and more broadly within a country. As part of the process of achieving collaborative perspectives the authors suggest that megaprojects need to incorporate long term goals for communities rather than merely a focus on short to medium term project goals. However as Theurillat and Crevoisier 2013 explore vested financial interests play a considerable role in the articulation of urban planning in Western cities. Versions of sustainability are realized as a social construct by different actors and the nature of the concessions that each might make.

Kumaraswamy, M., Wong, K., (Kelwin Kar Wai-not sure if I need to include his other initials Alex?) Chung, J. Focusing megaproject strategies on sustainable best value of stakeholders (2017) *Built Environment Project and Asset Management*, 7 (4), pp.441-455.

The authors advocate the use of co-creation of shared value by all stakeholders in the preliminary stages of infrastructure proposals in order to bring about significant and sustainable impacts on built environments. An expanded view of megaproject efforts is recommended. Rather than a focus on short and medium term goals and infrastructure limitations the findings favour the inclusion of regional and national considerations in the context of each infrastructure megaproject.

Theurillat, T., Crevoisier, O. The sustainability of a financialized urban megaproject: The case of Sihlcity in Zurich (2013) *International Journal of Urban and Regional Research*, 37, (6), pp. 2052-2073.

In Switzerland a former brownfield site rejuvenated to establish the largest combined shopping and recreational center was bought by financial actors. A key influencer of urban development and design in Western cities is the form of financial involvement by specific actors within individual urban megaprojects. A conceptual framework to investigate and clarify the manner in which financial actors impact sustainability in urban areas is the key focus of this work.

Social Imperatives and Non-Financial Benefits

The non-financial benefits (NFBs) are derived from humanist ambitions, particularly when they emphasize improving the quality of people's lives (Bornstein, 2010). The focus on NFBs is partly due to an effort to generalize, as several researchers have shown: "cost-benefit analysis & social and environmental impact assessments (Flyvbjerg 2013). A paradigm shift is needed according to Walker and Lloyd-Walker (2016, p. 735): "it's become clear that a new set of skills and expertise is needed by project initiators and their project teams to deliver true sustainable value." Megaprojects' complexity stems in particular from the great diversity of the actors involved and the spaces of controversy they create, as shown by Pitsis, Clegg and Freeder (2018). Such diversity is understandable given the ambitious nature of these projects, particularly in terms of their impacts on society and the environment. These impacts are reflected in the NFBs of the megaprojects. While environmental considerations have been one of the criteria (or benefits)

of major projects for several decades, the addition of societal impacts is more recent and less defined (Edum-Fotwe and Price, 2009).

Bornstein, L. (2010). Mega-projects, city-building and community benefits. *City, Culture and Society*, 1(4), 199-206.

This article presented several megaprojects to highlight the range of strategies employed around large-scale projects and associated outcomes, and the lessons for planners, community groups and developers around routes to projects that better fit into their immediate neighborhoods while achieving wider strategic aims.

Buser, M. et Koch, C. (2014). Is this none of the contractor's business? Social sustainability challenges informed by literary accounts. *Construction Management and Economics*, 32(7-8), 749-759. doi: <https://doi.org/10.1080/01446193.2014.927898>.

To discuss the social challenges linked to suburbs' renovation in Sweden, an alternative method is proposed: the analysis of literary accounts. The goal is to assess whether stories relating the lives of residents in deprived Swedish suburbs can inform and therefore contribute to the development of socially sustainable solutions.

Edum-Fotwe, F. T. et Price, A. D. F. (2009). A social ontology for appraising sustainability of construction projects and developments. *International Journal of Project Management*, 27(4), 313-322. doi: <https://doi.org/10.1016/j.ijproman.2008.04.003>

The authors of this paper put forward an ontology that should provide a systematic articulation to the issues that impinge on the social dimension of sustainability appraisals.

Eskerod.P. & Ang. K. (2017) Stakeholder Value Constructs in Megaprojects: A Long-Term Assessment Case Study, *Project Management Journal*, Vol. 48, No. 6, 60–75

The Astoria-Megler Bridge that spans the Columbia River between Astoria, Oregon and Point Ellice near Megler, Washington, in the United States is an interesting social opportunity example. This bridge has brought pride and fame to his community despite scepticism around its construction. However, the incorporation of a social study into an infrastructure project will always depend on adequate funding, realisms, good communication and capacity-building alliances.

Fischer, J. M., & Amekudzi, A. (2011). Quality of life, sustainable civil infrastructure, and sustainable development: strategically expanding choice. *Journal of urban planning and development*, 137(1), 39-48.

This paper reviews the role of quality of life (QOL) in civil infrastructure decision making. It provides an overview and critique of methodological approaches to defining QOL and explains the significance of

QOL in infrastructure decision making for sustainable development. A new paradigm that views infrastructure development as part of a sociotechnical system is considered.

Fontan, J. M., Klein, J. L., & Tremblay, D. G. (2004). Innovation et société: pour élargir l'analyse des effets territoriaux de l'innovation. *Géographie, économie, société*, 6(2), 115-128.

The city of Montreal has a long-history of citizen engagement with large scale projects. Protests against highway construction, residential redevelopment, and tourism facilities have led to re-orientation of projects towards neighborhood-defined priorities.

Herazo, B., Lizarralde, G. et Paquin, R. (2012). Sustainable development in the building sector: A Canadian case study on the alignment of strategic and tactical management. *Project Management Journal*, 43(2), 84-100. doi: <https://doi.org/10.1002/pmj.21258>

The research examines three building projects commissioned by one institution. It bridges the gap between studies that have concentrated exclusively on the client organization and studies that focus on the projects themselves. Results allow project managers to better understand the influence of sustainable development in both strategic and tactical decision making. It raised the important role of sustainable development as a facilitator in the alignment process between project management and business strategy.

Lehrer, U. and J. Laidley (2008) Old mega-projects newly packaged? Waterfront redevelopment in Toronto. *International Journal of Urban and Regional Research*, 32.4, 786–803.

These authors consider the City of Toronto to exemplify a new generation of megaprojects. They show how the projects is depoliticized. Sponsors' objective is to present the urban transformation as beneficial for social groups and the project's advocates use social benefits as a legitimization device.

Orueta, F. D., & Fainstein, S. S. (2008). The New Mega-Projects: Genesis and Impacts. *International Journal of Urban and Regional Research*, 32(4), 759-767.

The result of the analysis shows the growing convergence of North American and European projects. This convergence is visible in their physical form, their financing and in the role played by the state in a world marked by neoliberalism. An analysis of each of the mega-projects and its particular conditions (who will benefit? what will be the urban consequences?) helps the establishment of the importance of neoliberalism for understanding these processes. At the same time, the new projects do display a greater environmental sensitivity and commitment to urbanity than the modernist schemes of an earlier epoch.

Pitsis, A., Clegg, S., Freeder, D., Sankaran, S. et Burdon, S. (2018). Megaprojects redefined – complexity vs cost and social imperatives. *International Journal of Managing Projects in Business*, 11(1), 7-34. doi: <https://doi.org/10.1108/IJMPB-07-2017-0080>

Megaprojects should make a positive contribution to the development of society and the environment. These authors stress the need for rigorous stakeholder engagement and the deployment of collaborative learning.

Salvatierra-Garrido, J. et Pasquire, C. (2011). Value theory in lean construction. *Journal of Financial Management of Property and Construction*, 16(1), 8-18. doi: <https://doi.org/10.1108/13664381111116043>

These authors look at the constraint-opportunity duality, i.e. minimizing negative impacts and enhancing the project's value through positive impacts, pervades the entire literature on the NFBs of major projects. This duality evokes another: opposition between research into NFBs directed at impacts on the project (or megaproject) itself and research into their impacts on society. This research also shows that society is too important to be relegated below the interests of specific clients.

Vasauskaite, J., Teufel, S. et Teufel, B. (2017). Smart framework: Application under the conditions of modern economy. *Engineering Economics*, 28(2), 180-186. doi: <https://doi.org/10.5755/j01.ee.28.2.17631>

The research into impacts on society is much more holistic than research that studies impacts on the projects. Holistic research often uses the concept of sustainable development specific to the modern economy.

Zidane, Y. J. T., Hussein, B. A., Johansen, A. et Andersen, B. (2016). PESTOL-framework for «project evaluation on strategic, tactical and operational levels». *International Journal of Information Systems and Project Management*, 4(3), 25-41. doi: <https://doi.org/10.12821/jjispm040302>

These authors propose to integrate the non-financial benefits through the PESTOL model, sustainability being the element that overshadows all the other more traditional elements, such as relevance, effectiveness, efficiency.

Zhou, Z., & Mi, C. (2017). Social responsibility research within the context of megaproject management: Trends, gaps and opportunities. *International Journal of Project Management*, 35(7), 1378-1390.

These authors point out that the use of social resources by megaprojects, given their importance, entails obligations to preserve society and the environment.

Kennedy, L. (2015). The politics and changing paradigm of megaproject development in metropolitan cities. *Habitat International*, 45, 163-168. ISSN 0197-3975, <https://doi.org/10.1016/j.habitatint.2014.07.001>

The articles analyse the challenges that megaprojects throw up for urban sustainability and discuss the peculiar issues facing cities characterized by extreme social inequalities, limited mobilisation of community groups and growing pressure on governments to implement neoliberal urban development policies. The aim of this special issue, of which this article is the introduction, is to examine this trend, with a focus on four cities: Cape Town, Durban, Delhi, and Lima.

Lin, H., Zeng, S., Ma, H., Zeng, R., & Tam, V. W. (2017). An indicator system for evaluating megaproject social responsibility. *International Journal of Project Management*, 35(7), 1415-1426.

ISSN 0263-7863, <https://doi.org/10.1016/j.ijproman.2017.04.009>

Megaproject social responsibility (MSR) is fundamentally crucial for megaprojects' sustainable development. This study develops a holistic indicator system that is addressing the multi-dimensionality of sustainability goals for the well-being of the wider society. It also simultaneously integrates project life-cycle dynamism, stakeholder heterogeneity, and social responsibility interactivity. The results provide an alternative solution to the substantive improvement of MSR management—one that balances the interests of every stakeholder.

Wang, G., He, Q., Meng, X., Locatelli, G., Yu, T., & Yan, X. (2017). Exploring the impact of megaproject environmental responsibility on organizational citizenship behaviors for the environment: A social identity perspective. *International Journal of Project Management*, 35(7), 1402-1414. ISSN 0263-7863, <https://doi.org/10.1016/j.ijproman.2017.04.008>

This paper presents an individual-level analysis that explores the impact of project participants' perceptions of megaproject environmental responsibility (MER) practices on their environmental commitment and on organizational citizenship behaviors for the environment (OCBEs). The findings provide new insights for managing MER practices to stimulate the emergence of OCBEs and thereby improve environmental performance.

Bornstein, L. (2010). Mega-projects, city-building and community benefits. *City, Culture and Society*, 1(4), 199-206. ISSN 1877-9166, <https://doi.org/10.1016/j.ccs.2011.01.006>

Although mega-projects are adopted to pursue global ambitions, concerted community-based demands are to use them to satisfy local needs (value for the community). This article examines mega-projects that address both city-building and local concerns. Cases – situated in Montreal, Vancouver and Los Angeles – are examined in which innovative practices prioritized the quality of residential areas and needs of low-income households. The article reviews how agreements were reached, the form they took and neighborhood outcomes.

Environmental factors

Environmental policymaking necessarily includes the incorporation of social, economic and environmental facets. In principle environmental considerations are meant to entail attention to a range of issues. These include accounting for the long term impacts of projects and ensuring public involvement with a projects decision making processes. Furthermore an environmental emphasis is meant to take into account the precautionary principle of mitigating risk through the application of preventative measures. Defining genuinely adequate levels of public engagement remains problematic as does providing ample means for marginalized and powerless segments of society to engage Simpson and Basta 2018. The authors Simpson and Basta 2018 investigate the capacity of the capabilities approach to assess the satisfactoriness of public involvement. Harris, Riley, Sainsbury, Kent and Baum 2018 concentrate on a specific component of environmental impact assessments. They use

three infrastructure megaprojects in road and rail to evaluate the associated health risks. By contrast Agostini, Silva and Nasirov 2017 highlight how community resistance can also have negative impacts.

Agostini, C.A., Silva, C., and Nasirov, S. (2017) Failure of Energy Mega-Projects in Chile: A Critical Review from Sustainability Perspectives Sustainability 9 (1073), pp.1-17.

DOI: 10.3390/su9061073

Insufficient planning for sustainability in energy sources has resulted in a series of energy crises in Chile. Despite a positive energy investment market in Chile adversarial responses by communities on the anticipated deleterious environmental and social impacts of energy projects has also had a negative impact.

Harris, P., Riley, E., Sinasbury, P., Kent., and Baum, F. (2018) Including health in environmental impact assessments of three mega transport projects in Sydney, Australia: A critical, institutional, analysis.

Environmental Impact Assessment Review, 68 (2018), pp.109-116.

<http://dx.doi.org/10.1016/j.eiar.2017.09.002>.

This study draws attention to the emphasis on environmental risks of projects as opposed to the health effects of megaprojects. The authors also suggest that where impact assessments on health are completed they favor particular health hazards rather than broader health considerations.

Simpson, N.P., Basta, C. Sufficiently capable for effective participation in environmental impact assessment? (2018) Environmental Impact Assessment Review, 70 (2018), pp.57-70.

<https://doi.org/10.1016/j.eiar.2018.03.004>

Environmental justice fails in circumstances where environmental deliberations do not provide sufficient means for impacted stakeholders to exert any influence on the decisions being made. This study also suggests that the application of an environmental impact assessment may exacerbate the already marginalized state of those affected. The article surveys the insights that might be gained by using the capabilities approach to procure effective engagement by otherwise marginalized individuals.

Megaprojects – criticisms and debates

The symbolism of skyscrapers encompasses representations or metaphors for elements such as status, power economic wealth, dominance and identity Graham 2016. Graham 2016 draws a parallel between the violence that attracts terrorists to target skyscrapers with the violence that is extended to urban streetscapes when they are destroyed to make way for a new skyscraper. Sarkheyli, and Rafieian 2018 draw out the benefits derived by the City of Portland's active engagement with stakeholders and community organizations in their South Waterfront project. The authors also acknowledge that even with consultation power dynamics still preclude the petitions and appeals from some stakeholders. Locatelli, Mariani, Sainati and Greco 2017 extend the discussion of vested interests prevailing to the role that corrupt practice plays in favouring some projects over others. The paper outlines the different forms of corruption that exists and projects that are more susceptible to corrupt practices taking place.

Graham, S. Vanity and Violence On the politics of skyscrapers. (2016) *City* 20 (5), pp.755-771.

DOI:10.1080/13604812.2016.1224503 <https://doi.org/10.1080/13604812.2016.1224503>

This paper gives consideration to the politics associated with skyscrapers in modern-day contexts and their connection to economic and geographical factors in international relations and trade. A comparison is drawn between projects in North America and those in the Middle East, Asia and the Gulf. Reflections are also made on the role of skyscrapers as purportedly necessary symbols of a global city.

Locatelli, G., Mariani, G., Sainati, T., and Greco, M. Corruption in public projects and megaprojects: There is an elephant in the room! (2017) *International Journal of Project Management* 35 (2017), pp. 252-268. <https://doi.org/10.1016/j.ijproman.2016.09.010>

The authors suggest insufficient attention is given to the choice, organization and provision of megaprojects in environments where corruption prevails and its impacts. The article applies institutional theory to focus the analysis of corruption.

Sarkheyli, E., Rafieian, M. Megaprojects and community participation: South Waterfront project in Portland, Oregon 2018 *Housing and Society*, 45 (2), pp.104-117.

<https://www.tandfonline.com/doi/full/10.1080/08882746.2018.1508936>

Notwithstanding the benefits that might eventuate as a result of the development of a megaproject conflicts amongst stakeholders in public-private partnerships can cause economic and social concerns. Community engagement in the planning stages of a megaproject is a measure used to moderate the potential for disputes. To explore the role of community participation the South Waterfront Project in Portland Oregon is used as a case study.

New Arenas

How will disruptive technologies affect megaprojects in ways in which they are conceptualized, implemented and delivered. These are some of the questions addressed by papers being published using building information models (BIM), artificial intelligence (AI), big data analytics, Internet of Things (IoT), social media, genetic algorithms, robotics and automation applied to megaprojects. This area is quite new to megaproject research and evolving rapidly. An area of special interest is the evolution of smart cities as megaprojects which use technology to deliver several strategies. These are expected to affect the way we live and work in cities of the future including technologies like driverless cars. Smart cities involve both smartening up existing metropolitan cities as well as developing and building greenfield cities using smart technology to deliver niche strategies. An example of such a city is GIFT near Ahmedabad in Gujarat in India being developed as a city to provide financial services to the world. As Davies, MacAulay and Brady (2019) point out, it is crucial to connect study of these new technologies to the affordances they provide for broader delivery model innovation.

Davies, A., MacAulay, S. C., & Brady, T. (2019). Delivery Model Innovation: Insights From Infrastructure Projects. <https://journals.sagepub.com/doi/full/10.1177/8756972819831145>

The paper focuses on delivery model innovation and relates to infrastructure projects including megaprojects.

Whyte, J., Stasiajs, A. & Lindkvist, C. (2016) Managing change in the delivery of complex projects: Configuration management, asset information and 'big data' , *International Journal of Project Management* 34 (2016) 339–351

Explains how changes in assets and the associated asset information are managed in the delivery of complex projects using 'big data' and issues that arise with configuration management.

M.M. Kumaraswamy, S.T. Ng, O.O. Ugwu, E. Palaneeswaran, M.M. Rahman, (2004) "Empowering collaborative decisions in complex construction project scenarios", *Engineering, Construction and Architectural Management*, Vol. 11 Issue: 2, pp.133-142, <https://doi.org/10.1108/09699980410527876>

Presents a model of a proposed ICT enable collaborative construction project management support system (MSS) to empower the integrated optimisation of collaborative decisions in complex construction projects. Discusses the role of Distributed Artificial Intelligence (DAI) in multi agent systems (MAS)

Huston, S., Rahimzad, R. & Parsa, A. (2015). 'Smart' sustainable urban regeneration: Institutions, quality and financial innovation, *Cities* 48 (2015) 66–75 .

Articulates and argues for the establishment of a smart and Sustainable Urban Regeneration ('smart-SUR') framework with procedural and multiple teleological dimensions, captured via smart institutions, quality projects, and innovative funding of projects.

Scarfò, A. (2014) Internet of Things, the Smart X enabler, *International Conference on Intelligent Networking and Collaborative Systems*.

Illustrates how The Internet of Things (IoT) could bring opportunities of improvement in the Smart City sector, for the management of urban infrastructures such as: traffic flows, lighting, water systems, garbage collection etc.

Aziz, R.F., Hagez, S.M., Abuel-Maghd, Y.R. (2014). Smart optimization for mega construction projects using artificial intelligence, *Alexandria Engineering Journal* (2014) 53, 591–606

Presents a model which incorporates the basic concepts of Critical Path Method "CPM" with a multi-objective Genetic Algorithm "GA" simultaneously. The objective of this model is to provide practical

support for mega project construction planners who need to optimize resource utilization in order to minimize project duration and its cost while maximizing its quality simultaneously

Cooley, L. & Cholakis, P. (2013). Efficient Project Delivery: BIM, IPD, JOC, Cloud Computing and More, J Archit Eng Tech 2013, 2:1

Explains why cultural, technological and supply chain barriers to the AECOO (Architecture, Engineering, Construction, Owner, Operations) creating inefficiency and waste. Suggests that these barriers could be broken down by the application of disruptive technologies—specifically BIM and Cloud Computing) resulting in transparent and collaborative project delivery methods.

Memon, S., CahangFeng, W., Rasheed, S., Pathan, Z.H., Yixin, O & Yanoping, L. (2015). Communication Management of Large Projects in Big Data Environment, *International Journal of Hybrid Information Technology* Vol.8, No.11 (2015), pp.397-404 <http://dx.doi.org/10.14257/ijhit.2015.8.11.35>

Provides a model for communication in large scale projects in Big Data environment to enhance the communication management for activities in large scale projects.

Khan, Z., Anjum, A., Soomro, K. & Tahir, M.A. (2015) Towards cloud based big data analytics for smart future cities, *Journal of Cloud Computing: Advances, Systems and Applications* (2015) 4:2

Presents a theoretical and experimental perspective on the smart cities focused big data management and analysis by proposing a cloud-based analytics service. A prototype and data collected was tested on the impact of quality of life focused on crime and safety and economy and employment to measure the indicators spread over years to assess positive and negative trends.

Whyte, J. (2015). Cultures of coordination and control: Digital information and new forms of project organising, in A. van Marrewijk (Ed.) *Inside megaprojects: Understanding cultural practices in project management*, Copenhagen, CBS Press, pp. 69-102.

How meanings and uses of shared digital information become negotiated across three cultures – management, engineering and production – during a megaproject using London Heathrow Terminal 5 as an example and how they impact on project organising.

New Areas of Research

The research in megaprojects is showing signs of moving beyond traditional areas of concern such as cost and time overruns and shortfalls in benefits. In addition, areas of concern in projects such as project success, governance, stakeholder management and risk are also being investigated in different ways in the megaproject context. Some new areas of research are also beginning to appear regarding the four sublims that give rise to megaprojects – Technological/Political/Economic/Aesthetic

(Flyvbjerg 2014). Megaprojects are also being portrayed as arenas for innovation due to the uncertainty and complexity that requires innovative solutions to be found using open innovation strategies such as used in complex infrastructure projects like London Crossrail or the construction of new delivery models (Davies, MacAulay and Brady, 2019). Another area of interest is new ways of management and investigating new challenges when megaprojects are used in the nuclear industry. The application of new technologies such as artificial intelligence, IoT, building information modelling, the use of local media in investigating stakeholder relationships are also of concern.

Locatelli, G., Mikic, M., Kovacevic, M., Brookes, N. & Ivanisevic, N. (2017) The successful delivery of megaprojects: A novel research method, *Project Management Journal*, 48(5): 78–94

How project characteristics can be used to investigate their chance of success using Fisher's Exact Test and Machine Learning so that strategies can be developed to steer them towards success.

Sankaran, S. (2018) Megaproject management and leadership: a narrative analysis of life stories – past and present, *International Journal of Managing Projects in Business*, 11(1): 53-79, <https://doi.org/10.1108/IJMPB-07-2017-0081>

How can we learn about successful strategies used by megaproject leaders by thematically analyzing their stories? An investigation of stories of megaproject leaders from past and present shows that there are some common themes.

Andreas G.M. Nachbagauer, Iris Schirl-Boeck, (2019) Managing the unexpected in megaprojects: riding the waves of resilience, *International Journal of Managing Projects in Business*, <https://doi.org/10.1108/IJMPB-08-2018-0169>

How do we manage the unexpected in megaprojects using smart decision making? Such unexpected events cannot be taken into consideration during planning.

Gillett, A.G. & Tennent, K.D. (2017) Dynamic sublimes, changing plans, and the legacy of a megaproject: The case of the 1966 Soccer World Cup, *Project Management Journal*, 48(6): 93–116

A retrospective look at how the four sublimes proposed by Flyvbjerg dynamically changed over time during the organization of the Soccer World Cup 1966

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We need a better understanding of megaprojects because they are increasing in numbers and magnitude in addition to being applied in new sectors still with limited experience from the management of large-scale projects and complex systems integration. The four sublims proposed by Flyvbjerg (2014) are a guide but more research is needed to understand the paradox of megaprojects from different perspectives.

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