UNDERSTANDING THE SUPPLY RELATIONSHIPS OF GEOTHERMAL POWER GENERATION PROJECTS IN NEW ZEALAND

Vicente González[1], Mehdi Shahbazpour[2], Mauricio Toledo[3] and Juan Graell[4]

ABSTRACT

The increasing demand for renewable and clean energy has focused international attention on geothermal power generation. New Zealand, with a long and successful experience developing geothermal projects, is now enjoying an exciting resurgence of its industry. Geothermal development is a very complex process requiring a broad range of skills, specialized services and parties such as technical consultants, drilling companies, equipment suppliers and EPC contractors. Therefore, management of the supply relationships plays a strategic role in the delivery of geothermal projects. In contrast, supply relationships have been traditionally adversarial in construction causing detrimental effects on project performance. The current thinking suggests that the best practice in construction relationship management should always seek to develop highly collaborative relationships based on high levels of trust and transparency against opportunistic and adversarial approaches. This paper aims to shed some light on the factors influencing the procurement and relational strategies in the geothermal power generation projects. To achieve this, the researchers examined the relationship between key firms involved in the recent development of two successful geothermal projects in New Zealand. Through public reports and semi-structured interviews to key professionals involved in these projects, the underlying reasons for selection of certain supply relationship strategies were identified, and their impact on performance at project and organizational levels were analyzed. The three critical factors for a collaborative environment that lead to the successful delivery of the projects (i.e., ahead of time and under budget) were: procurement strategy, contracts, and teamwork and cooperation.

KEYWORDS

Geothermal Projects, Relationship Management, supply chain.

INTRODUCTION

The increasing demand for energy, together with a general tendency to switch towards renewable and cleaner sources, has focused international attention on geothermal power generation. New Zealand, with a long and successful experience in

[1] PhD, Senior Lecturer, Department of Civil and Environmental Engineering, The University of Auckland, New Zealand. E-Mail: v.gonzalez@auckland.ac.nz

[2] PhD, Lecturer, Department of Department of Mechanical Engineering, The University of Auckland, New Zealand. E-Mail: m.shahbazpour@auckland.ac.nz

[3] PhD©, Head of Construction Engineering Department, Universidad Andres Bello, Chile. E-Mail: mauricio.toledo@unab.cl

[4] MEngSt, Department of Civil and Environmental Engineering, The University of Auckland, New Zealand. E-Mail: jgra791@aucklanduni.ac.nz

developing its geothermal resources, is now enjoying an exciting resurgence of its geothermal industry (NZTE, 2011). In recent years, several plants have been successfully commissioned in New Zealand reflecting world best practices in the delivery of projects under budget, ahead of schedule and with performance exceeding guaranteed design standards. Currently, major projects involving large investments are under construction.

Geothermal development is a very complicated process requiring a broad range of skills and specialized services (KPMG, 2010). In the delivery of a project, developers have to involve some key players including technical consultants, drilling companies, equipment suppliers and EPC contractors among many other stakeholders. The success of a project is then the result of a successful supply chain. Any disruption to provide any good or service from suppliers has a direct and potentially serious impact on project performance (Bower, 2003). The way in which products are procured and delivered becomes a key factor of project success. With contracts being the basis of managing engineering projects (Bower, 2003), the contract strategy selected must take into account a wide range of factors. This will shape the behavior of the parties involved having a major impact on the project final results. The management of the relationships plays a strategic role on project delivery (Pryke and Smyth, 2006).

In construction, relationships with third parties have traditionally been managed through adversarial approaches causing detrimental effects on project performance (Palacios, et al., 2013). On the other hand, the current and popular thinking in construction is that the best practices to manage relationships should always foster highly collaborative approaches based on high levels of trust and transparency other than typical opportunistic and adversarial approaches (Cox et al. 2006). Based on the success of other industries, several reports have encouraged this approach in order to overcome a situation of low profitability and poor performance (Koskela, 2000; Latham, 1994; Egan, 1998). Nevertheless, there is not general agreement on the real application of this approach and it is argued that the latter is only appropriate under specific supply chain and market circumstances, not commonly found in construction environments (Palacios et al. 2013).

Having in mind the global potential growth of the geothermal industry, the aim of this study is to examine the relationships between key firms involved in the recent development of two successful geothermal power generation projects in NZ. In such a way, the underlying reasons that drive the procurement strategies, and their impact on each organization and whole project performance can be understood. Thus, the main purpose is to identify areas of success and improvement in this particular type of project, which could be used to support decision making in new projects (Graell, 2012).

RESEARCH METHODOLOGY

An exploratory case study research methodology has been adopted to conduct this research. Case studies can provide a suitable research approach when how and why questions are addressed, when the control over events is little and when the phenomenon of interest is within a contemporary real life context (Yin, 2003). The use of case studies looks to understand the underlying reasons behind procurement decisions: why they were taken, how they were implemented and with what result. Case study methods are useful to cover contextual conditions, in other words, when

the context affects the phenomenon of study (Yin, 2003). Thus, the case study approach is adopted as it was the best fit for the nature of this research.

The study has been structured as follows:

- **Literature Review:** In order to gain proper understanding of the subject of study, the research starts with extensive literature review. The review is split up in two parts. The first one focuses on geothermal development projects and the second part examines the literature on construction procurement, with special attention on supply chain relationships and its importance for project success. The goal is to get sufficient understanding of the research context and define the data needed to be collected. Thus, the literature review is instrumental in this research.
- **Case Study Analysis:** This research stage is focused on collecting data for detailed analysis. It is carried out using public reports and semi-structured interviews with relevant industry personnel in New Zealand. The aim of the interviews is to get a deeper understanding of the factors affecting procurement decisions by getting directly, the views and experiences from the people involved in the decision making process.
- **Discussion and conclusions:** This stage consists of a qualitative content analysis of the data collected, its discussion in order to understand the supply relationship nature of geothermal projects in New Zealand, and generation of the main theoretical and practical conclusions and perspectives of this research.

LITERAURE REVIEW

GEOTHERMAL POWER GENERATION REMARKS

Geothermal is a form of energy that takes advantage of the heat of the earth. It is a favorable source of energy which combines the sustainability of renewable energy with the reliability of base load production (KPMG, 2010). Thermal energy flows continuously to the surface of the earth and is estimated to be equivalent to 42 million MW of power (Islandsbanky Geothermal Energy Team, 2011). Although hot springs have been in use for centuries, as an energy source, electricity was first generated from geothermal resources at Larderello, Italy in 1904 (Gupta and Roy, 2007). In New Zealand, the development of the Wairakei field started in the 1950´s (Armstrong, et al., 2011), and in 1958 a small geothermal power plant began operating (Dickson and Fanelli, 2005). It was the second geothermal plant in the world to begin large scale commercial operation and the first to exploit a wet (rather than dry steam) geothermal resource (NZGA, 2012). According to the Geothermal Energy Association (GEA) (2010), both the number of countries producing geothermal power and the total worldwide geothermal power capacity under development appear to be increasing significantly. In addition, the New Zealand government expressed its long term view of a sustainable, low emissions energy system with the New Zealand Energy Strategy (NZES, 2007). With the government's commitment to renewable energy, the scene is set for considerable growth in geothermal energy (Lovell and Scholz, 2007).

Geothermal power projects consists of successive development phases that aim to locate the resources, confirm the power generating capacity of the reservoir and build

the power plant and associated structures (Hance, 2005). While the process is similar to other thermoelectric systems where heat is converted into electricity using a turbine/generator, the source of the fuel is completely different. In general, geothermal projects are complex and have long project schedules. They have a wide range of activities including the acquisition of land, surface exploration, permits and consents, exploration drilling, reservoir modelling, feasibility studies, plant permits, basic and detailed design, procurement and construction, commissioning and final operation (SKM, 2007). According to Armstrong et al. (2011), key success factors related to the procurement and project delivery of geothermal developments include: expertise in exploration (internal or contracted), development and sustainable management of reservoirs; ability to manage risks using appropriate procurement methods and financial backing for each stage; ability to match the most economically efficient technology with the geothermal resource for best total cost of ownership; careful selection of project participants and incorporation of incentives and penalties; and effective leadership in managing multiple stakeholder interests. As a result, management of the supply relationships plays a strategic role in the delivery and success of geothermal projects.

SUPPLY RELATIONSHIPS MANAGEMENT IN PROJECTS

The construction industry has been largely criticized for its underperformance. At the same time, driven by financial pressures and the need for cost reduction, the trend in the development of projects has moved towards a disintegration of the activities, leading to an increase in outsourcing and reliance on suppliers (Hicks, et al., 2000). The linkages between the organizations comprising a project supply chain define the way in which information, money and products flow. How these links are managed influence individual and team behavior and affect project performance (Palacios et al., 2013). Some authors suggest that an issue of major importance is a switch towards more collaborative relationships that could be sustained in the long term. Meanwhile others argue that the nature of the industry constrain the application of these cooperative approaches (Cox and Ireland, 2006; Egan, 1998).

Construction supply chains are characterized by a large number of firms involved in the design, procurement and assemble of construction (Vrijhoef and London, 2009). The industry relatively unique demand and supply characteristics is dominated by a high level of short term, ad-hoc and highly differentiated demand, with a highly fragmented and heavily contested small scale supply market (Cox, et al., 2006).

Fragmentation, both in the sense of the number and size of firms and the diversity of distinct disciplines and professions required to deliver a project, is a regularly cited characteristic of construction supply chains. These circumstances have ensured that the construction industry has been prey to a continuous culture of short term opportunism historically (Cox and Ireland, 2006). Poor management strategy and inappropriate contracting and procurement routes in a fragmented industry structure has been a major contributor to adversarialism in construction relations (Bower, 2003).

In addition, the traditional procurement route for construction considers design separate from construction (Bower, 2003). The client, either internally or using consultants, develops a detailed and complete scheme design and uses competition to minimize price (Broome, 2002). This is potentially the most disruptive management

approach to the project value chain (Male, 2003) and changes in design during construction may cause an increase in cost and result in adversarialism (Bower, 2003). Thus, it is argued that the traditional procurement route in construction is adversarial in nature (Male, 2003).

On the other side, supply chain management (SCM) has been seen as a catalyst for integration and cooperation for the supply chain in manufacturing. SCM is ´the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole´. Therefore, the focus of SCM is also upon the management of relationships (Christopher, 2005).

In ´Rethinking Construction´, Egan argued that most of the successful manufacturing practices are applicable to construction (Egan, 1998). In this regard, Egan (1998) proposed an integrated project process that utilizes a full construction team to bring together all the skills required for value delivery to the client. This integrated project process is grounded on Lean Thinking (Tommelein, et al., 2009). The Egan Report (Eagan, 1998) advocates for long term partnering relationships. However, it is much more feasible to implement ´project´ partnering relationships in construction. Many one-off projects do not necessarily imply short-term schedules, so project partnerships can provide several benefits avoiding long term commitments, which are sometimes hard to obtain due to the uncertainty of future demand and other specific industry peculiarities.

As a result, relational contracting (Macneil, 2000; Baker et al., 2002), partnering (Egan, 1998; Bygballe, et al., 2010) and alliancing (Broome, 2002) have become more and more popular approaches in the construction industry, helping to promote trust, collaboration, cooperation and win-win relationships in the supply chain when delivering projects (Palacios et el., 2013).

In contrast, Cox et al. (2006) have suggested that relationships between buyers and suppliers in construction are essentially contested, which means that while it is perfectly possible to engage in long term collaborative relationships at operational level, there will always be some conflict over objective commercial interests. Therefore, without the proper incentives to encourage the necessary investments required to develop a close relationship in the long term, the rational response is to optimize returns in the short term. Unless the demand and supply conditions support bilateral dependency, and the investments made to develop a collaborative way of working lead to superior commercial outcomes, than any of the more opportunistic alternatives, it is unlikely that this type of approach will be sensible for either a buyer or a supplier (Cox et al., 2006).

A relationship-based approach to project management seeks for project performance and client satisfaction through an understanding of the way in which a range of relationships operate and can be managed (Pryke and Smyth, 2006). The management of relationships is a competence, perhaps a core competence (Pryke and Smyth, 2006) and plays a strategic role in project delivery. In order to understand the real worth of relationships, there must be understanding of how they can add value to a service for the client and how the value derived from a service is translated into profit for the contractor. A relationship-based approach needs to be recognized as the basis of a strategy for managing projects, for it is trough relationships that continuous improvement is achieved (Pryke and Smyth, 2006).

CASE STUDY DESCRIPTION

Mighty River Power (MRP) is a state owned enterprise in New Zealand, whose core business is renewable energy and low-cost electricity generation. The case under investigation in this study is the construction of two geothermal power plants by MRP between 2006 and 2010. Both 90MW Kawerau plant and 140MW Nga Awa Purua plant were successfully delivered by the same project team ahead of schedule, under budget, and with capacity exceeding initial specification. Table 1 outlines the commercial arrangements made for various phases of these projects.

Table 1: Summary of commercial agreements for the case study.

Project Phase	MRP role on projects	Commercial Arrangement
1- Production & Reinjection Well Drilling	Design, procurement of casing and cementing were done internally.	• International tender • Contract was based on hourly rates for a fixed period of time
2- Steam Field Development	Steam field process design and procurement of pipes, valves and associated equipment were done internally.	• Tender • Fixed price contract for the detailed design and construction
3- Grid Connection	Completely outsourced	• EPC contract • Separate contract for supply of transformers
4- Power Generation Facility	Completely outsourced	• International tender • FIDIC based EPC contract with performance based specifications • SC was contracted to oversee the entire project, provide financial, insurance and contractual support • FES was contracted to provide technical support, manufacturing, procurement, installation, supervision and commissioning • HC was contracted for site investigation, design, consents, establishment, pilling, bulk earthworks and construction

CASE STUDY ANALYSIS

A thorough and systematic analysis of the case study was carried out using public reports and semi-structured interviews with the key personnel involved in the above mentioned geothermal power plant projects. Four senior managers and project directors from Mighty River Power (MRP) were interviewed following a similar structure where their personal views and experiences regarding contractual arrangements and inter firm relationships were addressed. The answers of the participants were subjected to content analysis to draw the main conclusions of this research. The main objective of this analysis was to identify critical factors that influenced the dynamics of the supply relationships in the context of geothermal

power generation projects. Based on this analysis, three critical factors of procurement strategy, contracting, and teamwork and cooperation were found to be instrumental for the successful delivery of these complex geothermal projects (see Figure 1).

PROCUREMENT STRATEGY

Essential for the success of the projects was MRP´s consideration of a procurement strategy for the whole geothermal expansion program, as it provided a clear guideline for selection of contractual partners and managing the supply relationships. This strategy was developed following a detailed analysis of the market, specific site conditions, MRP's internal capabilities and potential contractors. Special consideration was given to the issue of risk and how the risk can be adequately distributed to various parties based on their capabilities.

For instance it was determined early on that "The uniqueness of geothermal is in the fuel", thus in house expertise to closely manage the fuel supply was found to be a critical factor for successful geothermal development. Similarly for the steam field and grid connection contracts, due to long lead time and critical nature of products an internal sourcing strategy was applied.

On the other hand, for those aspects of the project which were fairly standard or internal expertise were not available, MRP used external contractors. For example, the construction of the steam field and grid connections follows a relatively standard process based on ASME codes with not much risk associated. An external sourcing approach was also used for the power generation facilities. The main rationale for this strategy was that this phase of the project consumes the largest portion of the project's financial resources and thus carries a high level of risk associated with the design, procurement and construction. In their analysis of the key players in the market, MRP's decision makers found that "most generation equipment suppliers have an excellent reputation of delivering their projects with good performance". The approach adopted by MRP was therefore, to directly deal with technology owners and using contractual arrangements to transfer most of the risks to the contractors.

Having an overarching strategy for the entire geothermal expansion program which involved multiple power plants also provided an opportunity for a collaborative approach to the supply management. This enabled MRP to set up more long term commercial arrangements that encouraged collaboration between stakeholders and contractors. It also allowed key decision makers in MRP to learn from the early experiences in the project and fine tune their approach for the more critical phases of the project.

CONTRACTS

Contracts are the formal manifestations of the procurement strategy. If developed and implemented appropriately, the contract is a critical factor for governance of the relationships of the parties involved and motivation of the parties to collaborate. The case study analysis reveals that the appropriate selection of procurement and contractual arrangements facilitated the successful execution of the projects, by providing a proper allocation of risks and common objective based on financial incentives.

The critical role of contracts was most evident in the power generation facility phase of these projects. Three external entities were involved: SC, FES and HC. SC was contracted to oversee the entire project, provide financial, insurance and contractual support. FES was contracted to provide technical support, manufacturing, procurement, installation, supervision and commissioning of the power generation facilities. HC was contracted for site investigation, design, consents, establishment, pilling, bulk earthworks and construction. In addition to the standard subcontracts signed between SC as the overall project contractor and FES and HC as subcontractors, the three parties also developed and implemented a project agreement, which governed the relationship between them. An important element of this agreement was a scaled performance bonus to be paid against early completion, which led to the development of an early completion plan. The early completion bonus was an important element for the alignment of the party's objectives, and was sustained by proper risk allocation. The financial benefits of early completion led to the development of a 100 week program, six weeks before the original taking over date, which rapidly became the master plan against which all activities were planned and decisions were made. Another success factor associated with the project agreement was that it opened up direct communication lines, which facilitated the share of technical information between FES, MRP and HC´s design consultants. This was critical for an agile decision making process required for the large amount of technical issues that were continuously reviewed.

An important aspect of contracts that is critical in generating the right motivations for collaboration is the provision for appropriate allocation of pain/gain. MRP employed fixed price approach to all the contracts in the program. In the case of the power generation facility, the selection of fixed price EPC contracts rather than other cost based approaches (e.g. EPCM) reflects the importance given to price certainty, essential for financing these projects. This is mainly due to the fact that a considerable portion of the risk is associated to the fuel supply uncertainty. The latter outweighed the possibility to reduce costs by eliminating the premium paid to the contractor for taking the risks. This extra cost was leveraged by MRP with strong market competition and pre contract negotiation. The inclusion of a bonus for early completion and post contract involvement during the execution of the project permitted a proper control of time and quality respectively. FES was responsible for the warranties and HC carried the EPC liquidated damages for performance against the program, and this was reflected in the portion of the bonus taken by each party. The procurement of plant equipment was kept by FES and only the installation was subcontracted to other local companies, resulting in an appropriate understanding of who was in the best position to manage the associated supply risks.

TEAMWORK AND COOPERATION

High levels of complexity and uncertainty associated with projects like construction of geothermal power plants, result in high levels of task differentiation and specialization. This leads to complex arrangements of subcontractors and high levels of interdependence between firms. Consequently, cooperation and teamwork play a crucial role for the success of projects. In this regard, the benefits of teamwork, which includes effective communication and cross functional cooperation, leads to trust and commitment, high performance and innovation (Anvuur & Kumaraswamy, 2007).

All interviewees agreed that effective communication among experienced staff contributed to the expeditious response to the technical challenges of the projects. They also observed that open and transparent communication was the major factor for success. Most problems were communicated early on through informal channels showing a high level of trust between project participants. As one participant noted, "The trust that was established early in the process was the foundation for the integrity of the relationship, a cornerstone of the project success". It was found that the climate of trust and collaboration among the participant was strongly facilitated by the "fairness" of the EPC contract that allowed the efforts to be allocated in the works instead of thinking of ways to get the money. Payments were always on time and there was a clear understanding from SC with respect to financial limitations of some of the smaller companies operating across the project.

Effective coordination between subcontractors was also found to be a significant contributor to teamwork and collaboration. Weekly coordination meetings were undertaken for this aim and attended by representatives of the relevant organizations. Constructive debate of the best way forward contributed to success. This resulted in a good working environment were all parties could focus their resources on the completion of their works.

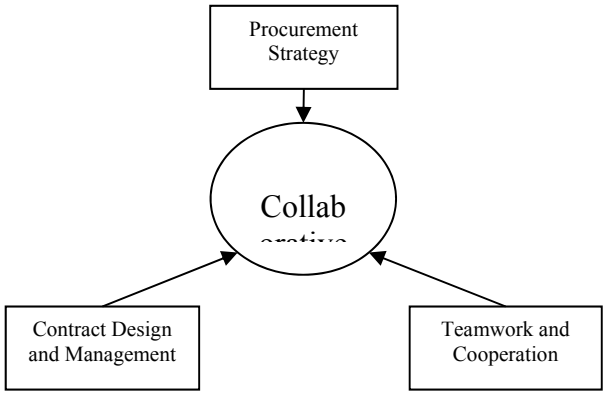

Figure 1: Factors affecting collaborative supply relationships in geothermal power plant construction projects.

CONCLUSIONS

Review of literature showed that there is a general agreement regarding the benefits of trust based, long term collaborative relationships and their effect on project success. However, in practice, supply relationships have been traditionally adversarial in construction causing detrimental effects on project performance. This paper aimed to shed some light on the factors influencing the procurement and relational strategies in the geothermal power generation projects. Analysis of the case study presented in this paper revealed the benefits of close and collaborative relationship among the parties in a highly complex project such as construction of geothermal power plants. Three critical factors of the procurement strategy, contracts, and teamwork and cooperation were identified as significant contributors to the achieved collaborative environment that lead to the successful delivery of the projects ahead of time and under budget. Strategic approach and special considerations given to the distribution of risks and rewards set the foundation for appropriate selection of suppliers and allocation of

responsibilities. This was reflected in the manner contracts were structured and contractors were encouraged to form collaborative relationships. This was further reinforced through establishment of climate of trust and commitment, which facilitated communication and problem solving.

The findings of this study are particularly significant since there is a lack of studies focusing on supply chain management in geothermal projects, where the projects are long, complex and highly technical and the supply chain plays a critical role in the success of the overall project. Furthermore, the case study approach used in this research has allowed the researchers to develop in-depth insights about the factors impacting the relationships within such complex supply chain. Nevertheless, it should be noted that achieving successful cooperative supply chain relationships in a complex project such as construction of geothermal power plants, may involve many other factors not covered in this study. Further studies involving multiple case studies are required to validate and extend the findings of this research.

REFERENCES

Anvuur, A., & Kumaraswamy, M. (2007). Conceptual Model of Partnering and Alliancing. Journal of Construction Engineering Management, 133(3), 225–234.

Armstrong, P., McDonnel, S. and Barrat, A. (2011). Geothermal Opportunities to Support Delivering the Energy for the Future. New Zealand Workshop 2011 Proceedings, Auckland, New Zealand, 21st -23rd December.

Baker, G., Gibbons, R., & Murphy, K. J. (2002). Relational contracts and the theory of the firm. The Quarterly Journal of Economics,117 (1), 39-84.

Bower, D. (2003). Management of Procurement. Thomas Telford, London, UK, 260 pp.

Broome, J. (2002). Procurement routes for partnering: a practical guide. London, Thomas Telford, 395 pp.

Bygballe, L. E., Jahre, M., & Sward, A. (2010). Partnering relationships in construction: A literature review. Journal of Purchasing and Supply Management, 16(4), 239–253.

Cox, A. and Ireland, P. (2006). Relationship Management Theories and Tools in Project Procurement. In S. a. Pryke (Ed.), The Management of Complex Projects. A Relationship Approach, Blackwell Publishing, Oxford, Boston, 316 pp.

Cox, A., Ireland, P., & Townsend, M. (2006). Managing in Construction Supply Chains and Markets. Reactive and Proactive Options for Improving Performance and Relationship Management. Thomas Telford, London, 293 pp.

Christopher, M. (2005). Logistics and Supply Chain Management. Creating Value - Adding Networks, Financial Times Prentice Hall, Harlow, England, 305 pp.

Dickson, M. H. and Fanelli, M. (2005). Geothermal energy utilization and technology.
Sterling, VA, London, 205 pp.

Egan, J. (1998) Rethinking Construction: Report of the Construction Task Force, HMSO, London, UK, 37 pp.

GEA. (2010). Geothermal Energy: International Market Update. [Online]. Available: http://www.geo-energy.org/pdf/reports/gea_international_market_report_final_may_2010.pdf. [February 7, 2014].

Graell, J. (2012). Exploring Supply Relationships in the Development of Geothermal Power Generation Projects in New Zealand. MEngSt's Project. Department of Civil and Environmental Engineering, The University of Auckland, New Zealand.

Gupta, H. and Roy, S. (2007). Geothermal Energy: An alternative resource for the 21st Century. Elsevier, Amsterdam, the Netherlands, 279 pp.

Hicks, C., McGovern, T., & Earl, C. F. (2000). Supply chain management: A strategic issue in engineer to order manufacturing. International Journal of Production Economics, 65(2), 179–190.

Islandsbanky Geothermal Energy Team (2011). United States Geothermal Energy Market Report. [Online]. Available: http://skjol.islandsbanki.is/servlet/file/store156/item102416/US%20Geothermal%20Energy%20Market%20Report%20web.pdf. [February 7, 2014].

Koskela, L. (2000). An exploration towards a production theory and its application to construction, PhD Dissertation, VTT Technical Research Centre of Finland, Espoo.

KPMG. (2010). World Geothermal Market and Outlook. An insight into KPMG's report on the international geothermal energy sector. [Online]. Available: http://www.kpmg.com/IS/is/utgefidefni/greinar-og-utgefid/Documents/KPMG_WorldGeothermalMarketandOutlook_oct2010.pdf [February 7, 2014].

Latham, M. (1994). Constructing the Team. H.M.S.O., London, UK, 130 pp.

Macneil, I. R. (2000). Relational Contract Theory: challenges and queries. 94 Northwestern University Law Review 877.

Male, S. (2003). Innovative Procurement Methods. In D. Bower (Ed.), Management of Procurement.Thomas Telford, USA, 235 pp.

NZGA. (2012). New Zealand Geothermal Association website. [Online]. Available: www.nzgeothermal.org. [April 24, 2012].

NZTE. (2011). Geothermal Energy: The Opportunity. [Online]. Available: http://www.nzte.govt.nz/media/344118/nzs-geothermal-opportunity.pdf. [February 7, 2014].

Palacios, J. L., González, V. and Alarcón, L. F. (2013). Selection of Third Party Relationships in Construction. ASCE, J. of Constr. Engrg. and Mgmt., ISSN 0733-9364/B4013005(10).

Pryke, S., and Smyth, H. (2006). Scoping a Relationship Approach to the Management of Complex Projects in Theory and Practice. In S. a. Pryke (Ed.), The Management of Complex Projects. A Relationship Approach, Blackwell Publishing, Oxford, Boston, 316 pp.

Tommelein, I. D., Ballard, G., & Kaminsky, P. (2009). Supply Chain Management for Lean Project Delivery. In O´Brien, J. O., Formoso, C. T., Vrijhoef, R. A. and London K. (Eds.), Construction Supply Chain Management Handbook, CRC Press, Boca Raton, 508 pp.

Vrijhoef, R., & London, K. A. (2009). Review of Organizational Approaches to the Construction Supply Chain. In W. J. O´Brien, C. T. Formoso, & R. a. Vrijhoef (Eds.), Construction Supply Chain Management Handbook, CRC Press, Boca Raton, 508 pp.

White, G. (2003). An alliance/partnering contract strategy. In D. Bower (Ed.), Management of Procurement.