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Status of knowledge of project management in geothermal projects in emerging markets

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STATUS OF KNOWLEDGE OF PROJECT MANAGEMENT IN GEOTHERMAL PROJECTS IN EMERGING MARKETS.

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**ABSTRACT**

Research has shown that standardized project management processes and sound decision making can increase how successfully projects meet their requirements such as being delivered on time, on budget and of agreed upon quality.

This paper looks into the project management process and governance present within organisations involved in the development of geothermal projects in various emerging markets. How formal and standardized are their project processes and what are some of the challenges they face when executing their projects. The research was conducted through interviews with experienced project managers from emerging markets, all working for a public entity and they are all former fellows of the UNU-GTP (now GRÖ-GTP) program in Iceland. The purpose was to gain insight from their experience in developing and executing challenging projects in emerging geothermal markets.

1. **INTRODUCTION**

Access to sustainable renewable energy sources is a key factor for modern societies to prosper and thrive. Energy sources that are currently available vary in many ways, especially when considering the effects of long-term use. Among factors that weigh heavily in the attractiveness of the energy source are price, sustainability and the environmental impact from utilization. With increasing greenhouse gas emissions from the use of fossil fuels and ever-growing awareness of the importance of alternative energy sources, nations look towards utilizing their natural renewable energy sources to reduce their dependence on fossil-fuels and increase their energy independence. Geothermal can be a part of the solution to this issue as it is a source of clean, renewable and environmentally friendly energy.

Geothermal projects are by nature complex, capital intensive and the uncertainty is high. However, this versatile renewable energy medium is highly sought after for its stable electrical production, and numerous direct applications, from district heating and cooling, bathing, washing, drying, aquaculture, greenhouses and to gas, mineral and metal extraction and production. With nations of the world aiming to increase their renewable energy production, many of those fortunate enough to have exploitable geothermal resources among their options, are taking their first steps towards developing their geothermal projects. Various steps have been taken to assist
emerging markets towards utilizing their natural resources, such as geothermal energy. These steps have included setting up risk mitigation schemes, international funding and loaning mechanisms, training and education programs as well as publication of reports on every aspect of geothermal energy. However, until recently, there has been more focus on providing education and training for geoscientists and engineers, rather than the execution and management of geothermal projects. Since 2015, UNU-GTP (now GRÖ GTP) has offered training for geothermal project managers with the aim of raising the standard of management and decision making for geothermal projects worldwide.

Standardized and proven project management processes increase the likelihood of project success. While project management has been widely researched for the past decades, where an increasing focus has been on factors that support project success, little research has focused on application of project management processes and project success in geothermal projects.

The principal purpose of this study is to evaluate the status of project management and decision making in geothermal projects in emerging markets. Throughout the paper and its research, the aim is to answer the following question:

*How is project management and project process in geothermal projects in emerging markets?*

1. Do geothermal developers follow standardized project management processes during development?
2. How are project management roles defined and practiced in the context of geothermal projects?
3. What are the challenges that geothermal project managers face in emerging markets?

While it is not the purpose of this research to find one universal answer to the questions, rather shine some light and gain understanding of what factors influence geothermal project management in a selected sample of developers in emerging markets.
2. LITERATURE REVIEW

The following chapter focuses on review of relevant literature regarding project management and processes in general, including theories and best practises. It also examines geothermal energy projects and how they differ from other renewable energy projects.

Project management

Project management is a relatively young profession, the term project manager first appeared in 1950’s although mankind has been executing projects for centuries, with the pyramids in Egypt and the Great wall of China as lasting monuments of project success (Seymour & Hussein, 2014).

Professional project management bodies were formed during the 1960’s, the International Project Management Association (IPMA) in 1965 and the Project Management Institute (PMI) in 1969 (Stretton, 1994). They are by far the most influential project management associations, and both publish standards, body of knowledge, books and journals on the subject.

The Project Management Institute (PMI) defines project management as the application of knowledge, skills, tools and techniques to meet project requirements and is accomplished through the appropriate application and integration of the project management processes for the project (PMI, 2017).

Both IPMA and PMI define projects as having a life cycle consisting of predefined set of phases or process groups such as initiation, planning, execution, monitoring and controlling and closing (PMI, 2017). The IPMA identifies 28 competence elements for project managers, categorized into three areas: people, practice and perspective. PMI uses 10 knowledge areas described in terms of component processes, practices, inputs, outputs, tools and technique (IPMA, 2015). The challenge for companies and institutions is to implement the guidelines and procedures for managing project activities based on the above-mentioned standards.

Project management combines activities that lead to new products or services, implement and develop new businesses and improve exciting procedures. Successful projects can improve quality, increase customer satisfaction and drive new sales and reduce costs. Companies are in ever growing numbers applying project management procedures to remain competitive and increase value creation in their business (Kerzner, 2010).

Project governance is the management framework of project management and how project decisions are made. It is a sub-set of corporate or organisational governance (Müller et al., 2013). The term project governance has been gaining interest over the past decade and much of the literature focuses on the public sector and large projects as demand for transparency and accountability as well as effective use of resources has increased (Crawford & Helm, 2009). Leodaly et al. (2013) illustrate the multiple factors influencing projects and project governance, as illustrated in Figure 1.
Geothermal

Development of a new geothermal power plant falls well within the definition of a project, being a temporary endeavour undertaken to create a unique product, service or results, as stated by the PMI (PMI, 2017). A common definition of the main stages of geothermal project is the one set forth by Gehringer and Loksha (2012, p3):

"A geothermal power project can be divided into a series of development phases before the actual operation and maintenance phases commences:

- Preliminary survey
- Exploration
- Test drilling
- Project review and planning
- Field development and production drilling
- Construction
- Start up and commissioning"
They also point out that there are four key elements to successful geothermal development: availability of information, effective and dedicated institutions, supportive policies and regulations as well as access to suitable financing. For energy development in emerging markets it is oft the latter two that pose the biggest barrier (Gehringer & Loksha, 2012).

Aggregated expenditures in geothermal projects in 2015-2020 were 10,367 million USD and time allocated, by degreed professionals, to work on international geothermal projects was approximately 30,491 person-years (Huttrer, 2020). PMI states that project management enables organizations to execute project effectively and efficiently (PMI 2017). Based on that premise it can be assumed that developers of geothermal projects can benefit from applying known project management processes to increase the likelihood of achieving successful projects.

Few papers have been published on project management in geothermal projects. Among the oldest publications related to geothermal project management is a book by Goodman and Love published in 1980. The book presents an integrated project planning and management cycle for geothermal development projects. The phases introduced are

1. Planning, appraisal & design,
2. Selection, approval & activation,
3. Operation, control and handover,
4. Evaluation and refinement.

The book then addresses three case studies of geothermal projects, in Hawaii, New Zealand and Indonesia, and applies the model to theses. (Goodman & Love, 1980).

A paper on the Icelandic approach of geothermal project management from 2008 emphasises the role of the project management team, that is to ensure that each phase of the project is carried out properly and that a qualified team can decrease owners’ risk and keep costs at minimum. A sound strategy for project management based on the expertise of a wide-range group of experts and the importance of aiming toward harmonizing different views and stakeholders (Gíslason, 2008).

In conjunction with short courses held by the UNU-GTP in Kenya and El Salvador, there are a few papers that focus on geothermal project management that have been published. Mangi (2016) covered the topic of geothermal project management, and the importance of monitoring and controlling within projects. Ngugi addressed the planning of geothermal projects and outlined in detail the main phases and steps to be taken in each phase of geothermal development at Kenya Electricity Generating Company (KenGen). He also points out the importance of project management and project plans in relations to negotiating with financers.

"A well packaged project plan assures the banks of a capable project management team. The project plans also provides the banks with an instrument for economic and financial project evaluation. The work plans act as a basis for owner’s contractual obligations with the bank and a reference for project progress evaluation and monitoring." (Ngugi, 2008)

Although focusing on one company’s procedure it gives a general insight, with defined objectives, scope of work, organization, output, duration and cost for each
step, notably all based on the KenGen experience (Ngugi, 2008). While the paper gives a detailed account for each step, it lacks definition on how a project can move from one step to the next. On few of the earlier steps, a go or no-go decision is part of the outcome, indicating a stage-gate process towards development, however, it is unclear who makes the decision and what happens to no-go projects.

Competent project management is the key for successfully completing a geothermal power plant and ensuring lasting consensus with local communities (Wallace et al., 2010). Their paper also points out some of the main challenges, developers face with geothermal projects, such as the fact that no two geothermal projects are truly the same as the underlying resource differs from one place to another and may change over time. Technically geothermal power plants are challenging due to the sheer number of components required for a power plant as well as corrosion and erosion issues related to the geothermal fluid and gases.

Uncertainty is high for geothermal projects as the energy source is underground and therefore it is impossible to verify the capacity without expensive measures such as drilling. Risk is defined as an uncertain event or condition that if realised, can have either a negative or a positive effect on the project (PMI 2017). The risk factors that geothermal projects face are in many instances the same as for any grid-connected power generation project, such as risk related to completion of the power plant and possible project delays, the market demand and price, and operational and regulatory risks.

There are two major risks that are unique to geothermal projects, the resource risk and the financial risk that arises from high upfront cost and long lead time (Gehringer & Loksha, 2012). The resource risk is the risk associated with the energy resource and its size and characteristics which can be split in to four different domains: its existence, suitability for production, size and sustainability (Ngugi, 2014b).

During the development of geothermal projects, the project risk decreases as new information is obtained and the project progresses. Necessary steps to obtain information on the resource are twofold, surface exploration and test drilling, with the latter being significantly more costly. As seen on figure 2, the project risk is significantly decreased during and after test drilling, where information on the underlying resource is obtained. Notably the figure is only representative of projects with all the necessary characteristics of an exploitable resource. If during test drilling the resource is deemed unfit for production, the risk of that particular project has not decreased.

While all geothermal projects share certain complexities as mentioned here, emerging markets face an added level of complexity related to development and financing a project in a country with no or little history of utilizing geothermal energy. Difficulties with regulators and financial institutions that are unfamiliar with the nature of the project can cause concerns (Wallace et al., 2010).
Bankability of a project is determined as its ability to attract financing from commercial sources (Gehringer & Loksha, 2012). While the term is widely used when addressing financing of projects, its meaning lacks a common understanding. Different players, such as banks, financial institutions and equity investors, each have different focus when evaluating bankability (Hampl et al., 2011).

Bankable documents are project documents prepared and presented by the project owner in order to secure financing for the project, in forms of loans, grants or credit application (Ngugi, 2014a). Bankable documents consist of project proposal or a business case that ensures the lender that the project will meet its objectives and ensure future cash flow, while addressing the project risks, both technical and financial, and how these risks can be mitigated or overcome.

Arguably many of the decisions taken during the development of a geothermal power plant can have significant effects on the total cost of the project and its profitability. Test drilling is the first major hurdle developers face. The price of each well is a few million dollars making it much more capital intensive than in previous phases.

"This is when the developer has to make significant investments, without knowing whether the geothermal resource has enough potential to recover the costs." (Gehringer & Loksha, 2012, p69).

The second major decision in the development, if the project has progressed with positive results though the previous phases of the project life cycle, is the decision
to continue on to drilling of production wells. A single production well can cost between 1-7 million USD, where the dept of the well and the local conditions factor in. Drilling comprises 35-40% of the total capital cost of a geothermal project and if the resource is not found, that investment is lost (IFC, 2013). A report by the World Bank found out that only 50% of the first wells drilled in a site, were considered a success. In total, the success rate of all wells drilled was 78% and the likelihood of drilling a successful well increased as more wells were drilled in the same field (IFC, 2013). Successful drilling of wells is a major factor in the overall success of a project and as it is both costly and time consuming, any delays during drilling can have a significant effect on the project financial viability.

The third and last major decision is when to initiate construction. As the production drilling phase is time-consuming, developers often seek to push its successors forward, by starting with design and tendering of the main components and equipment. Lead time for delivery of a steam turbine can be around 2 years (Belyakov, 2019). If drilling goes according to plan and the resource has been estimated correctly, starting construction while drilling can speed up the project and increase the long-term profitability. However, if the drilling or the resource do not meet the design criteria of the power plant, the risk can be realised of having oversized the power plant.

Geothermal energy has the highly sought-after ability of producing stable base load electrical energy from a renewable source. However, the energy source is complex in nature and no two geothermal resources are exactly alike. Each resource is unique in terms of temperature, depth, pressure, geological conditions, steam and water ratio and compositions, minerals and gases present in the liquid and geographical location, etc. All of these parameters need to be accounted for when developing a geothermal project, such as design of the steam-field, equipment and power plant. It is therefore difficult to standardize and mass produce equipment and components. Opportunities can lie in standardizing evaluation and classification of resources, in forming and presenting of the project’s business case and streamlining of development processes. This is where project management can play a vital role by contributing to disciplined practices and management of time, human and financial resources.
3. RESEARCH METHOD

The basis of the research for this paper is to evaluate the status of project management within selected emerging markets in geothermal energy with special focus given to the challenges that project managers face within projects.

Selection of countries and candidates was based around former students of the formerly United Nation University, Geothermal Training Program (UNU-GTP), now a part of GRÓ - International Centre for Capacity Development – Sustainable use of Natural Resources and Societal Change. The GRÓ GTP offers a 6 month postgraduate training program in Iceland with emphasis on assisting developing countries in capacity building within geothermal exploration and development.

The sample consist of 7 UNU-GTP alumnae working in various fields of engineering, geosciences and management in North America, South America, Africa and Asia.

Research approach

Data gathering is a vital step in any research. Options to gather information and data by investigating the status of knowledge within the project management and decision-making process would either be the use of quantitative methods such as questioners and a large sample to gain statistical data on the subject, or qualitative methods such as case studies or interviews.

The aim of this research is to contribute to a better understanding of a theoretical framework of project management in emerging markets. The research method best suited for this research is one of the qualitative research methods, on-one interviews. Conducting in-depth interviews with pre-selected candidates invites opportunities to discuss in depth details of certain aspects of the research topic required to gain further insight. Questionnaires and a sufficiently large sample size can give a potential indication which could be generalizable and statistically valid. Interviews on the other hand can have the potential to generate insight and understanding. Semi structured interviews have a set of questions to be asked, while maintaining the flexibility to ask sub-questions to be used by the researcher if necessary to explore further (Rowley, 2012).

Among the limitations of the qualitative research methods is the lack of generalization which can be concluded from the research based on the collected data. It is better suited to gain a point of view of the selected sample that can be seen as gestures. Bias is a risk which cannot be overlooked, particularly when trying to verify a hypothesis (Halldórsdóttir, 2013).

Candidates were selected based on a purposive sampling, a sampling technique where participants are selected deliberately based on having qualities, knowledge or experience that could contribute to the research. The selection is non-random and is based on experts having the most value for the research or information rich cases. Expert sampling method is a useful tool when venturing into new areas of research and gain information whether to investigate the matter further or not (Etikan et al., 2016). The candidates were selected to ensure diversity in terms of geographical distribution, experience with geothermal, position with in their companies and gender. However, as the sample was chosen from UNU-GTP alumni, there is an inherit bias.
One of the selection criteria for GTP participants is that they must be employed with in public organisations to receive UNU Fellowships. Therefore, it limited the variety of business background.

Questions asked during the interviews were based on a study by Musawir et al. on project governance (2017), on the PMBok by PMI as well as questions specifically related to development of geothermal projects, based on the ESMAP report by Gehringer & Loksha (2012).

**Structure of interviews**

Each interview was conducted through one-on-one meeting over the internet and lasted about 40-60 minutes. All interviews were conducted in confidentiality while all were recorded. A list of questions was prepared beforehand. Questions on interviewees background and their organisations experience in geothermal were sent before the interview. Questions on project management and challenges were discussed during the interview. The questions can be categorised in to the following sections:

- Personal background: Background information, education, work experience and specially experience in the field of geothermal energy and project management.
- Geothermal maturity: Gaining insight to the experience of the interviewee’s organisation on geothermal development
- Project management: To gain information on their views towards project management and its governance with in their organisation, project processes and success.

**4. RESEARCH RESULTS**

This chapter explores some of the most important findings from the interviews with the seven interviewees.

**Personal background**

The aim of this section was to gain understanding of the experience of interviewees in geothermal projects, educational background and project management experience. To shield interviewees identity, they will be given a number and their experience rounded off to <5y, 5-10y, 10-20y and 20+y, see Table 1 below).

In total seven interviews were conducted between 9-13th of May 2020. Out of the seven interviewees 4 were male and 3 were female. The interviewees were from North America, South America, Africa and Asia.
Table 1: Overview of interviewees background

<table>
<thead>
<tr>
<th>INTERVIEWEE #</th>
<th>EXP. IN GEOTHERMAL SECTOR</th>
<th>HIGHEST LEVEL OF EDUCATION</th>
<th>FIELD OF EDUCATION</th>
<th>PROJECT MANAGEMENT CERTIFICATION (IPMA / PMI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 - 10 Y</td>
<td>M.Sc</td>
<td>Engineering</td>
<td>(PMP in progress)</td>
</tr>
<tr>
<td>2</td>
<td>5 - 10 Y</td>
<td>M.Sc</td>
<td>Engineering</td>
<td>IPMA - C</td>
</tr>
<tr>
<td>3</td>
<td>10 - 20 Y</td>
<td>M.Sc</td>
<td>Geosciences</td>
<td>IPMA - D</td>
</tr>
<tr>
<td>4</td>
<td>5 - 10 Y</td>
<td>M.Sc</td>
<td>Engineering</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>&lt; 5 Y</td>
<td>B.Sc</td>
<td>Engineering</td>
<td>IPMA - D</td>
</tr>
<tr>
<td>6</td>
<td>20+ Y</td>
<td>M.Ph</td>
<td>Inform. Sciences</td>
<td>IPMA - C</td>
</tr>
<tr>
<td>7</td>
<td>5-10 Y</td>
<td>M.Sc</td>
<td>Engineering</td>
<td>PMP</td>
</tr>
</tbody>
</table>

Interviewees all have experience in the energy sector, especially in geothermal projects and project management. Six out of seven have a masters degree (Table 1) and five out of seven have already completed a formal project management certification, and one is in progress (Figure 3).

Geothermal experience with in organisation

The geothermal experience within the interviewees organisations and home countries varies greatly. For some of the countries geothermal development has been ongoing successfully for decades, while others are taking their first steps in developing their geothermal resources.

Interviewee #1: The interviewee’s organisation is currently undertaking 6 geothermal projects at different stages of development. Most of which are in...
exploration stages of development. Currently there are no geothermal power plants in the interviewee’s country and their organisation therefore has not developed a geothermal power plant from greenfield.

Interviewee #2: The interviewee’s organisation is currently undertaking development of two different geothermal fields. One is in early stages of drilling while the other is in final stages of production drilling and construction is expected to start soon. The interviewee’s country has already developed over 500MWe of geothermal energy.

Interviewee #3: The interviewee’s organisation has the task of monitoring and regulating the geothermal sector and is not directly involved with developing geothermal projects. It however does take on some of the early stages of development, such as exploration, preparation of feasibility studies and tendering out concessions. The interviewee’s country has already over 1000MWe in installed power from geothermal resources.

Interviewee #4: The interviewee’s organisation is currently developing one geothermal project. They were developing four different areas and have since selected one to continue with. They have not built a geothermal power plant from green field before and the country currently has no geothermal power plants.

Interviewee #5: The interviewee’s organisation is currently developing quite a few geothermal projects. They have in the past developed 2 geothermal projects from green field with installed power of over 100MW. The interviewee’s country has over 1000MWe in installed power from geothermal resources.

Interviewee #6: The interviewee’s organisation has a long experience with developing geothermal energy. They are currently developing 3 geothermal projects and have developed over 500MWe of geothermal power.

Interviewee #7: The interviewee’s organisation does not develop geothermal projects, they are more of an implementation hub. In their region, only one country has developed a geothermal project for power production.

**Project management**

*Definition of a project and project success*

The interviewees had similar ideas of what defines a project. In general, they all consider projects to have a beginning and an end. Having a scope of work and activities that need to be done. They all mentioned projects having timelines or time constraints and a budget. One participant mentioned that all geothermal projects are bound by time in their country as government legislation states that developers have 7 years to execute their projects from exploration to being operational. Another mentioned that a project entails that the resources required for its execution have been identified and made available.

“A project is like a triangle, that is the cost, time and scope. But inside it we have to put quality. At the end of the day, that is the outcome of the project.”

Interviewee #2
When asked what defines project success with in their organisations the participants answers varied more. The interviewees all, but one, mentioned the importance of staying within budget. It was an important factor in their mind, and the first one, which most of the interviewees mentioned.

"Successful projects meet the requirements set out initially in the project charter and of course satisfy the stakeholders. Stakeholder engagement must be carried throughout the whole project process.” Interviewee # 6

Second most mentioned was to finish projects on time. The reasoning behind the importance of delivering project on time was emphasised by two of the interviewees. One mentioned being a government owned entity with political pressure behind them while the other mentioned the importance of operating in the power generation business, and that any delays in the power plants being operational and online, are basically delaying the process of economic development required by the people of their country.

Communication with locals and stakeholder engagement were also mentioned as success criteria for projects. That projects must be carried out with the consent of local communities and authorities. The importance of having accident free projects was also mentioned. For a drilling project, one of the success factors is that no one is injured on site during drilling or construction of the power plant.

"Health, safety and environment, timeframe and budget these are the most important factors” Interviewee #3

Two of the participants described what a successful project end stage would encompass, having commissioned the power plant and started the operation and production of electricity without running into problems.

“A successful project when you are in the commissioning phase and you are already producing the steam and run the power plant. That is the success of the geothermal power project.” Interviewee # 2

External evaluation was mentioned as a factor for one of the interviewees organisations, where they rely on positive feedback in report from government officials and funding agencies having visited and audited the project. Lastly, the higher purpose of projects and the importance for their communities:

"Success is however not just about building the power plant itself, the true purpose of that project must be met. The main purpose is making the electricity available to the people to make a living of it and better their lives.” Interviewee #6

**Project structure**

Interviewees were asked about the project structure and formal roles. Whether their organisations would always appoint a project manager for projects, and it they use the role of a project owner.

Almost all interviewees agreed that their organisation have a specific project manager for each project. It might not be one and the same person throughout the
project life cycle, but all projects were assigned a project manager responsible for its progress.

"All projects have a defined project manager who is responsible for ensuring the project is delivered within time and budget and successfully." Interviewee #6

One said that the project manager is always the deputy director of their organisations during exploration stages of projects while another mentioned that during exploration phases of geothermal projects, one of the business development team members will take the responsibility for the project, but not always formally.

Two mentioned that after the feasibility study or report has been conducted, the project will get a dedicated team to execute it and follow the project throughout the project lifecycle. One mentioned that their organisation uses a project management unit to execute projects, and they hire external project management consultants to assist the PMU through all the steps of development and construction until the power plant is commissioned.

"All projects get a dedicated project manager after the feasibility study phase, who will follow the project to the end. And with them a dedicated team to that project." Interviewee #5

The role of project owner was not used formally for most of the interviewee’s organisations. Many of them report that they do not use the role of owner when executing projects. For many of them, their project managers must however report directly to the company director or directors. For donor funded projects two mentioned that it is a requirement from the donors to have a project owner, a dedicated project manager and a dedicated team, a project implementation team for a specific project.

For one organisation, ownership is based on the size of the project. For small projects, an owner is always defined, but it can be assigned to an individual division director or manager, based on where that project belongs within the company structure. For larger projects, including the construction of the power plant, it is automatically the top management.

"For large projects, the owner is always the CEO” Interviewee #2

Only one interviewee mentioned the use of sponsorship within their organisation. Where every project is assigned a sponsor from top management to champion and support that project whenever needed.

**Standard project processes**

The interviewees all come from different entities and organisations and their definition of a standard project process is reflected in that. Not all of the organisations have a standard project process for geothermal projects or projects in general.

Two of the interviewees are from relatively young entities and they have not formalized a project process yet. Of those, one mentioned following the PMBOK by PMI as a project standard as their organisation does not have a standard project process of their own. They instead rely on the PMBOK when in initiating new projects and
during the planning phases of projects. Others mentioned following the EPMAP Handbook definition of phases for development as a standard process.

Three of the interviewees mentioned the influence of donor funding on project procedures. All of them said they would follow the donors or banks procedures or project standards, rather than their own, in donor funded projects. Two mentioned that the banks standards are more strict measures than their own, or government procedure for projects.

Those with a standard procedure in place, stressed the importance of following a standard procedure, to ensure projects are executed well. One, also emphasized that being an ISO certified company, they have formally defined the process and must follow it in order to be compliant with their certification.

The importance of following a procedure, and to monitor, measure and control the process was a common answer from participants. Even those who said their organisations did not have a standard project process mentioned monitoring and evaluation project progress against set parameters.

The fact that the interviewee organisations are all public entities was also a reason for them to follow procedure. Project documentation and project closure were mentioned as being of added importance for public companies. And as one mentioned:

"...being a public company we are accountable to the people of our country."

Interviewee #6

Another mentioned the importance of public funding and how it increases the complexity when contracting and purchasing for projects. The need to follow public procurement for small and large contracts and that it can be a lengthy and a difficult process, especially for smaller procurements.

When asked if all projects follow the standard process, if they have one, and the reason why if not all projects follow the standards, their views varied. Only one was very firm on the fact that all projects follow the standard process, without exceptions:

"We don’t allow people to have different standards, or for different projects not to follow the standard. We are ISO certified and we have defined procedures, and we need to follow it. Sometimes it depends from one pm to the next but ultimately the standards have to be followed."

Interviewee #6

Among reasons projects do not follow the standard process, pressure from politicians and government was most often mentioned. They state that they feel pressured from politics towards certain projects. The project managers must then balance between following the standard to the letter or going ahead, waiving some requirements or procedures to get things done.

"Politics is the main reason we might violate our own procedures”

Areas for improvement in regard to project processes

When asked what in their organisational project process they would like to improve and the reasoning behind it, the answers varied greatly between interviewees but all
of them could point out a few things that could be improved. For those who previously mentioned that their organisation did not have a standard project process, all mentioned that they would like to have a formal project process, a standard operating procedure or framework for geothermal projects.

Many of the interviewees would like to improve how projects are started or initiated within their organisations. Most of them mentioned the same argument for improvement, like having a project charter and clear milestones.

“Often projects are started without detailed identification of stakeholders and without a formal project charter. A project manager is appointed to a project but has little information on the project baseline, scope of the project, key objectives, the project metrics and milestones, or how success will be measured.”

“Stakeholder engagement and a project charter are very important parameters as they drive the conversation, otherwise you are in the execution phase and you have to come back and redo everything, and things get confusing.” Interviewee #1

Two addressed the political support needed for development of geothermal projects and the necessity of having consistency in political support for projects. Geothermal projects take a long time to develop and can be difficult to understand. The political environment can change much during the project lifetime and government support is fundamental to move projects forward.

Many of the interviewees also mentioned that with change in leadership or top executives in their companies or in ministries, they could feel a change in prioritisation of projects or the support for their projects. That the project reasoning was no longer valid and previous decisions were not honoured. The incoming manager or minister needed to be convinced about the need of a particular project. The project technical and financial viability were questioned. Their project needed to be reevaluated and they were even asked to update all data regarding the project, with the added cost and time delays.

Another is the staffing of projects and the human resource capacity of their organisations. The importance of having the right people to execute the project with the right qualification and experience. One mentioned this being problematic as they do not have enough projects to work on for highly specialized staff while others were on the opposite end. They mention that among the issues they face are that some of them are executing many projects simultaneously and they do not have enough employees to execute them properly nor the support from their organisations for recruiting new people. For some of the project managers are managing more than one team and projects and by doing so they lack focus.

“Every project should have a dedicated pm/owner or a project person with each team, that way we are going to manage projects efficiently according to the project management processes.” Interviewee #2

To focus on implementing and practising project management in every aspect of their company’s activities, one would like to see their company move from operating at functional level to being fully projectized, where everyone and everything is considered a project, regardless of function. By getting to that stage they would be
able to accurately account costs of all aspects of a project, internal and external, as well as assisting them to deliver projects on time.

Communication was also a topic that many wanted to improve. Both internally within their company and externally with stakeholders. Internal procedures of information sharing, reporting and information channelling so that everyone working in a project team knows what is happening in their own projects. Added emphasis is on stakeholder engagement, especially in the early phases of project, e.g. to see more consideration of how the projects will affect and impact the genders differently as well as different age groups.

"I would like to see more emphasis on looking at stakeholders with a demographic lens, and incorporate, from the project design stage, gender responsive and gender transformative design elements." Interviewee #7

Finally, one of the interviewees would like to improve the operation environment of geothermal in their country by increasing the geothermal price. By increasing the price, the geothermal companies would not be as financially stressed and could be more relaxed in regard to decision making, such as deciding how many wells to drill, how many megawatts they should aim for with production. It could also benefit the engineering and procurement of the project, as they could then procure the best technology available for the project.

5. DISCUSSION
The aim of this research was to gain insight into the practices and challenges of project management in geothermal projects in emerging markets. The interviewees have different experience from five different countries in four continents and are all currently working towards developing their geothermal resources.

The interviewees all had a clear understanding of what defines a project. It being a temporary thing with a formal beginning and end, a set budget and timeline and carried out to achieve results. Their definition of a project aligns well with that of the PMI and IPMA. That was to be expected, as all of the interviewees have received training in project management and majority of them have a formal certification of knowledge or experience in project management from respected international accrediting institutions.

They however were not as unified in the interpretation of what defines a successful project. Different organisational emphasis on projects and the different status of project development might weigh in. However, all but one mentioned the importance of staying within budget and it was generally the first thing mentioned. The importance of handling public funds in project seemed to affect how the interviewees conduct their activities. The responsibility of operating with public funds in public entities and the importance of using those funds wisely was a vital factor for them to follow procedure. It also appeared to put additional pressure of accountability towards the citizens of their countries.

This focus of handling funds wisely and strictly staying within budget, was somewhat surprising. One would expect this strict adherence to budget and careful spending to be more dominant with private developers investing their own equity to
develop projects than with public entities operating for the good of the public. Nevertheless, the issue of internal costing in projects was not addressed and it is therefore unclear whether the interviewees were only addressing external costing or the total cost of a project.

All of the interviewee’s organisations define a project manager responsible for the project progress. However, it is interesting how few of them formally define a project owner, and only one mentioned the use of project sponsor. When discussed further it became apparent that for many of them top management acts as project owners, having the final decision-making power in project execution.

Influence of international donors and international financial institutes is apparent in the execution of geothermal projects in emerging markets. The donor agencies expect and enforce application of their own project processes, often with added requirements on structure, formal procedures and reporting. While not addressed in this study, it would be of interest to assess those procedures, and evaluate if they can better ensure the successful execution of projects, with regards to requirements. And secondly, research how different they are as one interviewee addressed the complexity of managing projects under different funding agencies frameworks. It might be of benefit to organisations in emerging markets receiving international donor funds if their framework and requirements were similar.

Challenges the participants face when managing their projects were many and differ between projects and countries. Political influences on projects were evident in some of the discussions, as the participants aired challenges they face while pursuing professionalism in the management of their projects. Politics and political pressure can delay project progress in some cases and in others it can pressurise the project manager to overlook some of their requirements and procedures to push the project timeline forward.

Importance on stakeholder engagement, inclusion of local communities in decision-making and project design, as well as carefully defining the project in the beginning were all critical factors according to participants to ensure successful execution of projects. They align well with the emphasis of PMI and IPMA on a well-defined project charter with a clear vision or purpose where stakeholders’ expectations are addressed as well as the project environment.

A point raised by one of the participants was on gender and how projects can affect the sexes in different ways. The importance of project developers to consider the possible consequences their projects can have towards different social and age groups and for the project manager to be aware of this fact. Incorporation of procedures to look at projects with “a demographic lens” as the interviewee so eloquently put it, not only in the initiation phase, but throughout the project lifecycle.

While there may be an indication that the interviewees have a clear understanding of project management and its practices with in the geothermal context, it remains unclear if their organisations are as mature in their project management governance and structure. Some key project management concepts were not mentioned by the participants, such as change-management, portfolio and program management, the use of project steering committees and more. A few did discuss using somewhat formal decision-making processes, such as stage gates and panel discussions, and only one addressed the topic of risk management. This coupled with
the points raised on political influence and lack of formal processes of information sharing and documentation within projects suggest there is room for improvement.

This study only interviewed project managers working in public entities. It would be of interest to conduct the study with a larger sample size, including private developers of geothermal projects, preferably operating within the same countries. That could provide a comparison of experience in regard to developing geothermal projects in emerging markets.

To address the different development schemes or business cases for geothermal project development and how decision-making regarding project processes affects the project success might be of further interest.

6. CONCLUSIONS
The status of knowledge and practice of project management with in the geothermal sector in the emerging markets varies greatly between countries. While some have been executing geothermal projects successfully for decades, others struggle to see a single project develop and have a harder time in demonstrating the benefits the project can bring.

Developers of geothermal projects mainly follow a somewhat standardized process when executing their projects. Political influence and international donor funding can have a noticeable impact on the execution and the project progress. Project managers of geothermal projects in public entities accentuated the importance of keeping true to the budget, careful management of public funds and the significance of delivering projects on time to contribute to the economic development of their countries.

Project managers of geothermal projects in emerging markets are on a journey towards improved discipline and professionalism in their project execution and management. While many may have acquired these skills, their organisation and working environment may not have come as far. Continued emphasis on supporting the emerging markets and providing training and consultation on the topic of project management is vital to help them on their path towards project excellence.

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7. REFERENCES


