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How Can Small and Medium Enterprises Maintain a Balance of Research and Development?

"Final Project Report"

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Executive Summary

The objective of this project is to gain a better understanding of how small and medium sized enterprises (SMEs) balance research and development (R&D) activities.

We explore modern R&D tools and methodologies through literature research. These tools and methodologies are then aligned with "External Variables and Internal Conditions" as identified by Keizer et al. and a framework is created. [10]

This framework is applied to two case studies. The first case study examines HECO, the Hawaiian Electric company, representing a small enterprise. The second case study examines Logitech Inc, a consumer electronics company, representing a medium enterprise.

The results of this analysis show that the proposed framework for understanding SME R&D programs is viable. Both case studies provided examples of the variables, challenges and opportunities faced by small and medium sized R&D programs. Areas for future research include a stronger understanding of the impact of education, motivation and experience on the output of an R&D organization and the flaws in the current funding system for energy research.

1. Overview

1.1 Introduction

Small and Medium Enterprises (SMEs) have played and continue to play significant roles in the growth, development and industrialization of many economies around the world. SMEs have been driving the U.S. economy in the last few decades, by providing jobs for over half of the nation's private workforce. One article notes the following:

> *"Office of Advocacy funded data and research shows that small businesses represent 99.7 % of all firms, they create more than half of the private non-farm gross domestic product, and they create 60 to 80 percent of the net new jobs*." [1]

Not only did industry funding for R&D grow rapidly in recent decades, but so did the numbers of R&D alliances, mergers and acquisitions, and patent licenses. Moreover, the share of R&D conducted by SMEs and business funding for university research increased significantly. [2]

This suggests that SMEs have adopted "new models" of knowledge creation, management, and sharing that supplement more strategically oriented internal R&D activities with greater use of externally acquired technology.

We have to aligned these new models and tools with variables that can be considered as "possible predictors of innovation efforts" as defined by Keizer et al. [10]. Keizer's paper conducted in depth research of the different variables impacting R&D in SME's. They concluded that the variables could be classified as *external variables* and *internal conditions*. External variables refer to opportunities SME can take advantage of in regards to its environment, while internal conditions refers to the characteristics and policies of SMEs. [10]

1.2 Aim of the study

This report intends to explore the models and key business survival strategies, which have worked for SMEs. These strategies are listed in Table 1 below.

Table 1: R&D Strategies Used by SMEs

Partnerships with Universities and other companies [4]
Global teams [5]
Open innovation [6]
Licensing, Patents and trade secrets [4]
Speed to Market [4]
Corporate Entrepreneurship [7]
Collaboration tools [5]
Improved designs and processes [8]

Platform based development [9]

By applying these variables and tools to the two case studies, we hope this report will lead to a better understanding of the way in which SMEs conduct research and development activities.

1.3 Challenges and Opportunities

The problems and challenges that SMEs contend with are enormous. For example, they have to deal with limited resources, inability to spread risk over a portfolio of new products, too many partners, problems in funding longer-term R&D, and marketing issues [3]. Moreover, the unfair competition and government policy inconsistencies and bureaucracy increases these challenges and make it difficult for SMEs to innovate [11].

However, it is important to note that many SMEs are able to overcome these challenges. This should provide a basis for optimism that there is an opportunity and a way out.

Due to their relatively small/young environment, they enjoy a number of behavioral advantages over their larger counterparts. They have an interactive management style which makes internal communication more efficient so they can respond rapidly to external threats and opportunities. SMEs can make decisions and implement them faster. They can react more quickly to input from customers or challenges from competitors, and evolve their business models more rapidly [3].

Their smaller size makes smaller markets attractive to SMEs. This advantage allows SMEs to exploit new trends sooner when entry costs are still quite low. Moreover their focus lets them execute very effectively against larger, diversified firms. It was also found that SMEs attract more entrepreneurial R&D employees. All of these advantages lead to their strong licensing ability [12]

2. Background

A lot of research has been conducted recently to find out which factors contribute to innovation efforts by SMEs. These studies revealed that activities directed to innovation correlate with a number of variables. These variables were classified by Keizer et al. as **External Variables and Internal Conditions.** External variables refer to opportunities SMEs can seize from the environment. Internal variables refer to characteristics and policies of an SME. [10]

2.1 External Variables:

- *Collaborations with other firms*
  SMEs can be integrated into the supply chains of large companies, using a technical- and business-skills mentoring approaches such as: partnerships with other firms, open innovation, and licensing,

- *Linkages with knowledge centers*
  This tool helps make SME's more competitive through consultation with universities, researchers, and technology centers.

- *Utilizing financial resources or support regulations*
  There are number of financial programs for SMEs, some of them are governmental funds, and some provide a number of different resources and opportunities for finding SMEs funding.

2.2 Internal Conditions

- *Strategy*
  There are different R&D strategies for SMEs, which allow them to compete with larger firms, like speed to market. SMEs take decisions faster and implement them more rapidly. They can react more quickly to input from customers or challenges from competitors, and evolve their business models more rapidly. [12]

- *Structure*
  Efficient internal communication & interactive management style often represent the structure of SMEs. Their smaller size allows them to attract smaller markets. Their focus and business specialization lets them execute very effectively against larger, diversified firms. [12]

- *Technology Policy*
  Through patents, Intellectual Properties, and Licensing, SMEs can be integrated into the supply chains of the large companies. Moreover, these policies are considered survival methodologies that allow SMEs to become a key player in the market.

- *Level of education*
  Presence of qualified engineers & the number of PhDs & Masters researchers plays a key role in the development of the SMEs and the effectiveness of their research. Also, the degree of education of the founder/manager is an important factor in the progress and sustainability of the company. [10]

- *Investments in R&D*
  Investment Policy is critical for SMEs. Unlike large firms, R&D investment is considered risky and controlled by many factors, such as: company's age and size, available funds, priority of the project, and relativity of the project to their main goal.

- *Geographical Location*
  This variable refers to the influence of location (Rural or urban location) on their collaboration with other firms, universities, and research labs, etc. Of course this depends on the enterprise's industry. The company should also explore the potential advantages and disadvantages of "Virtual and Global teams" for maximizing the impact of R&D investment.

We can take these external variables and internal conditions use them as a framework to help analyze our case studies. For each case study we will look for evidence of this framework and identify how the SMEs are impacted.

Case Studies

The goal of the following case studies is to show how small and medium sized companies handle research, development and deployment of new and innovative products or concepts. Two real world case studies are used to help highlight and understand concepts found in literature research. The first case study is for the small company, the second is for the medium company.

3. Case 1: Hawaiian Electric Company

3.1 Introduction

For the small company case study, the selected organization is actually a subset within a much larger company. Due to the nature of their work and the structure of the industry, this group functions very similarly to a small company and therefore met the criteria of the case study. The selected small company is the Renewable Energy Group that is part of one of the main Hawaiian utilities, Hawaiian Electric Company (HECO). Although the parent utility is a large organization, utilities have historically not functioned as R&D institutions. Therefore even though the renewable energy group is technically part of HECO, in many ways it runs like a small, semi-independent group. This includes the ways that they find sources of funding, develop industry and academia collaborations, and their portfolio development strategies. The interface with the larger utility mostly occurs once the technology or concept is ready for deployment. As such, the renewable energy group fills an RD&D role for the utility- research, development and deployment.

The source of information for the HECO Renewable Energy Case Study was interviews with the Director of the Renewable Energy Group. Research for the case study was conducted through a written questionnaire and phone interview. The study focused on the group's strategies for funding, developing collaborative relationships with external organizations and portfolio development. Many of the challenges, as well as the opportunities, found in the literature research are demonstrated in this case study.

3.2 Background

The utility industry does not historically have a reputation for being leaders in research and development activities. Due to strict regulations around system reliability, utilities are cautious to take on risk and make changes to the system. But as both the government and the public begin to demand more focus on fossil fuel alternatives and energy efficiency, the utilities are entering into a world that they have historically not participated in – research, development and deployment. HECO has been an active and leading player in the push towards upgrading and innovating both generation sources and distribution methods of the Hawaiian electric grid. The HECO Renewable Energy group (referred to from here forward simply as "HECO") provides an informative example of how utilities can begin to successful enter and participate in R&D activities.

3.3 Collaboration with Other Firms, Universities and Knowledge Centers

Successful collaborations have been one of the biggest factors in HECO's success. There are two benefits to the collaboration of R&D for utilities. The first is the more obvious one, which is the sharing of resources and ideas that can lead to stronger innovative efforts than either side could produce alone. This is especially key in the area of energy because the end users, the utilities, often are not doing their own development. This can result in both a stagnation of progress, as well as a disconnect between the developer and the user. But a collaboration between the utility, industry and academia helps tie the research abilities of academia with the development resources of industry with the deployment potential and end user needs of the utility. The added advantage of partnering with academia is that research for real world applications helps develop and train a future workforce already knowledgeable on the issues of the industry.

The other benefit of collaboration relates back to the structure of the funding resources. Most of HECO's funding come from external sources that require strategic and creative approaches which necessitate partnerships with academia, research facilities and industry. Collaboration is often the key to winning grants and is often one of the intended outcomes of such programs. While researching the effect of government funded programs in Hungary, Inzelt comments "Throughout the world, policy programmes tend to call for collaboration and integration, and R&D and innovation policy programmes are important coordinating forces in the field of funded research and of supported innovation activities." [13] Although government funded grants are sometimes intended to encourage these collaboration, the system is often so complicated that only experienced teams can successfully find partners, apply for, win the grants and then properly spend the money in qualified projects. HECO's success in understanding this system and the type of relationships that are needed has been crucial in helping them become a successful and innovative player in the renewable energy field.

3.4 Utilizing Financial Resources or Support Regulations

As mentioned in the previous section, funding is a big issue for HECO. Since utilities historically haven't functioned as R&D organizations, they are not set up to support large research and development programs. This means that a R&D group like the Renewables Energy Group is often responsible for securing their own funding resources. But this is not a unique problem and finding funding is an issue most SMEs groups grapple with. The quest for funding can often be difficult

and introduces additional risk to the program. The ability to successfully navigate the funding avenues can be the determining factor between small companies that have successful R&D programs and ones that do not.

In the case of HECO, much of their funding comes from grants but this does not come without its own set of challenges. The literature found that two of the challenges SMEs face are "problems in funding longer-term R&D" and "government policy inconsistencies and bureaucracy". [3][11] Both of these issues are clearly demonstrated in US federal grant programs for energy research, which often are short term. This makes it very difficult for groups to plan far in advance. This is a problem for most small R&D programs, but it is especially challenging for groups in the utility industry, which has historically been slow to change and requires significant testing before any modifications to the system can be made.

In addition to the constraints of the funding timelines, there seems to be some other disconnects between the funding sources and the funded programs. While researching factors impacting innovative research, Keizer et al found a study concluding "only a very small number of SMEs seeking financial resources failed to succeed"[10] This is perhaps a misleading statement because it does not necessarily account for all the small R&D groups that would like to apply for funding but have not successfully figured out a way to even enter the system. HECO has observed two main disconnects between the funding sources and the hopeful funding recipients. The first disconnect is in academia. The educational research groups are often able to get the funds, but they don't necessarily know the needs of the industry well enough to successfully use them. The second disconnect is industry, which knows what the research needs are but doesn't understand how to get the money or how to work within the stipulations of the grant. A successful R&D groups needs to understand three key areas- how to find the funds, how to apply for the funds and how to use the funds. This need for collaborative efforts and a broad range of skills sets is one of the reasons the previously discussed partnerships and collaborative efforts are so key in developing a successful program.

3.5 Strategy

HECO's strategy for project selection is a strong example of the impact of external variables. The main variables that effect HECOs program portfolio are need, funding, regulatory factors and public policy. Industry culture is another factor since utilities are often risk adverse and more reactionary than proactive when it comes to change. The issue of public policy is a complicated one because it is influenced by its own set of external factors and is constantly changing. But when partnered with an accepted roadmap and aligned with the larger goals of the organization, it is possible to successfully move forward with project development and deployment.

The HECO Renewables Group has a roadmap that helps them determine which projects to focus on. In general their goal is "to sustainably and reliably bring on more renewable to the islands and advance the state of the industry"[14] Their platforms look at new technology, improvement of the efficiency of existing technology and data collection to better model and develop the overall system.

3.6 Level of Education

In the case of HECO, the internal variable defined in the literature as "Level of Education" can perhaps be more broadly defined as caliber of employee. A well known factor in successful project management is that great programs attract great employees. Since the energy industry has not historically participated in much innovation, the push for exploration of new ways to produce, distribute and use energy has created an exciting environment that is helping attract talented people to the field. Since HECO has become one the leaders for renewable energy research among the US utilities, it has helped them to attract capable and motivated employees who are both excited and challenged by the innovative projects they are working on. Director Dori Nakafuji commented , "This is an exciting time to be working in the energy industry".

3.7 Challenges

Most of the SME challenges that HECO faces tie back to funding in some way. From the list provided in Section 1.3 of this paper, the SME challenges that apply to HECO are Limited Resources, Problems in Funding Longer-Term R&D and finally, Government Policy Inconsistencies and Bureaucracy. Although the government grant programs help initiate the formation of partnerships, the short life cycle of the grants are ironically counter-productive both in the collaborative relationships and the level of R&D that can be supported. A solid partnership can take 10, or even 20 years, to solidify but the funding programs are often five years or less. Therefore the issue of limited resources and government inconsistencies end up causing problems with funding longer term R&D programs.

Despite these challenges, HECO has been unusually successful in finding ways around them and could serve as a valuable learning tool for other US utilities hoping to advance their involvement with renewable energy and energy efficiency R&D programs.

3.8 Opportunities

Although being an SME has its challenges, there are also advantages to being a small organization and, when used properly, can provide unique opportunities. Of the advantages listed in Section 1.3, the three that are well demonstrated in the HECO case study are Rapid Response, Focus and Speed.

Focus is perhaps as much a product of the industry, as HECO's size. Their focus is on renewable energy technologies, improved resource forecasting and integration, improved distribution and allocation and smarter systems on all levels. This is obviously an extensive list and not necessarily a narrow focus, but since the regulatory forces on utilities have specific requirements around when and how changes can be implemented, HECO has at least some direction on where to focus their efforts. They work off of a living roadmap that focuses on five platforms of need.

One of HECO's biggest advantages is their size. In this case, although the parent utility is large compared to the Renewable Energy Group, it is in fact still considered a smaller utility. This has allowed them to be more nimble and adopt changes more easily than some of their larger sister utilities in other states. The flip side is that their victories don't always have as much widespread impact on the industry. In the future, HECO would like to continue using their small size as a

chance to be a test bed for new solutions but also become an example of programs that can then be rolled out to larger utilities around the country.

3.9 Conclusions

HECO proved to be an interesting case study but not only because of their status as a small R&D organization. Their understanding of the R&D funding labyrinth in the renewable energy industry, as well as development and deployment in the utility industry, provided valuable insight into the weakness of the current system and ways that support of R&D programs could be improved in the future. The end conclusion was that the money is there, the needs are there and the brainpower is there for renewable energy research, development and deployment programs. But the hurdle that is left is figuring out a way to better connect the three so that these programs can really start to flourish.

4. Medium Sized Business Case Study: Logitech Audio Business Unit

4.1 Background

Logitech is a company that is primarily known for design and manufacture of PC peripheral products. These products cover the areas of "control devices" (computer mice and key boards), "video" (webcams), "audio" (PC speakers and digital music products), "digital home" (Google TV), and "business to business" (conferencing solutions). Taken as a whole Logitech is a large company with around $2.5 billion in sales yearly, but we are going to focus this study on the Audio Business Unit. This business unit includes around 150 employees, about half of which are a part of R&D. Additionally, each individual business unit is provided with a yearly budget from corporate, which means that they have to adapt their R&D activities to fit within the financial resources that are provided.

Based on the size of the business unit, and the constraints of the limited budget, we can consider the Logitech Audio Business unit a medium sized business for the analysis in this paper. The Audio Business Unit is located in Camas, Washington and the content for this case study was created through interviews with the VP of engineering, the Technology Strategy Director, and the Senior Manager of Software Engineering.

4.2 History

Historically, the Logitech Audio Business unit faced the challenge of detaching research from product development. Every new product had new requirements that had never been researched. As a result, the research had to take place as part of the product development process. This was a huge challenge that introduced risk and jeopardized schedules. The VP of Engineering notes that research is event driven while development is schedule driven. Effective research cannot be constrained to a schedule the same way that project development can. [try to find a source to back this up]

As a general rule, Logitech tends to be risk averse. This is a condition that comes from being a market leader for a number of years. In order to maintain market share in a broad range of markets, Logitech has to make the products that have historically been successful. They are forced to be more predictable. The danger of this condition is that a small upstart company can identify a

single niche in the market and start to chip away at Logitech's market share by introducing an innovative new product.

4.3 Collaborations with other firms

Collaborating with other firms is critical to the success of the Logitech R&D department. By following this method, they are able to bring cutting edge technology into their products, often before that technology is available to competitors.

A key advantage for Logitech is their high volumes. They are able to use these volumes to entice IC vendors to provide exclusive, new, and unique technologies.

Logitech also uses external design partners to provide module solutions for products. These partners can provide patented technologies and specialized skills that would cost too much for Logitech to develop on their own. The downside of this approach is the additional royalties that have to be paid to the design partners, but if partners are able to provide innovative designs that save component cost, then the trade off is much more acceptable.

In order to get the most from their development dollars, Logitech partners with the factories that will be building the products. Many of the more simple products can be designed by the factories, freeing up the local team to focus on more challenging technical issues. This type of model can work well if the factory has the capabilities to complete the design; however, this is not always the case. Often, Logitech will have to invest more engineering resources to help resolve the issues that the factory design teams are not capable of fixing.

4.4 Partnerships with Universities

Logitech has an active relationship with several universities. One key relationship is with the Ecole Polytechnique Fédérale de Lausanne. There is a Logitech innovation center on the campus of this university which serves as a think tank for product innovation. Here is a press release from the opening of the Borel Innovation Center:

> *Lausanne, Switzerland — Sept. 30, 2010 — Logitech today opened the doors of the Daniel Borel Innovation Center, a new working environment that aims to continue the legacy of innovation set by its co-founder in 1981. The new facility is located in the "Quartier de l'Innovation" section of the Ecole Polytechnique Fédérale de Lausanne's (EPFL) campus and marks another important milestone in the special collaboration between the Swiss firm and the university at which Logitech's first mouse offering was conceived.*
>
> *This new site will allow Logitech to take its innovative spirit a step further, within an ideally suited environment to spur innovative thinking. The building design fosters team work and hosts the research and development of next-generation products for personal computing platforms as well as for TV screens in the digital home, smartphones and meeting room screens. Furthermore, the Logitech incubator will continue to best leverage its connections with EPFL, serving as a think tank for product innovation and the creation of new experiences.*

This relationship carries over to internships at all of the Logitech business units. There are currently several interns from EPFL working at the Audio Business unit in Camas, Washington. These interns are working on innovative technology projects for next generation products. An

intern developed the first Logitech smartphone application. Another intern developed an innovative test and measurement system for headsets. Interns are able to work on research projects with a limited scope and a well defined goal. The output of the interns' projects can be very valuable for the company and a good value for research dollars.

4.5 Strategy

Logitech follows a Project Lifecycle Management (PLCM) process. As a part of this process, there are separate roadmaps for technology and products. As much as possible, these roadmaps are followed such that the research of new technology can be complete in time for the development of new products. Sometimes market factors will force the team to jump into a product with unproven technology before it has been thoroughly researched. There will always be a risk of "reactive" products. The executive team carefully considers the risk profile of the portfolio so that the risk can be spread appropriately. The portfolio will always include well known low risk products to develop in addition to the unknown high risk products.

Typically the research done by the Logitech team is more of an implementation of new technology or a combination of existing technology. They look for value generating ideas, not just features. Often the innovation is in an implementation that allows the customer to have a better experience with a product as opposed to an advanced new feature.

There is an open policy around new ideas and innovation. The door is always open to a good idea that could come from any direction. There are two technology fairs a year where the R&D team gets to demonstrate the research that has been ongoing. This is a chance for the sales and marketing teams to see the new technologies and start to consider product applications for this technology.

Another strategy that is followed by the Logitech R&D team is the implementation and use of platforms and modules. Platforms have been used for common blocks of electronics such as amplifiers and signal processing. By reusing these platforms in multiple products, precious R&D time can be saved. Reusable modules have also been developed. A Bluetooth wireless audio module has been developed. This module can be integrated into any standard wired audio system to add a wireless input.

Logitech is always looking for more efficiencies to get the most from each engineer. This is one reason for the factory development that was described above. Ideally, the savings from intelligent investment of R&D dollars can be put towards future looking research and development.

4.6 Structure

The R&D department of the Logitech Audio Business unit is divided up into functional teams. These teams include Electrical Engineering, Acoustic Engineering, Mechanical Engineering, Product Quality Engineering, Project Management and Compliance. The management of each of these groups reports to the VP of Engineering. Additionally, there is one position, the Director of Technology Development, who exclusively works on research of future technology. Each of these functional teams is responsible for product development in addition to research, so there is no dedicated team for developing new ideas.

4.7 Tech Policy

Technology policy and the use of patents has evolved over time for the Logitech Audio Business unit. Initially, patents were used very heavily as a marketing tool to show the world that "we invent things, we're smart people". Then patents were used as an offensive/defensive position to prevent competitors from taking innovations (this is the most common approach). Today, patents are used more as bartering chips. If a competitor calls out Logitech's use of a technology, they can offer other patents as trade and pursue a cross licensing approach outside of court. Due to the costs involved with applying for and maintaining patents, Logitech is very careful and strategic about what they patent. They look for three key qualities in a new technology before patenting:

1. What is the long term value of the patent, how long will it be worthwhile before it becomes obsolete.
2. Is the use of the new technology immediate, obvious and meaningful? Can the technology easily be pointed out and recognized?
3. Is there a financial advantage that can be achieved through the application of the technology?

4.8 Education Level

A high level of education is not critical for an R&D team member at the ABU, but experience in product development is very important. While not many of the engineers have PhD's, most of the engineers are considered "senior" engineers. This approach reflects the strategy of the company. The engineers need to be skilled and experienced in bringing new products to market. This is the focus. Since research of new technology is a secondary activity, the specialized knowledge and skills gained through higher levels of education are not as critical for success.

4.9 Geography and Global Teams

There are several remote teams that are an integral part of R&D for the Logitech Audio Business unit. One of these teams is the Hong Kong based team. This group is primarily focused on interactions with the factories. The ideal concept is to have the Hong Kong team drive all development activities, freeing up the local team to focus on new technologies and platforms to seed into products.

The other main remote team is a software development team in Chennai, India. This team maintains software databases, works on fixing existing bugs, and implementing new features for existing products. This location is ideal because there is readily available engineering talent at a much more affordable cost than the US.

4.10 Conclusions

The Logitech Audio Business Unit uses many of the tools identified by Keizer. They are especially strong in collaborations and partnerships and global teams. There are some areas where we believe improvements could be made.

While there is a good relationship between Logitech and the University system, the Audio Business Unit does not take full advantage of this. They use the interns for small projects, but do not work with any universities to develop cutting edge new technologies. It is possible that by increasing the work done with Universities, more new exclusive technologies could be introduced into Logitech audio products. This concept is backed up by Hall who states, "Partnering between university and industry has been widely viewed as one of the contributors to successful U.S. innovation and growth in the past two decades." [15]

There is certainly a weakness in the structure of Logitech R&D in that there is no dedicated research team. The challenge here is that it is easy for the members of the R&D team to get completely focused on the more visible product development and not invest the required time into research activities. If a team could be structured around the Director of Technology Development, more advanced and meaningful research could take place. This is a challenge with the limited resources available to the R&D department. Just as this paper is being completed, it has been announced internally that Logitech will be creating an "incubator" research group. This group will be responsible for future looking research for applications that are two to three years out. In this way, Logitech hopes to address a weakness in innovation.

There are not many PhD level members of the R&D team. This higher level of education in not necessarily required for the type of R&D that takes place at the ABU, but there could still be advantages to having more highly educated team members. In order to achieve the more advanced research required by the Incubator discussed above, it may be necessary to employ more team members with advanced degrees.

5. Recommendations and Future Research

By using the External Variables and Internal Conditions identified by Keizer et al. as a framework, we can effectively evaluate our case studies. We can see the importance of partnerships, either with other companies, or with Universities. We can also see the challenges surrounding funding and how critical this is to success.

It was interesting to note that in both cases, higher education was not critical. This is due in part to the type of research that takes place at these companies, but it shows that SMEs do not typically prioritize those capabilities. It may also point to the fact that individuals with advanced degrees don't typically choose to work in these environments. It would be an interesting area of future research to see if the lack of PhD's in SMEs is due to the companies or the individuals. In addition, it could be valuable to explore the impact of employee experience, education or motivation to determine if one produces better results than the others.

For the small company case study, a deeper analysis of the funding structure for energy research at utilities could be a valuable study. With energy increasing becoming an area of focus at both

local and national levels, it is a critical time for research, development and ultimately, deployment of new technologies and strategies. It would be valuable to understand the weakens and faults of the current funding structures so that improvements could be made that would allow for stronger R&D efforts.

6. Conclusion

The results of our research show that there are many variables involved in the development and long term survival of a successful SME R&D program. The variables, challenges and opportunities identified in the literature were easily correlated to the real world case study examples, indicating that our proposed framework for analyzing SME R&D efforts is viable. Although both of the case studies dealt with companies that have been successful in managing R&D efforts, the ongoing struggles they face highlight the challenges than accompany the opportunities of managing a small or medium sized R&D program. But if done properly, it can produce a rewarding, exciting and successful program.

7. Acknowledgments

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