Great Expectations: Five Projects That Did Not Have their Predicted Market Transformation Effects

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ABSTRACT

The tale of five market transformation projects that did not result in predicted market impacts. Some were successful projects developing innovative products and services, but for one reason or another did not live up to the initial expectations of market transformation. The paper discusses, contrasts, and compares the following five projects.

1. A semiconductor grade silicon process improvement project resulted in significant energy and non-energy benefits.
2. A compressed air control system monitoring and control system project that resulted in significant savings.
3. A service was developed for the secondary wood products industry to optimize low-pressure conveyance system performance.
4. The development of an innovative magnetic adjustable speed drive was developed to address many of the technological and other barriers of implementing speed control in industrial motor systems.
5. A motor distributor rebate project aimed at promoting Premium Efficient Motors.

Common issues encountered among and risks associated with these diverse industrial projects will be discussed and analyzed. This paper will highlight the lessons learned and make recommendations for developing market transformation projects in the industrial sector.

Introduction

The Northwest Energy Efficiency Alliance (Alliance) was founded in 1997 with a mission to catalyze the Pacific Northwest marketplace to embrace energy efficient products and services through the mechanism of market transformation[1]. The Consortium for Energy Efficiency defines MT as a strategy that promotes the manufacture and purchase of energy-efficient products and services. The goal of this strategy is to induce lasting structural and behavioral changes in the marketplace, resulting in increased adoption of energy-efficient technologies. This vision of a sustained change in the market place is one of the defining features of MT.

The Alliance has a portfolio of MT projects that target the residential, commercial, industrial and agricultural sectors. Over the years about fourteen industrial projects have been funded and achieved varying levels of success. This paper examines five case studies of MT industrial projects that began in 1998 and promoted a variety of innovative products and services. All of these projects were developed through competitive solicitations that the Alliance

[1] The Alliance is a regional organization operating in the states of Idaho, Oregon, Washington and Montana and funded by the region's electric utilities and public benefits organizations.

put out in 1997 and 1998. The main criteria for selection were cost-effectiveness, likelihood of long-term sustainable market change, and level of electricity savings. All of these projects resulted in cost-effective projects at individual plants, but have not yet resulted in the sustained market change that was forecast when the project was initially funded. Each project is described below and common themes and differences between the projects are analyzed.

Case Studies

Case #1: What Happened to the Market*?*

Since the 1980s the Northwest has become one of the national centers for the microelectronics industry and the Portland area has been dubbed the Silicon Forrest. During this time it also attracted many wafer manufacturers that provided the silicon substrates on which the microelectronic chips were etched. In 1997, double-digit annual growth was forecast for the wafer industry. The wafers are cut from a single crystal ingot that is grown in an electric furnace called a hot zone. The production of semiconductor grade crystals is very energy intensive. This market is small and secretive with less than ten major global manufacturers.

The region was also home to one of the largest photovoltaic crystal growers Siemens Solar (now Shell solar). Siemens sought funding to improve the efficiency of its crystal growing process. The market transformation aspect to this project was that Siemens agreed to share the results of its energy efficiency improvements and to license any patentable applications to the semiconductor-grade crystal growers. Siemens Solar was in a position to share its process improvements, as it was not in direct competition with the semiconductor-grade manufacturers.

The Siemens project was quite successful in achieving large improvements in energy efficiency and productivity (Peters and Feldman 2001). Less scrap was produced and other inputs such as argon and the crucible in which the silicon was melted were also reduced. Another project breakthrough was the development of a recharge mechanism that allowed the addition of silicon during the crystal growing process resulting in longer crystals. Engineers from regional semiconductor crystal growers were invited to a presentation of the results, as well allowed to view the manufacturing process. The results were published in trade journals and presented at international conferences.

The impact of sharing the results was difficult to track because the crystal growers that sell into the microelectronics industry are very protective of their proprietary processes. Confidential conversations indicated that some crystal growers felt that many of the improvements had already been known, or adopted by the industry and that the Siemens project had only achieved incremental improvements. One concrete improvement is both existing hot zone manufacturers now offer a recharge mechanism as an option as well as an attachment to their growers to accommodate longer crystals.

The actual impact on the regional industry has become somewhat of a moot point. The regional microelectronics industry did not see the double-digit growth that was initially forecast due to a downturn of the microelectronics industry in 1998, the subsequent national recession in 2001, and the regional energy crisis. This microelectronics sector decline had a major impact on the crystal growing industry that supplied it. What was once a vibrant high-growth industry with five existing and expanding regional plants has virtually vanished. One plant was built but never put into operation; another crystal grower dismantling both of its plants and shipped the equipment to other states and another removed all of its crystal growing equipment. As of today,

only one manufacturing plant remains in the region that actually grows crystals for the microelectronics industry. In this case, most, if any, of the project's benefits will accrue to firms outside the region.

Case #2: Doesn't Everyone Need One?

In 1998, the Alliance helped fund the development of a compressed air (CA) monitoring system targeting CA systems with multiple compressors. The company that developed this system was SAV-AIR, a new start-up. The market transformation hypothesis for this project was that the installation of the monitoring system would make the true cost of CA visible and lead to the optimal and energy efficient operation of CA systems. Monitoring would identify excessive leakage, non-optimal control strategies and also result in many additional non-energy benefits, such as reduced downtime or stable pressure. The Alliance saw the need to develop a CA monitoring system because there were no CA monitoring systems being offered on the market at that time. The Alliance saw SAV-AIR pioneering the market and that its success would lead to the development of competition. The Alliance estimated that there were approximately 800 facilities in the region that had medium sized (avg. 750 HP) multi-compressor systems that would benefit from the application of such a system. The Alliance projected that market penetration would be 25% of the market by 2010.

The SAV-AIR CA monitoring system was developed and modified to include additional control features in response to customer requests. The system was marketed in the region and eventually installed in 13 industrial facilities in the region resulting in six case studies. Energy savings averaging 35% were achieved and in addition many of the installations documented significant non-energy benefits (Scott 2004). The case studies were at plants of well-known multinational firms. The system was very favorably received by the CA operators and resulted in cost-effective energy savings in the plants where it was installed.

As with other industrial projects, the national recession and regional energy crisis also took its toll on this project. For a fledgling company such as SAV-AIR, the effects of such a recession can be quite damaging. The cost of a SAV-AIR CA system involved capital expenditures and, more often than not, required additional capital upgrades to optimize the system. With the recession capital budgets of many regional manufacturing plants were reduced or frozen and the increased energy costs from the 2001 energy crisis tended to absorb much of the remaining available capital for investment. This caused a lengthening of the sales cycle for any equipment that required capital expenditures.

Being a small start-up company, SAV-AIR needed to use scarce resources to develop the sales and marketing infrastructure. Selling a new and unproved technology to a risk-averse market also requires a much more time compared to a known and trusted technology. With the poor economic conditions, the lengthening of the sales cycle negatively impacted the new company and strained its limited resources. The merger of a major customer that had taken significant resources to land with another wood products firm also put a damper on sales. All of these factors combined with selling into a skeptical, highly competitive market is a daunting market barrier even in the healthiest economic environments. The more sophisticated SAV-AIR monitoring and control system has not yet achieved the sales growth that was initially envisioned. In response to competitive pressures and to meet customer needs the company widened its product offering and developed a sequencer and a lead-lag controller.

Other competing products to SAV-AIR were identified but they are not currently offered in the region. These competing firms have also encountered difficulties in selling more complex monitoring and control systems to the industry. This shows that SAV-AIR's troubles on this front are not out of the ordinary. The market has become highly competitive with competing CA vendors now offering systems based on simpler technology, such as sequencers. Compressor controls have improved over time so that many simpler systems may have many of the features that the more sophisticated system SAV-AIR has. This technological change has not been driven by the project but by innovation by the industry. Economic environment, technological change, lack of existing sales channels, competing products, and unexpectedly long sales cycle all appear to be factors that have stymied the adoption and market penetration of the more complex CA monitoring and control systems like SAV-AIR.

Case 3#: Market Demand or Other People's Money?

In 1999, the Alliance funded an initiative called Just Enough Air (JEA) whose objective was to increase the energy efficiency of industrial low-pressure pneumatic conveying systems (PCS), with an initial focus on the secondary wood products industry. The market transformation story with this project was that regional service providers would be recruited and trained to offer fan speed reduction services through resheaving of fan pulleys. Case studies of projects were also to be funded and used to market and promote these services through the region. JEA also had specially configured ASDs made for the participating service providers as a sales tool that would be temporarily installed to convince end-users that fan speeds could be slowed without reducing PCS performance. The marketing of the success stories would result in the overall acceptance of the service by the market.

Initially, JEA proposed to train only four service providers[2] but eventually trained eleven. Early in the project, the scope of the project also widened to include the optimization of whole systems. Actual projects where fan speeds could be reduced turned out to be quite scarce. The development of projects went slower than expected but by extending the schedule, nine of the ten proposed case studies were completed. However, only four of the case studies focused on fan speed reduction services. These came from a pool of 37 facilities at which PCS evaluations were performed. The average project savings were nearly 200,000 kWh, representing a 35% reduction in system energy use, though many had paybacks of over 3 years. The project also developed a "Best Practices Manual". Almost all of the service providers were highly satisfied with the project and continue to offer it. However, of the 28 projects that were offered after the project ended, nearly 90% were completed using utility incentives (Currents Consulting 2004).

JEA operated during national recession and a regional energy crisis. It also focused on the secondary wood products market that had been contracting over the past two decades. Both of these economic trends do not bode well for growth of most types of product and service offerings. Though JEA did eventually meet its targets of trainings and result in case studies it did so only by extending the schedule and expanding the scope of the project. The scope of the project was expanded, as the initial fan- speed reduction service was not viewed as having a sufficient market to support this service offering. Even expansion into whole system optimization can be viewed as one of the many services an engineering design firm can offer. As stated above the fact that only one out of ten projects offered since the program has ended is not

[2] In addition to the two that were part of the PCS team.

receiving utility incentive dollars is indicative a sustained market for these services without incentive dollars has yet to be developed.

Case #4: Too Late to the Market?

In 1999, the Alliance funded the development of an innovative magnetic adjustable speed drive (ASD). The MagnaDrive ASD was viewed as targeting large horsepower medium voltage motors and other applications that had been neglected by electronic variable frequency drives (VFDs). The target market for the MagnaDrive was viewed as motors that would typically never receive an ASD. The introduction of the MagnaDrive was viewed as a method for spurring on the regional and national speed control market and increasing the penetration of ASDs in all industrial applications. The Alliance's market hypothesis is that competition from MagnaDrive would propel the market to address some of the issues surrounding ASDS such as harmonics, price, and application to the older existing motors base. The Alliance initially projected that MagnaDrive would expand the market for speed control and eventually capture over 20% of the market by 2010.

Funding came after MagnaDrive was founded for the specific purpose of commercializing the MagnaDrive ASD and associated technologies. The ASD received extensive laboratory testing and the final results showed that significant savings could be achieved though somewhat less than an electronic drive. After the testing and a number of on-site installations the MagnaDrive was redesigned. The project also funded the development of a number of case studies. All of the installations where the MagnaDrive was installed achieved cost-effective energy savings and in many cases the non-energy benefits were significant in reducing maintenance costs or even downsizing motors. The customers also were highly satisfied with the product (Quantec 2003). MagnaDrive continued to expand its line of drives (ASDs for 10-1500 HP motors are currently available) and expanded its national sales network. Sales have continued to expand but not at the rate that have lead to a market response from the incumbent drive manufacturers. To widen its product line, MagnaDrive also offers a set of magnetic couplings that have no significant energy savings but many of the same non-energy benefits that the ASD has.

The national recession and the energy crisis in 2001 reduced capital expenditures and had drastic impacts on the overall drive industry. MagnaDrive weathered these forces and has experienced sustained growth though not to a level to reach the initial projections. Also, the speed control market has also changed over the past eight years. VFDs have been drastically improved over this period of time and in many size ranges have become a commodity product. Improved electronics have made significantly reduced harmonics in VFDs, improved and rationalized interfaces have improved the ease of installing and commissioning many VFDs. Competition between drive manufactures has reduced prices significantly and most of the large drive manufacturers have expanded their product lines into the larger motor and medium voltage markets. These trends, through sought by the Alliance's project, have come about with extraneous market trends.

The market for MagnaDrive is still quite large as their application can be applied to the installed base of motors many of which cannot be retrofitted with VFDs. There are also many other niche applications that the MagnaDrive ASD has a competitive advantage with its many non-energy benefits where the market for speed control can be expanded. As the MagnaDrive

ASD is still being produced and actively marketed it is still be too early to say what market impacts the technology will eventually have.

Case #5: Don't You Make the Decisions Around Here?

The Premium Efficiency Motors (PEM) Program, which began in early 1997, was a regional effort to "increase the quantity of energy efficient motors purchased and used in the region by commercial and industrial facilities by increasing awareness and product availability through dealer incentives, educational tools, support of consistent national motors standards and motor testing." The market transformation hypothesis was that one of the major barriers to the wider market penetration of PEMs was that dealers did not stock the PEMs in sufficient quantities. It was thought that when a motor failed it would typically be replaced out of the dealer's existing inventory of standard efficiency motors, so as to reduce downtime. By increasing the number dealers that had PEMs in inventory, and the number of PEMs available, the decision to purchase a PEM would be facilitated and the market penetration of PEMs would increase.

The primary activities were marketing and explaining the program's dealer incentives for sales of motors meeting minimum efficiency levels. The program also offered dealer and customer training and motor testing, but there were only a handful of formal training sessions and less than ten motors were tested. By the end of the program, 68 dealers had signed participation agreements, and 31 of these received total incentives of $42,923 on 941 motors (Pacific Energy Associates 1998). This represented about 4% of the market.

This project had minimal if any impact on the market. Active dealer participation in promoting efficient motors was lacking in this program. Market research found that the little changed in the regions baseline market penetration rate for efficient motors (12%). Even with a fairly high incentive (18% of cost) only a small number of dealers participated and only a third of those that participated actually received an incentive. Also the incentive that was supposed to reward the dealer was primarily passed on to the customer. The market research indicated that the dealer was not active in making a sale or specifying equipment. Interviews with dealers indicated that that what they stocked did not determine what they sold as access to and shipping time of efficient motors was not deemed a problem. Thus, the market appeared to have shifted since the project was planned, as large extensive inventories were no longer required to ensure motor availability.

This project was terminated in 1998 and replaced by another project that promoted energy efficient motor management. PEMs were promoted as part of making an informed motor purchase decision. The development of the "NEMA Premium" motor brand during this time helped continue to communicate the PEM marketing message.

Project Comparisons and Lessons Learned

Significant Customer Benefits Are Not Enough

One of the common features of all of these projects resulted in cost-effective electricity savings, and in many cases very significant energy savings. Their customers and vendors received the products and services that were developed and marketed very positively. Three of the products also had significant non-energy benefits or features that made them attractive to the

customers. It is clear that significant energy and non-energy benefits are not sufficient to drive the market transformation process and increase market penetration.

There are many potential reasons for why benefits are not resonating with customers. It may be that products and services are not addressing the customers' true needs or connecting with the customers' current set of priorities. Lack of interest may be because new technologies are associated with risk, as they have not been proven. New products from startup companies increase this perceived risk as they have a greater tendency to go bankrupt and they do not have a proven track record for product support. The results of targeted market research should help to adapting MT products and services to further address the customers needs.

Regional and National Economic Conditions Can Ruin the Best Laid Plans

All but one of the projects were launched in 1998/1999 and implemented during the national recession that began in 2001 as well as the regional energy crisis that resulted in spiraling electricity costs. A national recession combined with high energy costs will impact projects that require significant funds as capital expenditure budgets tend to be reduced and higher variable costs will cut into any remaining available capital. Products promoted by four of the projects did require such capital expenditures. Ironically, rising energy costs alone might normally have increased the demand for these products and services but in combination with a recession the investment funds were not available.

A recession combined with an energy crisis can accelerate existing industrial trends such as consolidation, off-shoring, or plant closures. The region experienced the almost complete disappearance of the aluminum industry that had at one point represented nearly 25% of national production. The wood products industry saw many plant shut downs and closures and the regional pulp and paper (P&P) industry saw 6% of its capacity evaporate and many mills idled for a time. The regional microelectronics industry saw a virtual halt to the growth and expansion of plants. Many other industries that supplied these industries were also severely affected. Also, mergers between market players typically put many capital projects on hold often indefinitely as the new company decided on how to combine its current operations.

These events would typically not have a dire impact on a larger diversified company but many of the projects involved smaller start-up companies where the loss of a major customer, cutbacks in plant expenditures leading to slower anticipated sales will be major hurdle to sustained success. Also in the case of the crystal growing project global economic trends led to the decline of the semiconductor crystal growing market in the Pacific Northwest. The Alliance practice of adaptive management allows the projects to have the flexibility to adjust to the unforeseen market conditions. Also the use of a sound business plan with proper financial resources will help the firms offering the products overcome poor economic conditions and events outside of their control.

Forecasting Market and Technological Change Is Difficult

As the saying goes "forecasting is difficult, especially about the future" and the project planning process unfortunately requires the Alliance to project future market conditions. As stated above the poor economic conditions and energy helped accelerate many market trends. Even in the economic growth years of the 90s the regional wood products market saw over half of its mills disappear. In the microelectronics and P&P industries the major areas of growth have

not been in the PNW. In the case of microelectronics most of the new growth has occurred in China, and this has been a recent trend. For P&P market the no growth trend has been apparent for a long time with most of the new national production occurring in the South East.

The Alliance in its planning process does try to incorporate existing long-term trends but cannot capture large unexpected events such as the closing of the crystal growing plants or an accelerated consolidation of the P&P industry as a result of higher electric prices and a poor national market. These unforeseen events have had large impacts on the many of its projects. The Alliance has managed the risks associated with these events by having a portfolio of projects that target a wide range of industries. The Alliance also uses adaptive management keep the project implementation flexible and to adapt to the current market conditions.

Technological change has also impacted many of the Alliance's projects in many cases limiting the demand for the products and services and as a result the scope of their market effects. In the case of MagnaDrive the VFD manufactures were in the process of improving their products to address many of the issues that MagnaDrive was geared to address. Also the competition in the industry especially in the lower horsepower drive ranges caused a rapid decline in prices that slowly impacted larger drives prices and features. Though this trend was apparent the speed at which it was taking place was not. The same can be said of improvements to compressed air systems controls that have rapidly advanced allowing for an expansion of the availability of control in CA systems.

One of MT's goals is to remove market barriers to facilitate technological change. The market may also be trying to remove those barriers. This fact should not be ignored and is an opportunity to leverage to transform a market.

MT Intervention Takes Time

The five MT projects have not as yet met their goal of sustained market penetration. The products and services developed through four of the projects are still offered in the market. The one exception is the PEM program that has been made redundant with the advent of the broad availability and marketing of "NEMA Premium" motors. SAV-AIR and MagnaDrive continue to offer their products and services throughout the region. Also, as mentioned above, the PCS services have been used in almost 30 regional projects and the two major hot zone manufacturers have adopted recharge mechanisms.

In many cases the Alliance may have been overly optimistic in its forecast market of initial adoption rates. The development and introduction of a new producer good or service may require many years of ongoing development and marketing before gaining a foothold in the market. Studies of the diffusion of innovation indicate that the introduction of new technologies is a long-term process especially for industrial processes with a time period of 10 to 20 years not being exceptional (Luiten 2001 and Nasbeth and Ray 1974). Therefore, it may still be too early to declare that these projects will not transform the market. The fact that the products and services are still being offered gives one hope that this may yet come true.

Adaptive Management Is a Key to Survival

All of the projects had significant changes over time.

- The SAV-AIR system was initially only a monitoring system and controls were added as well as additional less sophisticated controls to meet customer needs and competitive pressures.
- JEA was initially focused on speed reduction but added system optimization to its set of services to promote.
- MagnaDrive added magnetic couplings to its product offering.
- The Siemens project widened its initial scope to develop a recharge mechanism
- The PEM project was terminated and one focused on motor management was developed to take its place.

These changes came in response to customer feedback, competitive pressures and the need to widen the offerings of the company or initiative. The termination of a project is also part of adaptive management as was the case of the PEM project. There have also been major changes in the funding levels and schedules of the projects. Without the ability to make these changes the relative viability of some of the projects and the level of their sustained market would have been impaired.

Conclusion

Having detailed market research, good business plans, competent staff, and a well-designed product and service that addresses customer needs will go a long way in helping commercialize a product and help it penetrate the market. Products and services are continuously being introduced to the market and many are never adopted. Some products fail completely due to inherent design flaws or failure to meet market needs while others may be withdrawn because they do not meet a firm's return on investment or they are outside the firms core business. Introduction of new products and services should be considered a very risky business, even with an innovative technology that addresses many customer needs. Even the most careful market research will not provide information on unexpected market events or acceleration of trends.

What can be expected is that many new product and service offerings will fail for a variety of reasons, many outside the control of the project. To reduce the risk a project should develop contingency plans for some of the common effects associated with these factors. The most common is the lengthening of the product commercialization cycle. Having available bridge funding and managing expectations of managers, partners, and investors will be crucial to a project. Also useful in managing the risk of new product and service development is to spread the risk and have a portfolio of industrial product and service projects. Another way to manage risk is allow a project to adapt to changes in the market be they technological, competitive, or economic. The ability to change is one of the factors that has helped many products and services to maintain their presence in the market.

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