Small Manufacturing Companies are Still Viable Industry Partners

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Abstract **- The prolonged recession has forced many small businesses to abandon long-established market positions. Financial turmoil has become status quo. Small business owners are especially distressed as weighty economic issues fall on the shoulders of single owners or a handful of partners. Are these small companies still viable as university project sponsors and collaborators?**

This article describes the circumstances of small manufacturing companies as they face two major tasks that simultaneously demand exorbitant amounts of time and resources. The primary task, maintaining the existing customer base, is hampered by the urgent need to re-invent the business. The authors suggest that small businesses and engineering universities can enjoy mutual benefits by partnering to overcome these challenges. The small business gains much needed technically-savvy support which has the flexibility to be deployed on current customer issues or on the search for new opportunities. The university gains insight into engineering and business practices which are mostly invisible with large company partners. For universities that offer cooperative education programs, placing students with small businesses can lead to once-in-a-lifetime experiences. A university can expect to encounter a highly volatile business environment, but this environment is rich with opportunities to explore entrepreneurship, invention and innovation.

Index Terms – business, entrepreneurship, industry partner, market.

BACKGROUND: PLIGHT OF THE SMALL BUSINESS OWNER

The prolonged economic recession has taken a toll on small businesses in the United States. According to the Small Business Administration's report to the President of the United States, in the first three quarters of 2008 the United States lost 1,695,000 jobs, of which 60 percent were in small businesses [1]. Furthermore, of prime importance to the engineering community, two of the hardest hit industries were in the goods-producing sector, as construction and manufacturing lost roughly half of the overall total number of jobs lost in the economy during 2008 [1].

Companies that manufacture automobile components have been particularly hard hit. The data suggests overall employment in manufacturing decreased by more than 6% in 2008 alone. Times have changed for the numerous small businesses that were established during the good times. In the heyday of automobile manufacturing, an entrepreneur with the right expertise, product, or service could venture into the parts supply business with a reasonable expectation of success. Many of these entrepreneurs were former machinists, engineers, or technicians, not necessarily trained in business acumen, but willing to bear down and learn as they built their businesses from the ground up. The "gold standard" of success was a purchase order from one of the domestic "Big Three" automakers; Ford, Chrysler or General Motors.

As the economic recession continued and worsened in 2009, the country witnessed the economic meltdown of the automobile industry, including the previously unthinkable bankruptcy of General Motors and the sale of Chrysler Automotive [2]. Even the well-known moniker, big-three, (in reference to Ford, GM and Chrysler) has changed to become the "Detroit-three". It has been argued that the path to bankruptcy was inevitable [3], but even as late as 2007, the small business owner could not anticipate how quickly the end would come, and how rapidly assembly plants would drastically reduce operations. The small business owner faced immediate losses in sales, excess inventories and unpaid invoices.

Federal and state government agencies offer some relief as the small business owner faces tough times. An example of a federal program is the US Small Business Administration, which offers on-line training called "*How to Survive in a Slow Economy*" [4]. On the state level, an example is Michigan Economic Development Corporation (MEDC), which offers programs to start diversification of a small businesses' product portfolio [5]. To take advantage of such programs, it is incumbent upon the small business owner to investigate the value to their business, establish dialog with the relevant government agency, dedicate resources to fulfill the requirements of the program and follow through to achieve return on the investment of resources.

The difficult circumstances of the small business owner raise questions whether engineering colleges should assist or avoid the small business environment. Is it wise to get involved with these businesses as they struggle to survive and turn their companies in new directions? Collectively, small businesses can represent a large potential market, but as individual businesses, is it worth the effort, or perhaps it's too late? Are small businesses simply too small, too fragile,

and too beleaguered to warrant any attention from the academic community?

RESEARCH METHOD TO INVESTIGATE THE VIABILITY OF THE SMALL BUSINESS PARTNERSHIP

The authors set out to examine the situation of the typical small business owner and to determine if there is some role for an engineering college in the effort to turn a small business around. The approach was to study two small businesses in-depth, to determine the viability and nature of any relationship with the authors' university.

First it may be useful to consider the definition of the term "small business." The US Small Business Administration defines a small business in the manufacturing sector as any manufacturer with less than 500 employees. While a 500 person organization is small compared to a Fortune 500 company, that organization is likely to have at least a few people solely dedicated to functions such as marketing and sales, accounting and finance. There are a great many manufacturing companies employing only 10- 100 people, which the researchers define as small manufacturers. The owner(s) of a manufacturing company of this size tend to take on the roles of marketing, sales and finance simply because they don't have dedicated resources to allocate to those jobs.

Prior to approaching the subject companies, the authors hypothesized that the small business owner would most benefit from engineering support in the effort to diversify their product portfolio. In advance, the authors established a method for assessing current products and markets. The document would be used as talking points with the owners.

A senior engineering student was selected to develop the assessment method. The selected student had prior work experience through the university's co-op program, and was familiar with the automotive industry. The co-op experience was invaluable as the student's perspective on work assignments helped shape the outcome of the research.

To understand the government's approach to business diversification, the MEDC was contacted to determine the state's offerings and to get their perspective on the small business situation. MEDC offers a business diversification seminar, which is free to small business owners. The authors attended one such session to learn the process. MEDC also provided a list of small businesses that had attended business turnaround seminars. The list identified businesses that had limited (or none) contact with MEDC following the seminar. The authors selected two companies from the list of companies and approached them for in-depth investigation.

Two companies agreed to cooperate. Their products were assessed and their facilities were visited. The authors attempted to assemble a diversification research package to help the business owners explore potential new opportunities. Upon completion of the assessment, site visits and subsequent follow up, the authors drew conclusion regarding the nature of potential relationships with small businesses.

PRODUCT PORTFOLIO CHARTING IS A USEFUL EXERCISE FOR STUDENTS

A somewhat unexpected pedagogical outcome was the student learning experience gained as the student created a product portfolio map.

The authors had not intentionally designed a new learning experience. The goal was to search for a new, breakthrough market and/or product that small businesses could benefit from. The purpose of charting was only to become familiar with the small business' product offerings before meeting with the owners. The approach was modeled after the "blue ocean" strategy, in which new, uninhabited markets are sought where there are few competitors [6]. It was hypothesized that from a university perspective, unencumbered by the history of the business, a new uncharted territory could be identified. The student was assigned the task of entering data in a "strategy canvas", as described in the Harvard Business Review [7]. The goal was to create a visual representation of the company's capabilities and compare it to potential applications in other diverse industries. The process is described as follows. Figure 1 illustrates one component of the strategy canvas. This is the visual representation of the function of a product.

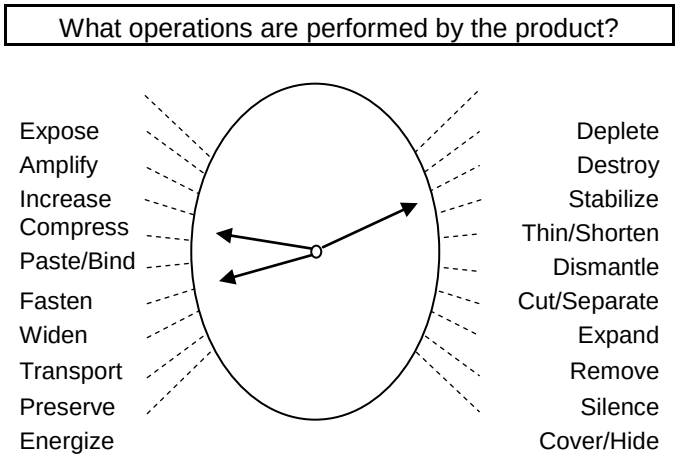

FIGURE 1
VISUAL REPRESENTATION PRODUCT FUNCTION.

For illustrative purposes, consider the example of a threaded fastener. The arrows represent the functions of the product, which is to FASTEN two components together. The product is also capable of COMPRESSING a joint and it can be used to STABILIZE an assembly. These fundamental functions of the product are applicable for many uses. In addition to product function, the set of visual maps addressed the following questions:

- What operations are performed by the product?
- What type of motion is the product capable of?
- How does the product make states change?
- Does the product affect time or sequence?
- Does the product cause changes in order?
- How does the product transform energy?

The complete set of visual representations can be used to search for similar applications in other industries. For example, if an application for fastening was needed in a aerospace application, a set of visual maps could be made for the proposed application. By visually comparing capability maps with product maps, a potential blue ocean destination may be discovered.

The exercise of completing the visual maps proved to be a valuable experience for the student. It required that the student carefully study the products offered by the business and scan whatever data was available from the company marketing and sales brochures and/or web sites. The on-line Thomas Register was another useful resource for building the strategy canvas. With only the aforementioned data, the student was able to come up with some remarkable conclusions about the sizes and type of manufacturing equipment available, the capabilities of the company's technical staff and the potential for producing similar products. The student came up with an improvement to the strategy canvas by creating an additional visual map which was termed the "Design Engineering Wheel". It portrayed the capabilities of the companies based on limited available data. Later in the process, the accuracy of the student's work was verified during on-site visits to the companies.

The exercise was a valuable learning tool as it reinforced the connection between manufacturing capability, product offering and business opportunity. The student gained an appreciation for the difficult task of balancing company resources with product offerings. In essence, by searching for small business partners, students can gain valuable learning experiences. The results of the student's work has been summarized and submitted in a student paper to the ASEE North Central conference [8].

SMALL BUSINESSES STRUGGLE TO MAINTAIN CURRENT CUSTOMERS

The investigation found that business owners face two major tasks that simultaneously demand their full attention. They must tend to their current customer base (or whatever is left of it), but also find new customers, modify product offerings and investigate new markets. The following paragraphs explore the potential for strategic partnership in the endeavor to maintain business.

The owner's highest priority is to maintain existing business, thus preserving a cash flow pipeline. Cash flow is the life blood of all business, but it is especially crucial to the small business owner that does not have large fiscal reserves or capital assets to leverage. Operating a business in a turbulent economy is much like navigating a ship through violent seas, the business owner cannot predict where or when the next wave will hit, or whether the storm will subside and permit operations at full speed ahead. The business owner is daily faced with new operating paradigms.

This was the case for the two businesses studied. Tending to their "normal" customers was anything but normal, especially in terms of cash flow and inventory turns. In the past, a common business practice was to use a purchase order as collateral for a "bridge loan". The business owner could rely on a local banker to cover payroll and raw material expenses while the small business ran their operation and delivered products. The loan was repaid promptly upon receipt of payment from the customer. This practice has changed dramatically. As foreclosures and bankruptcies swept the country, the availability of bridge loans became scarce. Due to the tightening credit situation, net borrowing by the overall business sector declined to an average of $695 billion in the first two quarters of 2008, to $451 billion, and then to $185 billion in the fourth quarter. That compares to $1.2 trillion in 2007 [1]. To make matters worse, large businesses face their own cash flow problems and subsequently delay payments for services rendered. In the past, typical payment terms were "net 30", which meant invoices would be paid in full within 30 days after delivery of products. Large companies now stretch payments well beyond 30 days, to as much as 60 days, 90 days, or in some cases, unlimited days past due. The cash flow squeeze has forced the small business owner to scramble to make payroll and in some circumstances resort to personal finances to purchase raw materials. In extreme cases, owners sometimes rely on "hand shake" promises. The financial health and ultimate survival of the business demands the owner's full attention.

While the cash flow situation was swinging wildly, the manufacturing production schedule became chaotic. Inventory turns become difficult to predict. Customer orders followed market demands. Special programs such as the US government CARS program (also commonly known as "Cash for Clunkers") caused a rapid increase in demand for parts. From July to November of 2009, total new vehicles sold or leased under the CARS program included 401,274 passenger cars, 274,602 light trucks and 1,966 heavy trucks [9]. Small business owners struggled to fill the surge in orders, while simultaneously managing cash flow situations. Table 1 shows the trends in vehicle sales in 2009.

TABLE 1
MONTHLY SEASONALLY ADJUSTED VEHICLE SALES VOLUMES [9]
(MILLIONS OF VEHICLES)

	2008	2009	Change
May	15.0	9.9	-34 %
June	13.1	9.5	-27 %
July	12.8	11.1	-13 %
August	13.9	13.7	-1 %
September	12.2	9.5	-22 %
October	10.9	11.2	+3 %

The table shows the dramatic drop in demand for product compared to May – June of 2008. It also show a substantial jump in sales in August 2009. For the small business owner, trying to manage material flow has become nearly unpredictable. In a stable market, a good business practice is to minimize inventories of raw and finished goods, only procuring and processing materials for which there are orders. But in uncertain times, owners cannot be certain that

their raw material supplier will still be in business or that an alternative supplier is available if needed. Owners struggle to maintain their supply sources. In one circumstance, an owner had established a good reputation for prompt delivery by stocking significant quantities of specialty finished goods for their best customer. The owner stocked up on finished goods, in the event the raw material suppliers disappeared. Unfortunately, that stock of finished goods has now become a financial liability because the target customer has declared bankruptcy. Production scheduling has become a nightmare.

In a small business, it is typical that the owners are performing many duties, acting as financial officers, technical experts and production managers as the situation arises. This is not a problem when the business is repetitive and predictable. For the two case studies of this report, the owners were in a frenzied situation, forced to react to the most urgent issues of the day.

Engineering colleges can become strategic partners in the battle for corporate survival. In many cases, the required expertise already exists within an engineering college. Cash flow, inventory turns and material supply are all relevant subject matters for engineering entrepreneurship. Many engineering colleges are adopting minors or master's programs in entrepreneurship. The turbulent economic conditions validate the need for this training. Engineers must be prepared to innovate new products, launch new ventures and help their companies survive the new business climate. Inventory turns are the subject of well established disciplines of lean manufacturing and six sigma methodologies, now a staple of typical manufacturing disciplines. Material supply may be addressed by the finding alternative materials or by developing new composites.

As the small business owners struggle with these topics, engineering colleges can offer technical support in the many ways. Cash flow stabilization could be an excellent master's thesis for an entrepreneurial student. A seminar in lean manufacturing could be offered to local companies. A collaborative search for alternative materials could be an excellent capstone project. These activities could be beneficial to the business owner and excellent learning activities for engineering students. It must be understood that the small business owner is in a daily battle for survival. Whatever programs offered, they must minimize the strain on the individual small business resources. Time and funds are in very short supply.

SMALL BUSINESSES STRUGGLE TO DEVELOP NEW SOURCES OF REVENUE

The chaotic situation of "normal" business is a major challenge for the business owner, but the business owner also recognizes that sales volumes will never be what they once were. They know they cannot sustain their business if they do not diversify their customer base and broaden their product offerings. This means that in addition to the burden of keeping up with changes in the business they once knew, they now have to learn the processes, protocols and politics of a new market, or offer a new product, or perform services in an unfamiliar arena. Companies that were primarily automotive focused are now looking elsewhere for new sources of customers and badly needed cash flow revenue.

The search for new markets was on the minds of the two businesses studied. Both owners conveyed their understanding that the switch to new markets is no small undertaking. First, the business owner must identify potential customers that may be interested in their products or services. Next, they need to learn the requirements to compete in the supply base. Finally they need a business plan and strategy to bridge the chasm between them and any new venture. These companies turned to the MEDC for advice and help.

The MEDC offers a one day seminar to help small businesses get started in the search for alternative markets. They also offer a list of training programs that are available from for-profit consultants. Unfortunately, due to limited time and resources, the for-profit programs were not an option for the case studied companies. MEDC provided the following map shown in figure 2 as the starting point. The map shows MEDC's suggestion of four major new markets for investigation; 1) aerospace, 2) government (including defense), 3) medical and 4) energy markets. As the map indicates, the four alternatives seem mutually exclusive. The small business owner has to consider them individually. Using the case study companies as reference, the authors investigated the four alternatives.

Aerospace products were well suited as potential product offerings by the two companies. It was easy to envision how the capabilities of an automotive parts supplier could be applied to the manufacture of aerospace products. In some ccircumstances, tighter tolerances may be required, but still achievable without major capital investments. Unfortunately, the automotive business is structured on volumes which are not typical in aerospace. Aerospace manufacturing business is based on short-run, low volume builds. Major changes to the small business operation would be required to enter the aerospace manufacturing business. With financial credit already tight, it seemed unlikely that venture capital could be found to finance any changes.

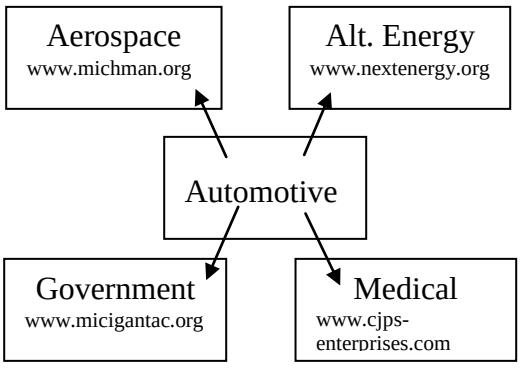

FIGURE 2
ALTERNATIVE INDUSTRIES SUGGESTED BY MEDC.

Government projects such as homeland security and national defense appeared to offer promising projects. The state government offers help through a non-profit organization called Program Technical Assistance Centers (PTAC). The authors visited the local PTAC and found it to be very helpful. The center helps match business with program by profiling the business offerings and identifying potential contracts. But that is only the beginning of the process to land a government contract. To qualify for, quote on and successfully land one of these contracts, a daunting set of guidelines, applications, and qualifications must be read, understood, applied for and satisfied. In addition, a virtual deluge of program announcements are available. Sifting, sorting prioritizing and pursuing the right project is a time consuming task. One of the subject companies was actively pursing this route. The other company was overwhelmed by the process.

Medical devices appeared to be promising as potential product offerings. Although the subject companies were capable of manufacturing such devices, the required degree of process control, documentation and certification would be problematic.

Alternative energy is the fourth potential business field suggested by MEDC. The fledgling alternative energy companies are often in start-up mode themselves. For an established company to pursue an alternative energy start-up, a business risk assessment would seem in order. Counting on a new venture to shore up cash flow did not seem advisable.

With the exception of alternative energy, these markets are not the much sought after "blue oceans". In fact, quite the opposite is true. The market segment was already filled with entrenched competitors, in a very bloody red ocean. As an experiment, the authors attempted to contact the purchasing managers of several potential customers. Based on the very terse responses, it was obvious that breaking in as a new supplier would be a formidable task that would require very knowledgeable and skilled sales staff.

Despite the discouraging findings, there are numerous opportunities for engineering colleges to support the diversification efforts of small businesses. In every scenario, a daunting amount of research is required to attempt entry into the new market. The business owner, swamped by daily tasks, cannot manage this formidable work. In many case, the owner is not trained or skilled in research. University students are well versed in research. The typical student has grown up with on-line databases and search engines. The student's skills can be put to use by dredging through data, sorting relevant works, and identifying pertinent next steps. Linking this type of work to a real-life, practical application can lead to learning outcomes not achievable in the classroom alone [10] – [11].

SMALL BUSINESSES PRESENT UNIQUE CHALLENGES FOR THE PARTNERSHIP

Small businesses present unique challenges to a partnership with an engineering college. Unlike the giant Fortune 500 corporations, a small business cannot afford to maintain and fund internal research programs. The resources of a small business are very limited. The owner's time is precious. As described earlier in this article, the struggle to sustain current business demands exorbitant amounts of time. Erratic cash flow forces owners to conserve on financial reserves. The small business owner can only afford one or two tiny projects at a time and return on investment must be certain. Large scale and broad scope projects are simply beyond the means of these companies.

If a research project is attempted, the compensation rates cannot compare to the large corporations. Top talent will be drawn away by the lure of more lucrative endeavors. Finally, academic administrators are quick to point out that it takes just as much time and effort to manage a small contract as is does to execute a much larger project with a big company. In essence, from a purely business perspective, the small company offers far less financial return for the university's investment.

Despite these challenges, the pedagogical benefits can be well worth the effort.

SMALL BUSINESSES CAN BENEFIT FROM A PARTNERSHIP

The partnership between a university and a small business can be mutually beneficial. From the business owner's perspective, the college may offer unique resources that the small business owner cannot find elsewhere.

As described earlier, the business owner must be a flexible resource for the company, ready to take on the most urgent task at hand. When it comes to special projects in which temporary personnel are needed, the business owner would like to have people that are flexible enough to be technically adept on the shop floor when production demands peak, yet academically savvy when production is down and new business is afoot. Engineering co-op students offer this kind of flexibility. This is an advantage for the university compared to a for-profit consultant service. For example, during the course of this investigation of alternative, one of the small businesses received an unexpected order for product. The student could have suspended the data search and moved to the shop floor to run a grinding operation.

Engineering student research offers technical sophistication at affordable rates. For example, companies that wish to pursue government projects will face a deluge of information as described earlier. Engineering students are accustomed to dealing with fast paced, information packed courses. They are well suited to the tasks of reading, comprehending, sorting and prioritizing data. For example, one of the subject companies was evaluating the potential to bid on a government posting. The owner was unable to concentrate on the posting as the rigors of daily operations were constant distractions.

In the search for new markets and blue oceans, a great deal of time is required to find even a few possible leads and additional time is needed to qualify the sales potential of any one lead. Once again, the engineering student is a good

candidate for this task. One question arises whether a student could accomplish the task without having experience with the small business. As a test, our student attempted to find potential customers for our subject businesses. Armed with only cursory knowledge of the subject companies and using the starting points suggested by MDC, he was able to generate a list of several potential customers. The list was reviewed with the business owners. The owners were impressed, because on the list were some current customers which had not been revealed to the student beforehand.

The university can benefit the small business by acting as conduit for government funded initiatives. Most universities are accustomed to government policies and procedures regarding grants and scholarship. They can help the small business owner through the red tape and help manage funding after a reward is received. Universities also staff grant and foundation interface offices which can help identify potential sources of funding for special projects.

UNIVERSITIES CAN BENEFIT FROM A PARTNERSHIP

The partnership between a university and a small business can be mutually beneficial. From the university financial perspective, the small business is not nearly as attractive as the large corporation with deep financial resources. But from a pedagogical perspective, the small business offers unique learning experiences that are invaluable to students (and faculty). This comes with a word of caution, as Walsh appropriately emphasizes, the partnership must be managed carefully on the university side [11].

Walsh also describes the benefits industry partnership: "*First, it enhances the curricular objectives of the college and satisfies the learning outcomes required of our students. Second, it provides a mechanism to underwrite educational costs by delivering value to industrial partners, a vital college constituent group. Third, it provides a vehicle to bridge the void between our professors and their colleagues in industry, providing common ground for communication and a vehicle to professional development*" [11].

For a small business scenario, the second point of underwriting educational costs may not be valid in all circumstances, but the first and third points are right on target. The first point, enhancing learning outcomes is very evident. Direct involvement in the strategy map of a company is perhaps a once-in-a-career experience for a student engineer. If the student eventually works for a large company, they may never again have the opportunity to participate in strategic planning. The third point, providing common ground for faculty and industry, is inevitable. Small businesses inherently focus on immediate needs. They do not have time or resources to speculate, hypothesize or experiment. They bring a sense of urgency to every situation. Waste and inefficiency simply cannot be sustained, or the company will soon cease to exist. This is a valuable "reality check" for academicians.

The small business partnership greatly emphasizes the importance of communications skills [12]. Students quickly learn that the business is counting on them to read, comprehend and report information. In a small business, the student will witness the effects of communications, good and bad, as the resulting effects are typically obvious and immediate.

Ironically, the financial turmoil of the small business owner means a more realistic experience for students. Of the small businesses surveyed, all were forthcoming with information and more than willing to share with students. This is an attractive pedagogical opportunity that shouls encourage engineering programs to view small businesses as viable industrial partners.

REFERENCES

[1] United States Small Business Administration, Office of Advocacy Annual Report to the President. "*The Small Business Economy: A Report to the President*", United States Government Printing Office 2009.

[2] Kroliki, Kevin and John Crowley, "GM Files for Bankruptcy, Chrysler Sale Cleared", *Reuters*, June 1, 2009

[3] White, Joseph B., "How Detroit's Automakers Went from Kings of the Road to Roadkill", *Hillsdale College Imprimis*, February 2009.

[4] "How to Survive in a Slow Economy." 2009. ww.sba.gov, http://www.sba.gov/training/surviving/index.html. Accessed: 28 January 2010.

[5] "Michigan Diversification strategy" 2010. ww.michiganadvantage.org, http://www.michiganadvantage.org/Diversification/Default.aspx. Accessed: 28 January 2010.

[6] Kim, W. Chan and Renée Mauborgne, "Blue Ocean Strategy", *Harvard Business Review*, October 2004

[7] Kim, W. Chan and Renée Mauborgne, "Creating Your Strategy Canvas", *Harvard Business Review*, June 2002

[8] Gage, Raymond T., "Small Businesses Present Opportunities for Business Students", Submitted to: *Proceeding of the ASEE North Central Conference*, March 2010

[9] US Department of transportation; National Highway Traffic Safety Administration Report to the House Committee on Energy and Commerce, the Senate Committee on Commerce, Science, and Transportation and the House and Senate Committees on Appropriations. "*Consumer Assistance to Recycle and Save Act 2009*", United States Government Printing Office 2009.

[10] Narayanan, Mysore, "Assessment of Innovative Environments that Address Intellectual Curiosity", *Proceedings of the ASEE Annual Conference, Austin*, Texas, 2009

[11] Walsh, Daniel, "Developing Succesful Industrial Interactions in Support of Project-Based Learning: An Organic Model", *Proceedings of the ASEE Annual Conference*, Austin, Texas, 2009

[12] Gunn, Craig, "Why Advocate Communication Skills in Experiantial Learning Coupled with engineering?", *Proceedings of the ASEE Annual Conference, Austin*, Texas, 2009

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