The Importance of Incorporating Industry Experience in the Classroom

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Abstract

The world of engineering has changed significantly over the past ten years due to global competition along with fast moving technology. In order to meet the needs of industry, engineering graduates must hit the ground running. For this to occur industry and academia must compliment one another. In addition to presentations on theory, industrial experience should be included in the classroom. The student needs to make the connection between industry and theory early to attain a good understanding of the basic engineering principles. Research has shown that being exposed to the application of theory, results in a stronger understanding and mastering of the engineering subjects. Bringing industrial experience to the classroom will enhance the student’s understanding of theory. It also allows an opportunity for dialogue in which the student can be made aware of the consequences of not mastering engineering concepts in industry, i.e. low performance ratings. Many employees who were not well prepared for industry end up switching careers. The value of the $50K or more spent per year by the state or parents for the degree is reduced. This paper discusses some of the key changes that have taken place in industry and the effect of these changes on the education of engineering students. The purpose of going to school and obtaining a four to five year engineering degree is to obtain a job or start a business to generate income and job satisfaction. In most cases the students are headed for an environment in which they know little about. The engineering curriculum today is based on theory and very little industrial interaction. Learning from the experience of engineers who have worked for many years is critical to narrowing the gap between industry and academia. Today’s industry needs students who can achieve high levels of productivity within a short period of time.
Introduction

There have been several significant changes in the technical marketplace that has had a profound effect on product development. These changes are mainly results of the market for most products changing from local to global. Most of the discussion following are based on the Telecom business, but it is reasonable to assume that the same trend is occurring in most of the other business that deploy engineering talent.

Many key advances in worldwide transportation and communication, along with government de-regulation practices, have opened the doors for companies across the world to compete in the same markets. This trend has created a much more competitive environment for suppliers.

Global competition has forced suppliers to reduce their prices and achieve their bottom line profit goals by manufacturing more cost effective products. The price reductions are generally achieved through price negotiations with vendors, reductions in manufacturing costs, reduction in fixed cost, and creative R&D. There are examples in the Telecom industry where new products today are being sold at 25% of the price that similar products were sold at just five years ago.

The competition has forced suppliers to significantly reduce their time to market. Market windows are much shorter now than ever before. There is a direct correlation between profitability and market entry. This has caused engineering to reduce their development cycles. A study from IBM showed that in a fast moving market being just three months late can cost over 25% of the product’s potential lifetime revenue. In many cases there is a window of less than two years to take a medium complexity product from conception to full production. This includes all the phases of development and product verification. The verification phase is becoming a much more significant piece of the development because the products have to support multiple markets.

Globalization has also driven the reliability requirement of products up significantly. It comes back to profitability. It becomes very expensive to fix problems in a timely manner if the equipment is deployed across the world. This forces development engineers to focus on quality in order to catch problems early in the development phase. In the past most equipment manufacturers owned the manufacturing facility and it was generally co-located with the development team. Due to the pressure to reduce products cost manufacturing is now being outsourced to low cost countries. These logistics force the development team to modify their processes to catch the problems before the design gets to the factory.

One of the biggest challenges introduced by globalization is in gathering the market requirements and designing to meet them. Even though the market is global there are requirements that are geographically, or culturally specific. Different areas of the world have various standards that are different or perhaps even non-existent in other areas. In many cases it is necessary to have multiple development teams deployed in different parts of the world to address these differences. Development of a common platform that has different characteristics for the different geographical markets requires close collaboration between the multi-cultural development groups.

The changes introduced by globalization are being addressed in several ways. Advancements in technology have been a very important player allowing suppliers to adapt. For instance, advancements in Integrated Circuit technology allow systems to be implemented on a single chip. The chips can be purchased instead of being developed by each development team. The level of integration also increases reliability. There are simply fewer parts to fail. Advanced design and simulation tools are available that allows complex systems to modeled, reducing the amount of time required for laboratory testing. Many new processes are in place to help synchronize remote developments. Training is now being provided in industry to address issues associated with joint developments with multi-cultural teams.
Changes in Development Strategy

Due to globalization, students entering into the engineering workforce today must be equipped differently from their counterparts that started in the previous era. The challenges that suppliers are facing in order to survive in this competitive market have been passed down to engineering. Engineering is being asked to shorten the design cycle, and at the same time design for higher quality and improved manufacturability. In many cases R&D budgets are being cut to help the bottom line. These cuts, of course make it more difficult for engineering to meet the new challenges. These demands have forced the engineering development model to change.

In the past the engineering model was to develop as much as possible in-house. The engineering staff contained all functional group required to develop a product. This included system architects, low-level designers, up to system integrators and verification testers. This model allowed tight control over the design and it protects Intellectual Properties. Another big advantage in this model is the reduced need to formalize the interface between the various functional groups. The down side of this model, as viewed by business unit managers, is that it requires a large headcount that is not consistently, fully utilized. The increased head count hurts the bottom line profits.

Engineering groups are finding that in order to meet the stringent objectives resulting from the complex global market, overall efficiency must improve. Many groups have established there own core competency and are staffed to only support that part of the development. Other development tasks that are not considered part of that core competency are being outsourced to other expert groups. This model allows each functional piece to be optimally developed by an expert group. It also allows the flexibility to dynamically adjust the number of resourced on an as needed basis by simply adding or removing expert groups. The competitiveness that is seen at the business level is pushed down to the functional engineering development groups. With these functions being outsourced companies can select the bids that better fit their business models.

Additional Challenges for Engineers

The global markets and the concept of outsourcing parts of development to subject matter experts have created a change in the way students must prepare for a career in engineering. The students must understand the breakdown of the various functional disciplines so they can decide where they best fit. The students should still strive to be as well rounded as possible. It’s always better to master all the functional disciplines, but this is rarely practical. Students must continue to master the basic theory and fundamentals of engineering. Additional focus must be dedicated to engineering from a business perspective. In many developments the toughest challenges are not at the implementation or design level, but more at the business level. An example is the decision to re-use existing designs, re-design in house, use off the shelf technology, or outsource the design. While these decisions are normally made by engineering managers, the expectation is that everyone on the development team contributes to that decision. Curriculums must be put in place to support the student’s preparation in this area.

Students should become familiar with the principles surrounding joint developments. The specific processes used to support joint developments and outsourcing may vary from one company to the next, but the fundamental principles are the same. For example the concept of clear technical communication across different economic, cultural, and social boundaries reduces development risk in this scenario. Many American companies have integrated product teams. Industry is interested in people who can do teamwork. The important thing is to know who the key players are. New employees must understand how to work with teams that are not of the same culture. This is due to companies merging. Engineering today requires more than knowing the subject matter. It is critical to know how to work with people and learn from people.
Additional focus must be given to the requirement and test phase of development. These phases are becoming a much bigger part of the cost of development. It is a significant challenge to understand all the global market requirements and to translate them into engineering requirements. The engineering requirement must be especially clear in order to take full advantage of outsourcing. The cost of testing and manufacturing complex equipment that addresses a global market can dramatically affect the bottom line. Engineers must be trained to take this into account during the design phase.

More emphasis should be placed on designing for high quality. This is especially import when equipment is manufactured and deployed around the world. The ideal design will have no defects. Since this is next to impossible, the designer must design for minimal defects. The designer must also understand the processes required for finding and fixing the defects as early as possible in the lifecycle of the system being development. For example, it’s much less costly to fix a problem found with a peer review in the early stages of development as opposed to the fix after thousands of systems have been deployed.

**Conclusion**

Most companies are asking their young engineers to contribute to the business objectives almost immediately upon starting their job. There is less time and money spent on training. Promotions, bonuses, and merit raises, are based on performance. In many cases it is simply based on contributions to the sales or profits. It is not enough for the new engineer to understand the basic theory and fundamentals of engineering. The new hire must have a better understanding of the dynamics of the business that they are a part of in order to increase their effectiveness. They must quickly establish themselves as subject matter experts. The marketplace is very dynamic and ever-changing. The level of the training for engineers must adapt as well to stay aligned with the market demands. This adaptation has been addressed in the past by the employers, and I believe this will continue in the future to a degree. Some of the required adaptation is more generic and should be pushed to the University level. Even though it is generic it is still dynamic and market driven. Collaboration between academia and industry would help bridge this gap. Due to budget cuts at both ends this collaboration has significantly decreased over the years. The impact is being felt throughout the industry. The playing field has changed for the engineer. In preparing for a career in engineering the student is faced with the same issue that industry struggles with; and that is doing more with less.

The presence of experienced engineers in the classroom exposes students to important topics not covered in a traditional engineering curriculum. The students are exposed to topics such as the technical marketplace, design cycles, verification tools, reliability and quality requirements, and the business perspective of engineering. This exposure allows the students to become well prepared and ready to contribute to the industry upon graduation. “Over the years, academia and industry have developed into separate institutions with different organizational structures. As a consequence, there is a considerable gap in understanding of cultures, practices, and strengths between business and education. How can we expect students who are prepared in one culture (education) to readily thrive in the other (business)” [2]. A way to bridge the gap between education and business is to bring industrial experts into the classroom. Learning from the experience of engineers who have worked for many years is critical to narrowing the gap between industry and academia.

**References**

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