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## The New, Old Research and Teaching Agenda

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**Abstract:** *Universities and the advanced educational system, particularly in the United States, are regarded as one of the key influencers in this nation's cultural, economic and social development progress. Starting during the colonial times and shadowing similar efforts in Europe, the system has grown not only in size but also in direct and indirect impact on the ability of this country to produce innovative technologies and the individuals who Shepard and utilize those technologies and systems. It has become clear that this nation has slipped from the number one position that the world looked up to in multiple categories, with a similar performance in the metrics we use to compare the competency of our educated youth. This paper looks at some of the historically relevant events that shaped our current advanced educational system and also looks further at some of the fundamental questions as to the value received for the time and money invested in acquiring the specialized, advanced educational skill-sets we have invested our future in. More notably this work asks some acute questions as to the responsiveness of the university current system when compared to the future needs of the nation and the global marketplace.*

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### 1. INTRODUCTION

Universities, particularly those in the United States, have carefully crafted mission statements including well-developed vision declarations, that are often little more than rhetoric prepared to convince the masses, both internal and external, of the value of the institution and of course the need for society to continue to support them. Clearly, it is hard to fault the current advanced educational system since we have convinced ourselves, with some degree of certainty and plausible evidence, that if not essential, our universities are at least contributory to the continuance of our social and economic system, as well as a necessary key ingredient in the future financial success of the youth that they educate and somewhat train.

As with most large organized efforts there are unique individual differences between these institutions, stemming from how they were originally set up, the cumulative internal and external leadership influences, the governance standards they adhere to and, sometimes more importantly, the geographical, environmental and cultural differences that the participants are drawn from. In a majority of these institutions advanced research is a fundamental element in the educational mix, viewed as a means to advance the fundamental understanding and knowledge of the faculty, the goal of exposing the students to this knowledge and of course to provide value to the economic and social system that supports the effort (1).

The university system has continually evolved, from its earliest start in this country, as a unique way to mature selected youth while providing them with specialized skill sets and a hoped-for appreciation of the current cultural and economic state of our society. Looking more globally, the first European universities were founded sometime during the 11<sup>th</sup> and 13<sup>th</sup> centuries, although these institutions did not develop beyond the status of formal teaching institutions until the 19<sup>th</sup> century (2).

The same can be said for US institutions, initially beginning as college centers for the teaching and preservation of knowledge in the 1600's. These universities did not evolve as research centers until the 20<sup>th</sup> century, where they started as partnerships with industry (3). Since then, the trend towards vested efforts into advancing research and development capabilities has become a critical focus of many of the larger institutions (1). This of course has been complimented through the developing social and technical connectivity of our communication systems, which has allowed access to a knowledge base without equal, if viewed against any other time in history.

Until the Civil War, scientific research was conducted as a profession supported by US government organizations, at first with a strong orientation towards military bureaus, and then later it branched out into civilian agencies, which were often still spun off from the military. By 1914 and the start of World War I, research universities had joined federal government laboratories as sites where organized, "professionalized" scientific research was conducted in the United States (2). It was

through these developments, and increased support from US legislatures, where universities' focus on research and innovative development gained a strong foothold (1) (4). As the nation's success became more hinged on the strength of its' ability to develop its people innovatively, it became the role of the US research institutions, through a growing number of university partners, to enhance this evolutionary process.

This effort today as in the past, which is assumed to be by conscious design, hopes to encourage the development of highly educated, well-rounded and integrated citizens who are ready, if not eager, to contribute to our society. By advancing the quality of these individuals entering the workforce this advanced educational system hopes to drive the development of competency and capacity for the solving of tomorrow's problems. Some would say these expectations should also include the fostering of a natural sub-set of these same individuals who are impatient for change with a different vision for the future state of our society, a state that has a more visionary mission. Clearly, all of these groups, as with all of our youth, will contain the hopes and aspirations of the future for more than just their parents.

Within this process, it is hoped that the advanced academic system will identify and nourish those uniquely qualified individuals who have a quicker and more earnest appreciation for the often mundane, but critical, elements of what allows our social framework to function, governance and infrastructure support. This system also helps to develop an appreciation for the personal and social complexity of the way we live in this society, as well as how others live, or have lived, in other social environments, with the hope of learning from past and even current mistakes.

### 2. THE POPULAR VIEW

We should acknowledge that it is hard to fault the advanced educational process that has produced such a great number of events and accomplishments. Taking a more popular view of the current system, it is easy to have a tendency to remember and reflect, particularly if you also attended, the highly visible events and accomplishments as presented from these institutions. This is particularly true for the numerous and measurably great things that we celebrate when we call into focus the years spent in our chosen institution, one of those being our graduation or that of our children. Fortunately, there are an unceasing number of these highly visible events within a university environment, which means there will always be something positive to highlight and brag about.

Though it might be difficult for the outsider to see problems or faults of any of these institutions, especially with so many recognized accomplishments, society is never-the-less compelled to be ever vigilant of any system or process that can be as impactful as an advanced educational system. These highly visible achievements are not necessarily in response to a designed or pre-established goal, and seldom come with a set of measurable metrics. They are often more in response to historical precedence and custom and courtesy. More significantly these recognitions are typically a result of the institution's internal governance and rule-based processes, none of which are necessarily directed to the future needs of society or to the individuals that are being processed through its halls.

Though we may want to criticize some of the accomplishments, we must also acknowledge that the system actually works quite well, even with the apparent lack of visionary planning and effective leadership. As a result we can genuinely celebrate its successes and cheer its many attributes and victories, particularly during our preferred sports season.

Even with these apparent productive achievements by the institutions that we know and love, and the ones we commit a significant portion of our gross domestic profits to, the reality may be that the current system is less of an altruistic benefactor for our children, and society for that matter, and more of a self-involved institutional enigma. Again, this is not to diminish the need for an advanced educational system. Instead the question becomes a balance between the values received versus the overall cost; the often coined "return on investment" (ROI).

### 3. THE EDUCATIONAL COSTS

The current economic climate that we are all facing is manifested through heightened stresses on research universities to expand their social and economic impact. The expectation is that by fostering innovation the end results will translate into new industries and jobs, while developing a proficient workforce, and promoting the next generation of leaders and managers, whether they reside in academia, government, industry or any of the commercial sectors (3) (5) (6).

Presently, there is a noticeable heightened awareness for the nation to encourage a growing number of its youth to consider higher education. Clearly, increasing the educational base for our population has growing potential for increased democratization as well as an improved path to economic growth and social prosperity. But this growth is clearly not free. With a university degree comes substantial financial baggage that not only must be met by the student and often their parents, but through a series of complex processes, through the nation's taxpayers as well.

As was noted before, these educational advantages come with substantial initial financial burdens to students and parents. According to the College Board, two-year, public community colleges will set in-state students and their parents back about \$10,550 per academic year, while the price tag for attending a four-year public institution of higher education averages about \$17,860. If a student opts to move away to attend out-of-state public universities the price tag is upped to an average of \$30,911 (7). Additionally, if a student chooses to attend a private, four-Year College or university, the cost jumps to roughly \$39,518 per academic year (7).

In recent years the state and government's responsibilities for funding student's education has been slowly shrinking leaving students, parents, and other private supporters responsible for more and more of the balance(8). Originally an agreement was accepted between state governments and state colleges and universities, assuming that, while the state's taxpayers would act as benefactors subsidizing most to the university's operations, state higher education institutions would charge the state's resident's a reduced amount of tuition (8). This arrangement has begun to falter as university budgets have grown faster than what the states can provide for.

This can mainly be attributed to the increase in widespread access to college in recent decades. Because of this educational institutions now face the dilemma of how to fund heightened enrollment financial responsibilities, especially for students from families with limited financial assets (9). The solution has thus resulted in heightened tuition costs, need-based grants, and significant loans, all in combination with increased levels of paid employment for students while completing their education (9).

Though the dollar amount federal governments provide universities has gone up 13% since 1980, some institutions receive less than 1/5<sup>th</sup> of their budget from their state legislatures, and any federal action to raise further funds through taxpayer revenue has become politically disadvantages (8). Therefore, because higher education institutions must rely more heavily on student and parent subsidy, tuition has gone up roughly 107%, supported with the argument that private institutions still charge substantially more in tuition expenses (8).

With higher education expenses growing into substantial financial undertakings the potential for a return on investment (ROI) becomes the primary justification for the higher initial costs. An example of the potential value to the student comes from the Census Bureau, which reported that adults with bachelor's degree or more earned an average \$81,761 in 2011. Those with high school degrees or GEDs earned an average \$40,634, while the average wages for workers who didn't finish ninth grade was \$26,545 (7).

The ROI potential, therefore, in many cases now becomes a compelling argument for growing the numbers of college graduates. Having considered this financial commitment, the question then shifts from the potential economic value to what we, the consumers, should really be getting for our investment? To further investigate these considerations note that those of us within the profession and on staff in these varied institutions are a product of our own designs and are clearly affected by the process that educated us. We are isolated from the purpose and every day process of a developing social and economic order and happy to be left alone to our own devices. Thus, very little from the outside world ever really affects us, or at least not on any reasonable time scale, except during the pursuit of financial support.

#### **4. EDUCATIONAL SYSTEM RESPONSIVENESS**

The question might be, is the system really responsive to the current and future needs of society? Or, quite possibly is it time to re-think or re-purpose its original mandate? What was once best in an earlier time does not necessarily mesh with the demands of today. More importantly, some of the earlier processes that were dropped for financial or efficiency reasons or expediency considerations may be of greater value today than what we currently use. Going further, who's to say that the

original reasons for the current system were out-of-line or in this case as is often described as ancient and simplistic, if not naïve.

Currently, for the most part, what we learn we in turn teach and how we learned it was the best for us, it is therefore the best process for others in the future. Note, again, it is probably the most successful system for advanced education currently in use, or of any time in our past. Nevertheless, being better than in the past is not necessarily being the best, it may thus be prudent to take a hard look at the overall process.

To get to the point, society needs to continuously ask what these institutions have done for us today, and then ask it again, tomorrow. As quoted by Napoleon, “glory is fleeting, but obscurity is forever.” Society needs to set aside and differentiate the expected celebratory events from those that accelerate the state of our economy and the social order, qualities that we count on for survival and future prosperity.

These necessary game-changing events may not show up as frequently as we might wish, as with premiere sporting events or graduation rosters. Rather they can be reflected though and stimulated by proper expectations and the utilization of well-defined metrics. Not only do we need to reevaluate our expectations for our educational institutions, we also must consider who and how these institutions reach and convey learning. If life-long learning has become the normal expectation how do our universities aid in that process? First of course they would need to define life-long learning and what a plan to implement it might involve.

### 5. THE DEVELOPMENTAL PROCESS

What everyone tends to forget are the evolutionary processes that this country has gone through and the growing need to accelerate that development if we are to stay ahead of the rest of the world, let alone the problems we have created through our nation’s continued growth. Our university system can and does provide some of those needed changes. Does the current system contribute enough and if not what will it take to refocus these immense resources to that effort? Likewise, how ready are our universities to effectively educate the increasing number of students enrolling each year (10)? This may become one of the most important sets of questions that will be addressed in the near future.

The youth of our nation possess the intellectual capacity to solve the problems created by their predecessors; this is the generational reality that drives the growth and success of every culture. They most likely are the only ones that can solve the current problems since they are living with them and they have the energy and need to make that contribution. This can be seen reflected in the increased desire of our youth to continue onwards into higher education.

A 1999 report by the Association of American Colleges and Universities (AAC&U) noted that nearly 80% of US high school students state an interest in pursuing higher education (10). This was further compounded by data showing nearly 70% of post high school graduates actually do enroll in some form of postsecondary education, a dramatic increase from the 4% of high school graduates attending college at the turn of the century (10). This reality, coupled with an enormous intellectual infrastructure within a well supported and developed university system, provides an invaluable supplement to our industrial and commercial sectors, plus it educates, inspires and matures the young professionals who will help people and lead those efforts.

Currently the university system provides an educational opportunity to a rather large portion of our youth, at least in the United States, and there is a plethora of evidence that would support the need to continue the use and development of an advanced educational system. According to the AAC&U now virtually all high school graduates may attend college with public colleges accepting many forms of credit or non-credit programs (10). Data from the National Center for Education Statistics’ shows that in 2010 the total enrollment reached 21.3 million, with 8 million of that total enrolled at four year public universities (11).

The real question then becomes: where does the education and training really occur, and what is the best way to develop those desirable, positive attributes that hopefully immerge? We have opened the doors to college without principally considering what educational strategies will actually help students reach their full potential within society (10). This question is in contrast to the parts of the current system, that are currently by assumed custom, as the best way to do the most for the greatest number of participants, at the least cost.

## 6. HISTORICAL PERSPECTIVES

Looking back into the establishment of this advanced educational system may shed some light on the current situation. What exactly is the charter that we granted to this mammoth system that has such a potential impact on our society, and its youth, and is worth the cost of the debt that is incurred to get that selected group through the process?

Amidst the environment of diminishing federal aid, rising tuition costs, stagnant grant aid, and an economic market recovering from the Great Recession, the goal of “college-for-all” in the US has encouraged a strong reliance on college loans for students to afford the foreseen higher education that will give them a leg-up in their career options. In turn, college students are now facing heightened financial debt augmenting from these loans that make higher education possible (9). It has been commented: “-while lower levels of educational debt are manageable, debt exceeding \$10,000 reduces the likelihood of college completion” (9). As stated by a report evaluating debt from American universities: “-today two-thirds of all college graduates complete their degree, in part, through taking on debt, with the median graduating debt reaching \$15,123 in 2008. The need for increasing numbers of students to borrow money to attend college coincided with the deregulation of the banking industry, which allowed loans to be made without collateral or with poor credit ratings” (9)(12).

We should also ask, exactly when did we grant this charter and when it was created, were there any success metrics established to determine whether we were, and are, getting what we need and what we are paying dearly for? Additionally, since the creation of this system what accountability have we put into place to ensure we are providing the social and economic value that we need while equipping our youth to make the best and most expedient decisions for our future best interests?

A land grant, or land-grant-type institution, is defined as a “-state-supported, four-year college and/or university with engineering education and research programs” (14). In response to the need for a more efficient level of established education, and to institute the precedent for public support of higher education, President Abraham Lincoln signed the 1862 Morrill Land Grant Act (13). Two other legislatures, the Hatch Act of 1887 and Smith-Lever Act of 1914, also assisted the Morrill Act in its effectiveness as they provided “-experimental situations and extension services” (14). With its creation, new openings for institution-driven research gained momentum. Not only this, the general population was now encouraged to, not only complete a high school level of education, but to pursue traditions of higher learning. The Morrill act allowed for ambitious Americans to learn and work for their families, escaping the “-expected lifetime of grinding poverty and drudgery” and encouraging the growth of knowledge for their nation as a whole (13).

These are interesting questions and ones that should be answered, or at least it would seem that they should be. Most would say that, if these questions are left unanswered, the advanced educational system in all of its many forms, will continue to produce the educated professionals it has in most recent times, assuming we are satisfied with the current output and the metrics indicate a fair ROI. Even with this acceptance though the final question might then become, what improvements could be realized if these questions became a mandate for the future? Would we produce more capable and better-directed citizens and would those same students then be better equipped to advance society to the betterment of us all, ideally at a lesser cost and a smaller realized debt? To this point, what will it take to get the US back on or near the top of the normally recognized metrics we compare ourselves against, globally. If we really want to stimulate the enormous and often untapped intellectual and innovative reserves that reside in this country, we will need to address all of these questions and issues.

## 7. A SHORT HISTORY LESSON

As briefly mentioned in the introduction, the first European universities were founded sometime during the 11<sup>th</sup> and 13<sup>th</sup> centuries and, although notable scientific visionaries such as Galileo Galilei and Isaac Newton conducted research in association with these earlier institutions, these learning centers did not developed beyond the status of formal teaching institutions until the 19<sup>th</sup> century (2). The same can be said for US institutions, conceptually imported into North America by British settlers during the colonial era, where education in the US began with the foundation of Harvard College in 1636 with the focus of teaching practical know-how and the preservation of knowledge (2). As the United States moved westward during the last decade of the 18th century and early 19<sup>th</sup> century, colleges were created in the newly settled territories. This was part of the Morrill Land Grant

Act and several other education legislatures, further establishing a foundation of knowledge in the newer frontier regions as the country continued to grow geographically (2). As with the European institutions, these universities did not evolve as research centers until the 20<sup>th</sup> century when university research partnerships with industry fueled research efforts into driving the innovation of new technologies to support the nation within the competitive world markets (3)(5)(6).

Even with all of the problems associated with starting a new country, coupled with the basic struggle of surviving the harsh natural elements, it was clear to the earliest U.S. settlers that the ability to read, write, and do fundamental mathematics (the proverbial 3R's), was beneficial and provided economic value in commerce and social development.

To share in these cultural values and to help insure a modicum of commonality in commerce and communications, most communities arranged to provide at least a primer in the basics. While not everyone was required to participate, the number of completed scholars was sufficient, at that time, to unite and move the social and economic order forward.

It was the intentions of the American Founding Fathers who realized that “education for all was important for society at large; therefore it was the government’s calling to encourage and enable all citizens access to education” (13). These capabilities were also expected to provide some level of cultural enrichment in the daily lives of its citizens especially when communicating with others, particularly since the groups could be quite diverse in economic backgrounds, and cultural and religious beliefs.

Until the Civil War, scientific research—mainly applied—was conducted as a profession exclusively in US government organizations. Initially their focus was strongly oriented around military bureaus, and then later interest began to take root in civilian agencies - though these were still efforts spun out from the military. By World War I research universities had joined federal government laboratories as sites where organized, “professionalized” scientific research was conducted for the United States (2).

Between the world wars scientists and engineers began to focus on industrial sectors such as chemical, petroleum, steel, telephone, radio, transportation, electrical machinery and appliances (3). These industrial research laboratories were established almost immediately after the First World War and by the 1930s the industrial sector had come to dominate research in the country (2) or (3)(5). As a result of the Great Depression research declined during the 1930s (2).

The earliest signs of research development by these institutions could be found where American professors sometimes served as paid consultants to government organizations, but this was done mostly outside of the resident institutions and was never, at least initially, an established program (2)(3). Amidst the post-World War II era a pattern shift began based on the legislature’s decision to establish the role of government in supporting the revival of both basic research, and research towards government agency development (3).

More recently the enactment of the 1980 Bayh-Dole Act was one of the more noteworthy legislatures that allowed universities to keep patent rights to inventions that might have resulted from federally funded research at their institutions. This legislation encouraged, and in turn thus generated, a new framework that encouraged the potential for innovation among faculty at research universities (1) (3). It is through developments within the US legislature where university focus on research and innovative development began to gain support and momentum. As the nation’s success became more hinged on the strength of the ability to grow its people innovatively it became the role of the US research institutions to enhance this developmental process (6).

As the identified problems and future needs of the country became more complex, the ability of a single individual or company to create and support the needed basic research and development became prohibitive. To achieve the breakthroughs, or game changers, in innovation required a pooling of both intellectual and financial resources (1). Larger commercial entities provided some of these capabilities and often the work of several organizations either working cooperatively or competitively helped to keep the innovative efforts moving forward(5).

Slowly, but surely, the role of government, representing the masses, became the primary sponsor for the basic developments in science and engineering, a growing portion of which was provided to the university system. Even with the early focus of government on the defense of the nation, the spinouts from that defense-related work benefited almost every commercial sector. It was within the university

system that many of the breaks through advancements and technologies were made and by association where the future employees would be matured, educated, trained and prepared to people those new advancements and technologies in the open market.

As the country started to industrialize and the need to accelerate innovations and the solutions to an ever-growing numbers of problems, it became clear that a more universal level of education with a specific proven level of competency was important if not a growing necessity. This became particularly evident in those regions where large-scale manufacturing and processing became a way of life. Within these larger companies the need for education became an important financial consideration. Managing and running a large company with an equally large set of complex processes and procedures required a more uniformly educated workforce. Plus the need to have more highly educated leaders, managers and innovators became a universally sought after, if not fought over, commodity.

While the improved social value of better education may not have been of direct interest to the companies, the indirect consequence was a better-informed and more pro-active workforce, which is reflected well historically. Note that a series of wars domestically and on foreign shores necessitated the further growing of the larger corporate entities and the need for the workers to stay current, educationally.

Larger companies and growing innovative technologies required a more uniform use of language and skills. The need to inform and transfer information also became a driving function for social and economic reform. This national maturation process was particularly enhanced by innovative technologies that initially made well-known products and processes less expensive, of better quality and easier to use. This also made these products and processes easier to obtain and share.

In most cases this process was well received by all. Part of the innovation process is the leapfrog capability that comes from a well-educated workforce that gets rewarded through their intellectual contributions. This in turn makes the more familiar technologies obsolete and thus the economic cycle continues. This places the informed in a better position to take advantage of improvements and thus encourages the same for their family, friends and co-workers. Note the key role that education played in this maturation process and the growing need that was then clearly recognized to be valuable for future generations.

## **8. THE FOUNDING OF THE LEARNING PROCESS**

Our forefathers realized the need to educate the next generation, connect with other nations, and establish centers of innovation (4). To fund these needs they created several independently funded institutions and the Land Grant set-aside that allowed for at least one such educational institution for each state. The objective was to create well-educated individuals with the basics in the liberal arts and as the country industrialized, more and more emphasis was given to the STEM related disciplines including medicine, engineering, and the hard sciences.

Thus the advanced learning process was initiated. These colleges and universities started with the best students and educators that could be located both domestically and abroad and provided them with the basics of proper citizenry and skillsets that would help them contribute to the economy that needed them. It also recognized those few that had special aptitudes in management, leadership and innovation capabilities and helped them to associate with cooperative organizations, employers and funding opportunities, much as the current system tries to emulate today(5).

During this earliest time the numbers of topics and the complexity of the subject matter was notably simpler than it is today. As the technology grew, the need to delve deeper into the basics of medicine, science and engineering became a major driving force. This required a more comprehensive laboratory and testing capability, which in turn provided the more interested students and professors with an innovation support capability not easily realized by the average citizen. This process also provided the need and the ability to justify and seek additional funding to perpetuate the growth process.

## **9. THE CURRENT PROCESS**

This doesn't sound too much different than the current system today, at least on the surface. If there are easily definable differences they most likely have to do with scale and the direct and immediate

accountability from working directly with a sponsor. The sponsors back then were the companies that needed the innovation along with the technology's creators to continue to succeed in the, then, growing and often-volatile economic environment(5). This also applied to the government that had increasing needs to provide value to all of the citizenry, to maintain and stabilize the growing economy and to also defend the nation from its potential enemies. Note there were also the venture capitalists and philanthropic benefactors that supported those select students, programs and institutions of their choice, as is also exercised today.

Over the many preceding decades the needs of the advanced educational process have become more complex and even harder to manage. The numbers of topics to be covered and the breath of the subjects have required a continuous splitting of the subject matter into more manageable but still growing, volumes of knowledge and skills. This is the nature of the problem and one where, if so inclined, the student can continue to learn their way into succeeding degrees to satisfy their thirst for knowledge and for the career they want to pursue. No one can learn it all but the need for life-long learning has become a necessity, not a convenience, in order to stay ahead in a chosen discipline.

Thus, the advanced educational system is compelled to increase in size and complexity and to provide an ever-growing set of capabilities for their charges and the society that they serve. They also need to continue to be responsive to the economic system that supports them and to the students that will one day provide the next generation to educate and an even more complex set of problems to solve. Note that the problems will not get easier or less complex and the abilities of the students, while they will increase, will nonetheless only be able to handle a certain level and learning rate of information and capabilities.

The current educational system may not be able to provide for the growing and future needs of our society. Most likely it is time to consider the way the system educates and transfers knowledge and possibly the way we provide the basic elements for the students' maturation process. Interestingly the process most likely contains most of the proper elements for the future needs of these students, albeit not necessarily in the weighting and distribution presently provided.

For example, the effectiveness of the current classroom lecture environment has often been put into question. While it may allow for the dissemination of a large quantity of information to an ever-growing group of individuals, its ability to provide experiential value is clearly in question. Not everyone learns at the same rate or using the same methods. More importantly what really needs to be taught versus what needs to be experienced first-hand may soon become the driving issue. As importantly, what environment encourages maturation and the pursuit of innovation?

In a study oriented around "active learning," conducted on 24 university campuses, it was found that between 73-83% of faculty reported that the primary method of instruction was lecturing in their undergraduate classrooms (15). Similarly, a more recent and extensive survey of U.S. university professors concluded lecturing to be the primary mode of instruction for 89% of the physical sciences and mathematics. This was reduced to 81% for social sciences and even further to 61% for humanities faculty (15).

It may be time to take another look at the one room schoolhouse and the dynamics that occurred during the maturation and learning that occurred within the youth of those days. While it is clear for a number of logistically and financial reasons, as in considering the enormity of the numbers of students and amount of information to be conveyed, that there was at least some value in that system and in many of the other offerings that have surfaced historically. First, we need to establish what we want to accomplish and then determine methods we will use to achieve satisfactory results.

## 10. THE RESEARCH DEVELOPMENT PROCESS

Following World War II, the U.S. government began offering large contracts to universities invested towards the utilization of faculty and students in driving the war effort. When the war concluded the practice became institutionalized with the creation of the National Science Foundation in 1945.

With an abundance of available research funding from the government, universities began a trend of restructuring their internal financial reward and advancement systems centered on sponsored research success. In turn, this directed the university faculty to focus on the production of publications. This "publish or perish" proliferation began to drive Ph.D. granting departments to stake everything on obtaining major federal research support (16). With such a focus on research, university faculty



became less focused on the classroom. In some cases the result was students receiving less than effective career advice, coupled with a disassociated faculty whose concern was now focused on research and consulting rather than the quality of the teaching and classroom experience (16).

With government funding pushing university faculty towards research efforts, a rift was generated between the students and their instructors. Because of this, students gained a negative perception regarding their college learning and experiences with university faculty. They began to believe that the faculty would prefer to ignore them as individual students. Furthermore, they saw that teachers began to conform to ideas of a directorial “quality teaching” that was merely the implication of tougher admission requirements and higher flunk rates (16). As noted by Peter Denning in *Educating a new Engineer*, “with reduced dedication on the courses themselves, the curriculums developed to encompass too much material, granting little opportunity of mastery over the essentials of the content. Focus is pushed towards only obtaining A’s and B’s, rather than learning, and the diploma becomes little more than a receipt for attending the prescribed classes and paying tuition” (16).

Meanwhile, professionals and employers complain that “the graduates that they work with do not contain sufficient practical competence. Graduates lack the know how to define a proposal, draft sample project budgets, prepare meeting agendas, work on teams, or bounce back from adversity” – unless this was already a prior aspect of their personal character (16). They feel that the concepts within the curriculum are oriented towards preparing- “research engineers, and not practice-oriented skill sets that would allow a competitive advantage in a working environment.” This results in heightened costs to the company when hiring as well as lost time to account for training programs spanning 12-18 months to catch up the new hires for the missing skills (16).

Aside from the educational issues derived from this emphasis in government funding, universities, at their core, have been improperly established around philosophies that are no longer applicable to our evolved society. The unspoken assumption that -“we must know and understand an accurate, fully developed, highly detailed model of the world before taking action”- is quickly losing its legitimacy. The world now changes too fast and has become too complex to allow full reflection before action (16).

Realistically people are pressed into action, or worse no action, before they fully understand what is happening. But with the universities producing brilliant minds that wish to fully understand the problems they are solving before acting is leading to excess hesitation or no decision at all, creating further frustrations for employers. This caution comes primarily in the form of indecision and inaction– which become detrimental to a business and often times even worse than a bad decision.

Because the inexperienced graduate wishes to become - “fully-comfortable” with what they are undertaking, they lack conviction when reality never produces this. They fear their decision will affect their company badly, and thus they falter. This lack of action becomes ever more fatal the higher the position of responsibility within the company. Therefore the desire to act effectively in the current work environment is showing up as a new demand by students and their employers for practical competence training (16).

## **11. THE REAL ISSUE**

This document is not intended to be an indictment of any, or all, of the current college-based institutions. In fact, great things do come from all of their halls of knowledge and wisdom. The question is more directed at the level of competency and accomplishment of the individual participants in contrast to any notion of inadequacy of the institution as a system. The question becomes, is the system utilizing all of the possible best practices and learning modes to better impact the greatest number of the young people they are charged to beneficially impact?

Quite possibly the real issue is the need for educational professionals to accept that additional value is in-process all of the time, there are always better and more effective ways to accomplish a task than to rely on what was used to educate them. The objective is to meet an acceptable and measurable standard, the actual requirement of the social order that supports them. Currently, the system of professorial leaders either are unaware, have too many other things to do or possibly aren’t properly rewarded for the extra effort needed to create, discover or implement these changes as quickly as they could. Educators are often so involved with sticking to the rule-set for their personal success within the institution that they have little time to reflect on what’s going on all around them. Their success metrics and those of the institution may not be in sink or appropriate for the needs of society.

The most interesting part of the educational process is the reality that one's growth during college is only partially attributable to the knowledge retained from classroom lessons. Some might even go so far as to say that the majority of the valuable intellectual growth and associated maturation that naturally occurs through the ageing process is completely outside of the classroom. Students who invest more effort into expanding their horizons through a variety of activities enhance intellectual and personal development. Skills such as- "cognitive complexity (e.g., critical thinking, intellectual flexibility, reflective judgment); knowledge acquisition and application; humanitarianism (e.g., interest in the welfare of others); interpersonal and intrapersonal competence (e.g., self-confidence, identity, ability to relate to others); and practical competence (e.g., decision making, vocational preparation)" - all stem from well implemented out-of-class experiences within a university curriculum (17).

Still, it is acknowledged that the educational process, along with individual maturation, is directly impacted, or at least linked in a cursory way, by the knowledge absorbed during lecture sessions, that is, in addition to the late night cramming that occurs on a predictable time schedule each semester. Thus, there is little doubt that the information and the resulting skill sets that result from a combination of classroom knowledge and outside experiences have a positive impact. Furthermore, these lessons are essential if these individuals are to function at any competency level in the profession they are seeking to participate in.

The real question becomes more to what degree does the student practitioner gain what they need from the classroom and how much "other"- stuff do they get by association or influence outside of the classroom. Any institution can improve the learning process for their students by effectively using existing but possibly unorthodox resources (17). If so, are we as educators and financial benefactors taking notes and making the changes that are required to enhance an improved, and most likely, evolving college experience? Furthermore, are we as educators acknowledging our shortcomings and now acting to allocate our focus accordingly in order to address the current inadequacies within lectures and course curriculums?

The fact of the matter is that out of class experiences and extracurricular learning often falls between the cracks of the predominant university model currently dominating the United States higher education. In most of these systems, a lack of reward for extra efforts is less of a concern to professors than the clear and present threat of alienation for straying from the prescribed, proper academic model.

Of course there is the problem of not seeking or really understanding the alternate ways to provide educational value and thus in some cases avoiding the issue is most likely the best alternative. Unfortunately, there are some individuals that ostracize and condemn those that want to try or really do see the better way. Typically we find that this may be the result of fear, feelings of inadequacy or in some cases just plain laziness.

Interestingly enough, this may be okay. Because a majority of university practitioners have the best intent, it is likely that the need and opportunity will finally hit them. From this they will respond, some with enthusiasm and others - well - not so much. This, in turn, becomes the nature of the participants in any large organization.

## 12. SYSTEM INERTIA

The university system has a lot of valuable inertia, which helps keep it safe. This inertia helps prevent any one person or group from doing irreparable damage to the system. When enough external pressure is applied though it will respond by seeking the less resistive path. This seems to be the natural order of things regarding the university system and effectively this is also the system and the lessons we bring to our youth.

The advanced educational system in this country is a bastion of knowledge and wisdom with a wealth of capabilities that most likely will be noted as unequaled in history, notwithstanding the previous comments. Its success has been the result of some solid, visionary planning on the part of our country's forefathers. It was also enabled from the globally originating social and genetic mix that came from all corners of the world, coupled with the knowledge and governmental influences from their original homelands.

To prosper in this new world, where survival was often the more pressing concern, required visionary planning and vast amounts of innovative contributions. These contributions would be accepted and made available through a systematic means of preserving and carrying on knowledge throughout future generations. A schematic had to be developed that could respond in time to make innovation available to the general public. This system also had to provide the trained individuals to carry that capability and technology to the marketplace and then to later make the improvements necessary to compete in a global economic market.

These institutions, using economics in combination with technological tools and societal aspirations, would also allow the nation to connect globally. Therefore, universities, in essence, become a defining commonality in allowing global networking to benefit innovation. For what we share in common, according to Bement, this is- “the pivotal role that research universities, that drive innovation, have and will continue to pay for economic development through people and knowledge”- (1) (3). Furthermore, it becomes the duty of these research universities to “expand their impact through the fostering of innovation that translates into new industries”- (4).

### **13. WHERE DO WE GO FROM HERE?**

Thus there came into existence the need for a more uniform educational system, particularly for the primary and secondary school-aged youth. As with most education the need was to provide each individual with the necessary tools and skill sets to interact and prosper in the, then, existing economic and social environment. The schools were run locally with significant support from the regional commercial and industrial markets. The end result, particularly in the last century was for the schools to somewhat resemble the same style of facilities that the future workforce would graduate to.

Noting that the educational system can and should evolve, most likely at a much slower rate than would be the most prudent, the schools of today in their curriculums and the bricks and mortar of their structures are uniquely different than in the last century. We also require a certain competency within our school age youth where a failure to achieve the minimum can and does impact the future potential of these individuals. Still we tend to teach the same way we did decades ago, even with the differing economic and social needs and the changing and expanding content of the required curriculum. The exceptions are a more hands-on environment that can and does occur in frequent situations but not normally as part of the fixed requirements of the nationally recognized educational system.

So, what we currently have is a better classroom environment, with better facilities for the transfer of knowledge and skills but with a growing amount of information and capabilities to convey. On top of this the need to accelerate the more complex portion of this capability is at an earlier age and at the expense of the social portions of the education. There is an increasing amount of information and understanding that is assimilated by our youth from resources other than the actual teaching environment, the classroom. This of course comes back to the earlier part of the discussion and the question of where the learning is taking place, where it should take place and how can we implement the best way to conduct this effort for the benefit of all parties.

### **14. SUMMARY**

It is clear to most that an advanced educational system, past that which should be a standard, such as primary and secondary education, is essential for any modern and technically advanced country or society. The United States has taken great strides in developing such a system and has for many decades reaped the rewards of such a system. Since it appears that we are slipping in our ability to intellectually and industrially compete with our global partners it may be time to ask some more fundamental questions as to the value we are getting for our investment. More importantly, when asked these questions we also need to have timely and properly prepared answers where there are metrics that validate the value and the impact. As with any successful business, survival is based on perceived and actual value and all of us should hold this all-important system to that standard of success.

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