

**Report Submitted to the**  
**Utah System of Higher Education**

**Engineering Education in Utah**  
**Activities, Observations, Recommendations**  
**and Conclusions**

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## Table of Contents

<b>Table of Contents</b> .....	1
<b>I. Executive Summary</b> .....	2
<b>II. Overview</b> .....	4
<b>III. Summary of Institutions Visited</b> .....	6
<i>Utah State University</i> .....	6
<i>Weber State University</i> .....	6
<i>University of Utah</i> .....	7
<i>Utah Valley State College</i> .....	7
<i>Southern Utah University</i> .....	8
<b>IV. Observations</b> .....	9
<b>V. Recommendations and Conclusions</b> .....	12
<b>Biographies</b> .....	15

## I. Executive Summary

Utah seeks to develop, grow, and meet the high tech workforce and education demands of its population and corporate citizens. The development of the very highest quality, globally competitive technician, technologist and engineering talent is paramount to maintaining and improving Utah's high-technology sector. Of the nine-credit-granting institutions governed by the Board of Regents within the Utah System of Higher Education (USHE), two Utah institutions, the University of Utah and Utah State University have historically been charged with meeting the bachelors-level and graduate engineering-education needs of the state. The other institutions have traditionally offered pre-engineering and engineering technology programs focused on regional needs.

In 2001 the Utah Legislature passed SB 61, often referred to as the Engineering Initiative, in recognition that the Utah economy increasingly depends on high tech industry. The objective of this legislation is to double the number of engineers and computer scientists graduating from Utah higher education institutions. While these and other efforts have been successful in increasing the number of graduates, the USHE has received requests to initiate engineering programs from Weber State University and Utah Valley State College. The Regents approved an integrated engineering degree at Southern Utah University in 2001.

To assist in better understanding the needs and opportunities for engineering education, USHE asked three experienced engineering educators/administrators to examine and review the engineering and technology programs at five of the USHE institutions and make recommendations about future courses of actions. After considering materials provided from and meeting with officials from the Utah State University (USU), Weber State University (WSU), the University of Utah (UU), Utah Valley State College (UVSC), and Southern Utah University (SUU), these consultants prepared the following report and recommend that the Board of Regents make every effort to:

- Determine accurate technical workforce needs now, and on an ongoing basis, within the state of Utah and beyond.
- Develop a state-wide strategic plan for both technical workforce education/development and for workforce creation. Benchmark and compare best practices from within and outside the state.
- Place a moratorium on new engineering and technology program development until the tasks above have been accomplished.

Based on our interpretation of the higher educational landscape in Utah, particularly as it applies to Engineering, we recommend that:

- Unless the ‘place-bound constraint’ is unequivocally insurmountable, invest preferentially in engineering programs at the two comprehensive Universities in the state, USU and UU.
- Develop a plan that utilizes the strengths of the two comprehensive universities to provide engineering education, combining judicious use of distance technology with commuting and use of local facilities.
- Hold those comprehensive universities responsible to commit to partner programs that will have unparalleled accessibility without compromising quality of either the content or the students in the programs.
- Convince large employers to commit to supporting minimum numbers of students for expensive programs that are being tailored almost exclusively for their needs.
- Continue both the Engineering Initiative and USTAR program, which have been successful for workforce development and economic development respectively. Independent Peer Review and Board review of the distribution of funds from those programs should be done regularly.
- The important roles of the technician and the technologist should not be overlooked in the mission of many of the Utah schools. There is a definite place for the type and/or academic qualification of the student in these programs.

Furthermore, in response to the direct questions posed by the Commissioner’s office the consultants offer the following recommendations:

1. *Given the Engineering programs that exist in the state of Utah, does the Utah System of Higher Education need to add additional programs offering Engineering Degrees to meet the increasing demand?*
  - It appears that additional capacity needs could be met by making judicious use of the two comprehensive state universities.
2. *If additional offerings are needed to meet the demand for Engineers in Utah, which specialties should be added at which institutions?*
  - This should be forthcoming from the results of a technological workforce needs assessment and a state-wide workforce education/development and workforce creation plan identified in the first two bullets. It does appear that engineering talent for the service sector is needed.
3. *Will a Bachelor of Science in Engineering serve students well if that is the only Engineering Degree the institution is offering?*
  - No, not under the circumstances proposed. These programs do not typically produce the highest quality graduates or graduates who are likely to contribute directly to job creation through entrepreneurial activities such as new company start ups. Exceptions for stand-alone programs are often at more selective or smaller private schools that also may have a strong liberal arts curriculum component.

## **II. Overview**

The Utah System of Higher Education (USHE) consists of nine credit-granting institutions and is governed by an eighteen-member Board of Regents. Two of these institutions, the University of Utah and Utah State University, have historically been charged with meeting the bachelors-level and graduate engineering-education needs of the state. The other institutions have traditionally offered pre-engineering and engineering technology programs. The Regents approved a bachelor's degree in integrated engineering at Southern Utah University in 2001. Since then USHE has received requests to initiate engineering programs from Weber State University (Bachelor of Science in Engineering) and Utah Valley State College (Bachelor of Science in Computer Engineering).

In 2001 the Utah Legislature passed SB 61, commonly referred to as the Engineering Initiative. The impetus of this legislation was the recognition that the economy in Utah increasingly depends on high tech industry, and the belief that increasing the available pool of engineers and computer scientists is vital to continued growth. The objective of this legislation is to “dramatically increase the number of engineering and computer science graduates in the state of Utah.” The objective of the Engineering Initiative includes:

- Doubling the number of engineering graduates in five years,
- Providing one-time funds for equipment purchases to improve the quality of instruction in engineering, computer science and related technology, and
- Increasing the physical capacity by funding new and remodeled capital facilities.

The Technology Initiative Advisory Board (TIAB) was created to make recommendations to the USHE Board of Regents regarding the Engineering Initiative. In TIAB's 2007 report to the legislature they noted that the growth in engineering and computer science degrees in Utah is around twice the national average, with a growth from 2000-2007 in engineering degrees from 862 to 1183 and in computer science degree from 482 to 577. The TIAB also reported that the demand for computer scientists and engineers “has reached unprecedented levels” and that some Utah companies are experiencing “constraints to business growth due to the lack of qualified workers.” The report further notes that the Engineering Initiative has never been funded at the targeted level. Since all of the institutions comprising USHE house programs involving instruction in engineering, computer science, and related technology, including pre-engineering, all have received Engineering Initiative funding. Because a major aim of the Engineering initiative was to increase capacity at existing programs, the majority of the funding has gone to the University of Utah and Utah State University.

Even with the implementation of the Engineering Initiative, it is reported that the demand for engineers and computer scientists in Utah continues to grow faster than the supply. Owing to many worthy and competing state-wide needs, finite legislature appropriations, and an uncertain economy, USHE wishes to plan wisely and efficiently for the future of engineering education in Utah. To this end, USHE engaged three experienced engineering educators/administrators to examine and review the engineering and

technology related programs at five of the USHE institutions and to address several questions. These individuals were supplied a briefing packet compiled by USHE, visited four of the campuses and spoke with administrators of each of the five institution on April 20-21, 2008, and met with USHE staff.

The briefing materials supplied to the consultants included:

- A listing of the majors/degrees of the USHE institutions offering engineering and technology programs.
- A table listing the composite annual combined number of engineering and technology degrees awarded by four USHE institutions from 2001-02 to 2006-07.
- A state map and table showing the population growth on a county-by-county basis.
- A table summarizing the *Utah Engineering Workforce Data Survey Results*.
- TIAB's *Utah's Engineering Initiative Comprehensive Five-Year Report*.
- TIAB's *Utah Engineering Initiative 2007 Report to the Legislature*.
- Overviews of the engineering and technology programs at
  - The University of Utah
  - Utah State University
  - Weber State University
  - Southern Utah University
  - Utah Valley State College
- The Proposal by Weber State University for a *Bachelor of Science Degree in Engineering*.

Each of the five institutions also offered additional printed information during the consultants visits. This was in addition to the open hospitality, facilities tours, presentations, and rich conversations between the consultants and the institution's educators and administrators. In several cases local industry representatives were on hand to discuss their needs. The sincerity, openness, and efforts of all of the individuals who interfaced with the consultants were useful and appreciated.

In addition to background information and rationale, the specific charge for this study and review was:

*With resources for new programs being scarce, members of the Board of Regents desire guidance for planning and implementing new degrees. The consultants are asked to address the following questions:*

1. *Given the Engineering programs that exist in the state of Utah, does the Utah System of Higher Education need to add additional programs offering Engineering Degrees to meet the increasing demand?*
2. *If additional Offerings are needed to meet the demand for Engineers in Utah, which specialties should be added at which institutions?*
3. *Will a Bachelor of Science in Engineering serve students well if that is the only Engineering Degree the institution is offering?*

### III. Summary of Institutions Visited

#### *Utah State University*

The visit to Utah State University (USU) was hosted by the Dean of the College of Engineering, H. Scott Hinton. Within the College of Engineering, five departments offer six different accredited BS degrees and a comparable number of MS and PhD degrees in various related areas. In 2006, USU College of Engineering granted approximately 250 BS degrees, 100 MS/ME degrees and 10 PhDs. Strong ties exist with research facilities such as the Utah Water Research Laboratory, funded by USU and the State of Utah, which give faculty and students educational opportunities not found elsewhere.

USU has a nascent partnership with Weber State University on the WSU Davis campus to offer engineering courses to Hill Air Force Base. Funding has been provided to USU and WSU to launch this joint initiative. This is a young venture and collaboration, and to date student response and demand has been modest. Whether this is an indication of the true interest in engineering degrees at Hill AFB, or a lack of awareness suggesting a need for effective marketing, is unknown. The USU College of Engineering has expressed a willingness to continue to expand its own programs and joint programs, including distance education, to meet the regional workforce needs, including that at Hill AFB.

#### *Weber State University*

The visit to Weber State University (WSU) was hosted by the Dean of the College of Applied Science and Technology (COAST), Warren Hill. Within COAST, Weber State University in Ogden offers a broad and comprehensive array of technology degrees and other technically-oriented offerings (such as technical sales). The Dean of the college is very active in not only the Weber State programs but as well in the pedagogy and accreditation of technology programs nationally. A pre-engineering program is also offered to students who can then transfer to USU or UU to complete an accredited engineering program.

The primary advocate for the engineering program at Weber State University is Hill Air Force Base. According to the representative from the base, their primary needs are shifting dramatically from engineering technology graduates to engineering graduates. Verbal descriptions of the new jobs, however, did not sound to the review team like the types of positions that typically would be filled by bachelor's recipients with engineering degrees. Further, it was not possible to ascertain the number of graduates that the base might anticipate hiring on an ongoing annual basis, nor could they specifically commit to supporting a cohort of students to pursue an engineering degree under base support.

### ***University of Utah***

The visit with the University of Utah (UU) occurred on April 21, 2008 from 3:00 pm to 7:00 pm, and was hosted by the Dean of the College of Engineering Rich Brown. In addition, each of the departments was represented by their chair who gave a departmental summary and tour. This meeting was followed by a dinner hosted by Provost Dave Pershing.

The University of Utah is a nationally recognized comprehensive research university and the College of Engineering contributes significantly to the University's stature. The College has state of the art laboratory and computing facilities for both graduate and undergraduate students. The quality of the students appears to be excellent and the expectation for these students is very high. A large number of students are involved in undergraduate research projects and/or similar experiences such as internships.

The College of Engineering has managed both the Engineering and Computer Science Initiative and USTAR funds very well. Undergraduate degrees have increased by approximately 30%, graduate degrees have nearly doubled, and there have been fourteen spin-off companies that have come out of the College over the last few years. The College has plans to increase the size of the student body by 40% and to increase the retention by 20%. If realized, both of these initiatives could add significantly to the engineering workforce needs of Utah since 70% of these students stay in the state.

The College of Engineering has capacity for additional growth in both its undergraduate and graduate programs. In addition, the College has been developing its distance education programs using easy to use and effective programs such as Macromedia Breeze which could be used in either a synchronous or asynchronous manner. Capabilities such as these coupled with on-site laboratory experiences (either at the remote location or, using the expanding mass transit system, at the host site on weekends or in the evening) could service the needs of much of Utah Valley. The College and University have expressed a willingness to accommodate these local needs.

### ***Utah Valley State College***

The visit to Utah Valley State College (UVSC) in Provo on April 21, 2008, was hosted by Dr. Ernest Carey, Dean of the College of Technology and Computing. Dean Carey was assisted Dr Abraham Teng, Chair of Computer Science and Pre-Engineering and Mr. Fred Orchard, Academic Advisor and Internship Manager. Representatives from industries in the Utah Valley, including IM Flash Technologies, Becton Dickinson, and Flowserve, participated in an open panel session.

Originally a community college, UVSC has offered bachelors degree since 1993. The current head-count enrollment is around 23,000. UVSC will become Utah Valley University on July 1, 2008. UVSC has submitted a proposal for an undergraduate Computer Engineering program. UVSC already offers a BS in Software Engineering and

a BS Computer Science degree containing an emphasis area in computer engineering. The Computer Science degree is accredited by the Computing Accrediting Commission of ABET.

A tour of UVSC laboratory showed both well-equipped and transitioning laboratories. For example, an electronics communication laboratory was outfitted with high-quality and ample function generators, power supplies, and the like. Large amounts of laboratory space previously used for discontinued programs such as welding technology and heating-ventilating-and-air-conditioning technology are available for transitioning to new purposes. Other existing technology programs are scheduled to continue as UVSC pursues implementing new engineering programs.

The impetus for UVSC's Computer Engineering proposal stems from several arguments. Among them are

- the expanded scope as UVSC transition to regional university status
- the rapidly expanding population of Utah and Wasatch counties
- the concentration of high-tech companies requiring 'soft' engineering support
- the existence of a computer engineering emphasis/option in the computer science curriculum
- the cultural tendency of students in the Utah Valley to only remain the Utah Valley for higher education opportunities
- the request from local engineering entities, governmental agencies, and students to offer engineering programs at UVSC.

Based on conversations with industry representatives, sustained demand for engineers in the region does not appear to be as great as suggested by some of the documentation.

Besides computer engineering, UVSC also has documented their future interest in exploring programs in several other engineering areas. Among the most immediate is their interest in civil engineering as it relates to their current building construction program and the heavy construction industry headquartered in the Utah Valley. The proposed computer engineering program makes possible some of the elements needed to offer electrical engineering. The existing UVSC pre-engineering program supports the first two years of study for students pursuing all engineering majors.

### ***Southern Utah University***

To reduce overall travel time, the meeting with Southern Utah University (SUU) was held in a UVSC conference room. Dr. Mikhail Bouniaev, Dean of the College of Computing, Integrated Engineering, and Technology, assisted by Dr. James Burns, Chair of the Department of Integrated Engineering and Technology, hosted the meeting. SUU offers an undergraduate degree in Integrated Engineering. The first cohort of students graduated in 2004 and the program was accredited by ABET in 2005. SUU also offers a pre-engineering curriculum.

The integrated engineering major was conceived to offer “students a balance of fundamentals in several engineering disciplines, connect those fundamentals with a systems perspective..., and to promote complex projects...” The four core ‘tracks’ in the integrated engineering program are structures, transport processes, electronics, and design. The curriculum consists of 123 semester credits. A new Center for Applied Research and Advanced Technologies (CARAT) seeks to serve as a regional resource in small and medium computing, engineering, and manufacturing businesses, thus giving faculty and students a venue for applied research.

Dr. Burns shared several of the recent senior design projects and they appear to be well executed and implemented. SUU engineering students are required to take the Fundamentals of Engineering exam and record a passing rate of over 50%.

There is apparent support from the surrounding region for an engineering program at SUU, though the engineering demand in this region appears to be modest. Students enter the pre-engineering program as a cohort and have the option to select engineering majors other than integrated engineering, and thus transfer to other four-year engineering programs. Like other regional universities in Utah, there is a tendency for students to desire to remain in the Southern Utah region for their collegiate education. And while a part of this phenomenon is related to religious tendencies and practices, at SUU there is also a geography factor, as SUU is a several-hour drive from the Salt Lake and Utah Valleys.

Future engineering considerations at SUU include the development of a masters program. It appears SUU is open to the possibility of doing this in partnership with another university.

#### **IV. Observations**

Prior to articulating the pros and cons of the strategy to expand engineering degree offerings in the state of Utah, it is useful to list some of the observations the Review Team made in the course of the visits and from reading support materials. These observations influence, to varying degrees, the landscape of the educational system in the state of Utah, and also influence the Committee’s final Recommendations and Conclusions.

- There appears to be no Strategic Plan in place for addressing state and regional workforce needs for technicians, technologists, and engineers, who should meet these needs and how they should be met are critical decisions for the future of Utah.
- Little benchmarking seems to have been done to compare the engineering needs and engineering academic programs to other states. Much may be learned by calibrating the size of the engineering academic enterprise in Utah ratioed to metrics and compared against similar measures in other states. For example, the Gross State Product (GSP) relates to a state’s population and commerce activities,

among other parameters. The current ratio of GSP to research-active public universities is \$192B for California, \$133B for Texas, \$78B for Arizona, \$76B for Michigan, \$59B for Nevada, \$58B for Colorado, and \$49B for Utah. This relatively low ranking for Utah implies that there is a proportionally smaller population/tax base to support each existing comprehensive university when compared to most other states. Clearly, adding other engineering schools in Utah will further lower this investment ratio. Other, even simpler comparisons that would be useful to consider involve demographics, overall state budget, and the number of programs and the state dollar investment per degree, etc.

- While there is some variation, many laboratories at all four institutions visited were, considering their current mission, well-equipped and spacious.
- While the Board of Regents is tasked to chart the strategic directions for the higher education system, there seem to be situations where it appears the political process generated opportunities that may not have provided the most prudent advantage for advancing state-wide engineering and related education.
- Retention of engineering talent in academic programs with open admissions programs is typically low. (This characteristic is true in most states, not just in Utah.) Proliferation of engineering programs without careful attention to the quality and rigor of the programs, in an environment with a general lack of competition, could result in the proliferation of weak engineering talent.
- There appears to be a lack of industrial engineering or service system engineering talent to address a large part of Utah's economy.
- There is a substantial difference in the academic background and preparedness of the faculty across the spectrum of universities and colleges visited. At Utah and Utah State, there is a very high proportion of tenured and tenure-eligible faculty who have received the terminal degree in their profession. A significant portion of the faculty at the other institutions do not have terminal degrees or degrees in engineering. One consequence of this difference is a lack of understanding of the fundamental differences between engineering and applied science degrees, or engineering and technology degrees.
- 90% of the state's population is within commute (and/or commute combined with distance education) of the two comprehensive engineering colleges.
- There needs to be recognition of and a more comprehensive look at meeting industry's ongoing need for technicians and technologists. Past experience from other states has shown that technology programs are often diminished or eliminated when counterpart engineering programs are introduced.
- The State of Utah higher education system is such that the lines between community college and four year college, and between four year college and comprehensive graduate-degree-granting institution, are significantly blurred. There seems to be, for the population of the state, a rather large number of institutions who offer, or aspire to offer, four year and graduate degrees. This proliferation of 'local' colleges and universities seems driven by a characteristic of the Utah culture that may be unique among the states, namely the strong predilection of the college-age population to insist on staying 'close to home' to pursue their degree. This is not the most efficient way to provide comprehensive,

quality university programs, but it may be a condition demanded by the general tax-paying population of the state.

- The often-cited constraints on the production of engineering degrees in Utah may not be due simply to the number of institutions offering degrees. It could also be a pathway issue, and in that case focus on preparation of K-12 students who are academically prepared to enroll in university engineering programs may be more critical.
- The state of Utah has an opportunity to develop, through system-wide planning based on an analysis of needs and resources, an effective and efficient comprehensive and innovative plan to meet the states engineering and technology education and workforce needs.

### ***Arguments for and Against the Addition of new Engineering Programs:***

The fundamental issue concerning the technical workforce needs of the State of Utah appears to be a debate between the development of new, autonomous degree programs at institutions other than the comprehensive colleges of engineering found at the University of Utah and Utah State University, versus the expansion of these colleges to accommodate both industry and population growth. This expansion could be through increased capacity at the comprehensive institutions or through enhanced and innovative distance education delivery or a combination of the two. The bullet lists that follow will try to summarize the arguments for and against along with a short rationale.

- Arguments for the expansion of engineering programs across the state:

- The culture within the State of Utah require that a part of the eligible student population interrupt their college studies through missions activities and then later stay at home to provide support for their families. The extent of these numbers appears to be largely unknown however there is anecdotal evidence that more than a few students have not gone on to get their engineering degrees from the pre-engineering programs due to this lack of mobility
- There is significant population growth along the Wasatch Front. The population of approximately 2.2 million people this area is growing and there will be a need for significant future job growth.
- There is industry demand for engineering graduates along the Wasatch Front. This demand has not been well documented but all of the companies that we spoke with indicated that they would be hiring engineers and many indicated that they had current openings. In addition, there was an ongoing demand for skilled machinists, technicians and technologists. Most companies preferred graduates from Utah universities but they did indicate that they would hire from more than the local educational institution. Our interviews and the workforce survey data indicated that industry has a growing need for advanced engineering degrees.
- Local universities and colleges are more responsive to the regional workforce demands and can be more flexible in meeting workforce demand than more distant state universities.

-Arguments against proliferation of engineering programs:

- The University of Utah and Utah State University both have the capacity to increase the number of engineering graduates at all levels. In addition, both universities have expressed a willingness to work with the regional institutions to meet workforce needs through various combinations of delivery such as distance education or commuting in combination with weekend or evening class offerings.
- Overall student quality for engineering graduates might be a serious concern. Open admission schools accepting the “B/C” student is much different than selective engineering schools who might take the top 10 to 15 percent of the high school class (exceptions will exist). In addition, lack of competitive peers will lower the bar for successful graduation by these students. Companies did indicate that they wanted globally competitive engineers.
- While many of the faculty involved in these programs had a Ph.D. and/or industrial experience, there appeared to be a lack of continued professional development. These faculty were typically not at the cutting edge of their fields. The large teaching load required by the institutions (12 semester hours per term) makes both professional development and the development of innovative educational programs difficult.
- The relatively high cost of developing additional quality engineering programs will take money away from the established colleges. Those funds could be used both for workforce development and economic development as additional spin-off companies are formed along the Wasatch Front.
- The real extent of the **on-going** demand for engineering BS graduates has not been well documented. If additional high school graduates move from studying in technician specialties and technology, the real shortage could be in these areas.

## V. Recommendations and Conclusions

Clearly, the value of our recommendations will depend significantly on the extent to which “we got it right” in terms of correctly interpreting the educational landscape in the State of Utah. Ideally, more data and analysis would be available to the Board of Regents so that they can more properly balance the issues before them. To that end, we recommend that the Board make every effort to:

- Determine accurate technical workforce needs now and on an ongoing basis within the state of Utah and beyond.
- Develop a state-wide strategic plan for both technical workforce education/development and for workforce creation. Benchmark and compare best practices from within and outside the state.
- Place a moratorium on new engineering and technology program development until the tasks above have been accomplished.

Based on our interpretation of the higher educational landscape in Utah, particularly as it applies to Engineering, we recommend that:

- Unless the ‘place-bound constraint’ articulated above is unequivocally insurmountable, invest preferentially in engineering programs at the two comprehensive Universities in the state, USU and UU.
- Develop a plan that utilizes the strengths of the two comprehensive universities to provide engineering education, combining judicious use of distance technology with commuting and use of local facilities.
- Hold those comprehensive universities responsible to commit to partner programs that will have unparalleled accessibility without compromising quality of either the content or the students in the programs.
- Convince large employers such as Hill AFB to commit to supporting minimum numbers of students for expensive programs that are being tailored almost exclusively for their needs.
- Continue both the Engineering Initiative and USTAR program, which have been successful for workforce development and economic development respectively. Independent Peer Review and Board review of the distribution of funds from those programs should be done regularly.
- The important roles of the technician and the technologist should not be overlooked in the mission of many of the Utah schools. There is a definite place for the type and/or academic qualification of the student in these programs.

In response to the direct questions posed by the Commissioner’s office we offer the following recommendations:

1. *Given the Engineering programs that exist in the state of Utah, does the Utah System of Higher Education need to add additional programs offering Engineering Degrees to meet the increasing demand?*
  - It appears that additional capacity needs could be met by making judicious use of the two comprehensive state universities.
2. *If additional offerings are needed to meet the demand for Engineers in Utah, which specialties should be added at which institutions?*
  - This should be forthcoming from the results of a technological workforce needs assessment and a state-wide workforce education/development and workforce creation plan identified in the first two bullets. It does appear that engineering talent for the service sector is needed.
3. *Will a Bachelor of Science in Engineering serve students well if that is the only Engineering Degree the institution is offering?*
  - No, not under the circumstances proposed. These programs do not typically produce the highest quality graduates or graduates who are likely to contribute directly to job creation through entrepreneurial activities such as new company start ups. Exceptions for stand-alone programs are often at more selective or smaller private schools that also may have a strong liberal arts curriculum component.

Utah has an opportunity to develop the Wasatch Front into a major technology corridor similar to others around the nation. The development of the very highest quality, globally competitive technician, technologist and engineering talent is of paramount importance. The emphasis must be on a quality (not quantity) workforce, even as the number of graduates increases, if existing companies are to thrive, new companies are to be attracted to the region, and if new companies are to be created. A coordinated effort by the Board of Regents must include the participation and cooperation of the educational institutions, the legislature, and the local communities, particularly industry. The opportunity is there but it must be seized before the unplanned proliferation of programs across the state takes place.

## Biographies

Benjamin S. Kelley is the Dean of the School of Engineering and Computer Science at Baylor University. He earned his undergraduate degree in Civil Engineering from Auburn University and his masters and Ph.D. in Mechanical Engineering from the University of Kentucky. Previously Dr. Kelley was senior scientist and Section Head at Southern Research Institute. More recently he served on the faculty of Mercer University School of Engineering, including Chair of the Department of Biomedical and Environmental Engineering. He was named Mercer's outstanding faculty member in 1997. He has also served as a visiting faculty member at Duke University and the University of Pittsburgh. Since coming to Baylor in 1999, student quality and faculty contributions have increased. Baylor's engineering program has been ranked nationally as high as fourteenth among peer intuitions by *US News and World Report*. Dr. Kelley has authored over 100 research and educational publications and presentations. He has international experience in Asia, South America and Europe. He is an experienced ABET program evaluator and was elected to the ABET Engineering Accreditation Commission in 2008.

Thomas W. Peterson is Dean of the College of Engineering and Professor of Chemical Engineering at The University of Arizona. He received his B.S. degree from Tufts University in 1972, M.S. from the University of Arizona in 1973, and Ph.D. in 1977 from the California Institute of Technology, all in Chemical Engineering. He has served on the faculty of The University of Arizona since 1977, as Head of Chemical and Environmental Engineering from 1990-98, and as Dean since 1998. He is vice-chair of the Executive Board for the Engineering Deans' Council of ASEE, and was Technical Program Co-Chair of the Engineering Deans' Institute in Tucson, 2005. He has served on the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET), and on the Board of Directors of the Council for Chemical Research. He is a Fellow of the American Institute of Chemical Engineers and a recipient of the Kenneth T. Whitby Award from the American Association for Aerosol Research.

Robert O. Warrington is the Director of the Institute for Interdisciplinary Studies at Michigan Technological University, where he was Dean of Engineering from 1996 to 2007. He served on the faculty at Montana State University for eight years, was the head of the Mechanical and Industrial Engineering Department at Louisiana Tech University for 11 years, and was the founder of the Institute for Micromanufacturing. He was an associate editor for the ASME/IEEE Journal of Microelectromechanical Systems and has over 145 technical publications and 39 research grants. Dr. Warrington is the founder of the Commercialization of Microsystems Conferences and past founding president of MANCEF and a member of the executive board. He is currently Associate Director of the Wireless Integrated Microsystems at a NSF Engineering Research Center. Dr. Warrington is VP for Education and sits on the advisory board for the Nanotechnology Institute for ASME. He has been involved in accreditation for over 25 years and served on the Engineering Accreditation Council and the Executive Committee of the Engineering Accreditation Council of ABET. Dr. Warrington is VP for Education for ASME and leads their accreditation activities. He is a Fellow of ASME and AAAS.