FAMU-FSU Joint College of Engineering Study

Final Report

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Preamble

The Florida Agricultural and Mechanical University – Florida State University
Joint College of Engineering Study

The Florida Agricultural and Mechanical University (FAMU) – Florida State University (FSU) Joint College of Engineering (Joint College) has served the citizens of Florida for more than three decades. During this period it has provided engineering educational opportunities, contributed to the advancement of engineering through scholarly research and through the graduation of students of varied backgrounds, most notably women, African Americans and other minorities. It has modeled the successful melding of diverse philosophies and approaches to education. FAMU and FSU arrived at 1982, the year in which the Joint College was established, with commitments to diverse missions and weighted by histories that challenged whether they could create a joint institution to advance both of their missions. Notwithstanding the worthy aims of the Joint College, it has experienced opposition to its existence and doubt about its viability since it was initially proposed.

Today, questions about the Joint College's viability are now combined with assertions that it is incompatible with the aspirations of FSU to become a world-class research university. Arguments along these lines have resulted in the study addressed in this document. Do past achievements of the Joint College and its potential for future contributions to engineering education and research ensure its continuation? The study described in this document does not attempt to persuade any course of action, but it does seek to illuminate factors that support the continuation of the Joint College and factors that support separate engineering colleges with differentiated programs at the two universities. The illumination of the two engineering education options aims to aid the Florida Board of Governors in meeting their responsibility to maintain an outstanding system of higher education. The aim of CBT UC in conducting the study is to make certain that the engineering education options available in Tallahassee are clearly analyzed and presented without bias toward either university or their constituents.

The Joint College of Engineering represents an experiment in American higher education, rich with elements that have forged differences and been sources of conflict in American society. It represents an experiment in which those elements have served as sources of strength. The investment of resources, the dedicated work by educational and political leaders, and the graduates produced, and the research pursued at the Joint College are significant. Whatever perspective is taken about the Joint College and whatever positions are taken about its past and future, its accomplishments cannot be overlooked. The women and African Americans whose paths into engineering have been provided by the Joint College, the careers in academe and industry that began at the Joint College, and the research studies produced at the Joint College represent achievements in American higher education that are likely to attract future academic studies.

Executive Summary

A team of consultants from CBT UC was engaged to study the choice between 1) maintaining the FAMU-FSU College of Engineering as a Joint College, or 2) splitting it into two differentiated colleges of engineering. The team did extensive economic modeling of the need for engineers in the Florida economy over the next 10 years. It also accumulated extensive information from the institutional research operations at various universities to obtain a detailed picture of the engineering graduate supply at bachelor's, master's and doctoral levels for both public and private schools in the state. Interviews and focus groups were carried out involving the Chancellor and his staff, the Presidents of both FSU and FAMU and their staffs, the Dean of the Joint College and his staff, the Dean Emeritus, the faculty, staff, students, alumni, and advisors of the Joint College in order to assess the current situation, and its relationship to the missions of each parent university.

The economic study shows that there are needs for additional engineers within Florida in a few disciplines including computer engineering. In other disciplines, such as chemical and electrical engineering, there may be an oversupply of engineering talent currently produced in the state. In any case, the expansion of engineering research capability in Tallahassee may help develop a high-tech corridor in the Big Bend region. FSU seeks to become a top 25 public research university and gain an invitation to become a member of the Association of American Universities (AAU). Florida has very few AAU schools relative to other states of its size. The leap forward by FSU to the scale of research that characterizes the output of a top 25, AAU university may significantly enhance Florida's high-tech economy. Hence, FSU's mission goal is well supported by economic development and citizen opportunity.

FAMU wishes to maintain its role in engineering for two reasons: 1) to continue to provide access to engineering as a career path for students who otherwise would not have the option, and 2) to achieve its emerging mission to expand its world-class research. As a land grant school, its original mission includes engineering as a focus. Hence, FAMU's mission goal to maintain strong engineering is well supported by its original mission and projected opportunities for Florida citizens.

All parties agree that the current organization and implementation of the Joint College is not reaching its potential. Enrollment numbers show that it not as successful as many other schools in the State University System, either in the overall production of graduates or in graduation of minority Floridians. This appears to be largely because of the strain between the differing missions of the two parent universities, and a poor organizational structure based on the

original Memoranda of Agreement. The structure seeks to save money, and to protect each parent university with little regard for the impact on student experience and faculty and staff productivity. The faculty, staff and students in the Joint College are of high caliber and committed to its unique mission, but are frustrated by the organizational barriers to success.

A critical factor in deciding whether to improve the Joint College or to separate it into two colleges is Title VI of the 1964 Civil Rights Act and the accompanying Fordice decision in the US Supreme Court. They appear to state that there cannot be duplicate engineering programs in Tallahassee, one that is predominantly white, and the other predominantly black. This would be viewed as a separate-but-equal educational system. Under this condition, separate engineering programs would either need to deal out the disciplines among the two parent universities, or to form two colleges with substantially different organizations (*e.g.*, one with traditional departments, and the other with Grand Challenge-based, multidisciplinary clusters). The former could result in two incomplete and ineffective engineering colleges.

The cost to set up a new FSU engineering college that has the scope of a top 25 public engineering college is estimated at $500 million. The Fordice Decision seems to imply that the same $500 million would need to be invested in the FAMU engineering college. Hence, the overall cost to set up a two-college system may be prohibitive.

Developing a more successful Joint College will also cost money. The Joint College will need a significant reorganization, focusing on student success and faculty productivity. This would include significant renovation of Buildings A and B, and completion of Building C. Many systems now borrowed from the two parent universities would need to be brought into the Joint College and customized to simplify administration and effectiveness of the unit. For the Joint College to be successful, FAMU would need to substantially improve the mathematics preparation of pre-engineering students, and reemphasize recruiting talented students through scholarships and marketing. FAMU would also need to bring its engineering faculty start-up and salary packages up to the level of FSU as part of the reorganization.

Neither path facing the Board of Governors is simple. However, the achievement of exceptional engineering education in Tallahassee holds great potential for economic development, particularly in bringing high-tech to the Big Bend region, and in career development and improved lives for many Floridians.

I. Introduction

A. Background

Although examples of cooperative agreements between historically black colleges and universities (HBCU) and historically white colleges and universities (HWCU) existed prior to 1982, the agreement between Florida A & M University (FAMU) and Florida State University (FSU) in 1982 to establish a jointly managed and operated college of engineering was unique. The potential it created to increase women and African American graduates in engineering; the shared responsibility it required for teaching, research, and management; and the level of communication and collaboration it fostered were unparalleled in prior agreements between HBCU and HWCU. Bound by their common interest in offering engineering degree programs, these two public universities with diverse histories, diverse missions, and diverse aspirations have met the challenges posed by these diversities and for the last thirty-two years, through the joint FAMU-FSU College of Engineering (Joint College), contributed positively to engineering education in America. The first baccalaureate degree in engineering was awarded in 1985, the first master's degree in 1989, and the first doctoral degree in 1991. Since those beginnings the joint FAMU-FSU College of Engineering has awarded more than 5,000 baccalaureate degrees, more than 1,000 master's degrees, and more than 200 doctoral degrees.

The college owes its origin not only to the goals of the two universities, but also to the confluence of other factors, especially Title VI of the Civil Rights Act of 1964. Title VI has been used by the Office of Civil Rights, of initially the United States Department of Health Education and Welfare and later the United States Department of Education, to compel several Southern states including Florida to dissolve the segregated educational systems they were found to have been operating in 1969. In subsequent agreements with the Office of Civil Rights that evolved during the 1970's Florida committed to the enhancement of Florida A & M University. That commitment was expressed in the plan entitled, "Florida's Commitment to Equal Access and Equal Opportunity in Public Higher Education," dated February 1978. In this plan, shared with the Office of Civil Rights of HEW, the state affirmed its intention to:

> Give priority consideration to placing any new undergraduate, graduate, or professional degree or non-degree program, which may be proposed at the traditionally black institution, consistent with its mission and consistent with the educational needs of the state. When such programs are proposed by Florida A & M University, consistent with its mission and consistent with the needs of the state and students, priority consideration will be given for program approval and for development assistance.

The Joint College, buttressed by the constraining forces of Title VI, the goals in engineering of FAMU and FSU, and the determination of the university presidents, began a journey without models to follow. Although their resource bases were different and although their philosophies of education were different, they both brought to the Joint College valuable assets. FSU brought the potential for a strong funding base to the college, stronger than FAMU alone could have provided and FAMU brought the potential for attracting an academically well prepared African American student population, stronger than FSU alone could have attracted at that time. The divergence between the two institutions in financial strength present in 1982 has not diminished in the intervening 32 years. The divergence between the two institutions in the ability to attract African American students present in 1982 has dissipated. Today, midst a decline in African American enrollment from FAMU in the College of Engineering and increasing financial support from FSU for research and teaching, questions about the viability of the Joint College have taken on a significance not heretofore realized.

Table I. Enrollments in the FAMU-FSU Joint College of Engineering

	Enrollment Years									
Institution and Degree	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**
FAMU B.S.	582	493	430	435	471	472	505	471	379	321
FSU B.S.	801	765	758	767	745	852	894	948	992	1109
FAMU Grad	56	39	36	30	29	35	35	31	26	24
FSU Grad	228	234	233	232	215	225	229	246	244	246

Critics of the Joint College now use the declining presence of FAMU students to advance the argument that the college should be separated. In Table I enrollments in the college from FAMU and FSU are shown. The enrollment numbers at the undergraduate level for both universities include only students with a declared major in an engineering degree program.

The undergraduate degree programs are Chemical, Civil, Computer, Electrical, Industrial, and Mechanical Engineering. The graduate degree programs include Biomedical Engineering and the undergraduate programs cited minus Computer Engineering.

The decline in the enrollment and persistence (see graduation data shown in the appendices) of FAMU students should have motivated some strategic initiatives. Significantly, the difference in total enrollment (FSU – FAMU), which was 391 in 2004 increased to 1,010 in 2013. Between fall 2004 and fall 2013 the total enrollment of FAMU students in the FAMU-FSU Joint College of Engineering declined 46 percent. Also of note is the fact that the FAMU undergraduate enrollment in Civil Engineering was 253 in 2004 and increased steadily to 409 in 2010 and then dropped dramatically to 136 in 2011, and reached a 10-year low of 66 in 2013. These fluctuations in enrollment numbers are largely explained by the fact that, from 2004 until 2010, all pre-engineering students at FAMU were assigned to the Civil Engineering major.

B. Purpose and Scope of Study

In the legislative session of 2014, an amendment was added to the General Appropriations Act to establish at Florida State University a separate college of engineering. The proposed separation of the Joint College was opposed by the President of FAMU and supported by the Interim President of FSU. That legislation stimulated debate among the supporters for the two universities with very diverse views expressed. Although race has been a factor in the history of the Joint College, the views that have been expressed about its proposed dissolution have not consistently been along racial lines. The opposition to the legislation resulted in a compromise whereby the Florida Board of Governors was directed to obtain the services of an independent non-Florida based organization to conduct a study of the proposed separation. Specifically, the RFP states:

> The Board (Board of Governors, State of Florida) is seeking to obtain the services of an independent non-Florida based educational consultant to conduct an academic feasibility study of the Florida Agricultural and Mechanical University/Florida State University Joint College of Engineering (Joint College) that will analyze the pros and cons of maintaining the status quo collaboration that currently exists between the two Universities with respect to the College of Engineering, including an examination of the original mission of the Joint College, and the pros and cons of developing differentiated engineering programs at each university. The study shall include a cost-benefit analysis of each option, analyzed in the context of Title VI of the Civil Rights Act of 1964 and with the goal of achieving world class engineering opportunities for students at both universities. The study shall also include an analysis of statewide public and private postsecondary engineering program offerings and workforce demand for engineering degrees at the baccalaureate and graduate levels.

The Collaborative Braintrust Consulting Firm's University Division (CBT UC) of Sacramento, California responded to the RFP and received the contract to conduct the study of the options as described. This report sets forth the analysis of the pros and cons of the two engineering options, an examination of the original mission of the Joint College, a cost-benefit analysis of the options, and an analysis of the constraints that Title VI of the Civil Rights Act of 1964 imposes on the two engineering options. The options have also been examined from the perspective that world class-engineering opportunities for students at both universities is a goal. The postsecondary engineering offerings at public and private institutions in the State of Florida are analyzed. The examination of another contextual variable, workforce demand for engineering degree recipients, undergraduate and graduate, through 2024 is also presented.

C. Organization of the Study

The study has involved reviews of two histories of the development of the Joint College, state plans for higher education, catalogs of the two universities, strategic plans, and program materials from the Joint College; budgets, data on enrollments, graduates, research, grants and contracts, patents, and endowments; interviews with the Board of Governors Chancellor Marshall Criser III and his senior staff, FAMU President Elmira Mangum and her senior staff, FSU Interim President Garnett S. Stokes and her senior staff, and interviews with the College of Engineering Dean Yaw D. Yeboah and his Associate Deans; Dean Emeritus Ching Jen Chen; focus group discussions with faculty, staff, students, alumni, and the Joint College Advisory Board members; and close readings of consent decrees entered into by some southern states in response to actions taken by the Office of Civil Rights. The study conducted and the findings are presented in four sections following this introduction. In Section II, entitled Situational Analysis, elements that both frame and inform the analysis of the two engineering education options are presented. Included in this section are discussions of the roles of engineering at the two universities. There are some factors, which challenge the viability of any proposed change in engineering education at the Joint College.

There are some factors that challenge the viability of any proposed change in engineering education at the Joint College. These have been termed critical factors and they are discussed in Section III. The original mission of the Joint College is described in Section II and examined in Section III. The heart of the report is found in Section IV under the heading, Analysis of the Proposed Engineering Education Options. In this section the pros and cons of the two options are described and critically examined. Also located in this section are the engineering workforce demand analysis and the cost-benefit analysis of the two options. The goal of achieving world-class engineering opportunities is brought into focus in the cost-benefit analysis of the two options. This report faithfully follows the RFP and does not contain any recommendations; however the major findings of the study are summarized in Section V, the Conclusion. References used in the development of the study are listed in Section VI. The Appendices are found in Section VII. They

contain tables of data on the scope of engineering education in Florida and engineering workforce needs. Information on the research process and the research team that conducted the study are also presented in the Appendices.

The study undertaken by CBT UC and set forth in this report provides the Board of Governors with a thorough examination of the two engineering education options. It affords them guidance and perspectives that are historical and futuristic. Ultimately, this report is a resource that can assist the Board of Governors and the Florida Legislature in fulfilling their responsibilities to the citizens of Florida.

II. Situational Analysis

A. The FAMU-FSU Joint College of Engineering

1. Historical Overview

In the late 1970's, the State of Florida was engaged in a continuous dialogue with the Office of Civil Rights of the U. S. Department of Health, Education and Welfare as it sought to obtain approval of its plan to dissolve the remnants of its former dual system of education, to enhance new program development at FAMU (its only HBCU), and to create a unified system of higher education. Also in the late 1970's engineering was a topic of discussion at both FAMU and FSU. FAMU had growing baccalaureate degree programs in civil and electronics engineering technology. In 1980 FAMU expanded its program offerings to include architectural engineering technology and construction engineering technology. FSU, almost two decades earlier, had ventured forward and established a School of Engineering Science in 1959. This endeavor was short lived and the school was eliminated in 1972 due to projected financial deficits. The desire to become a major research university persuaded the leaders at FSU that the establishment and operation of an engineering college was a necessary step toward this ambitious goal. FAMU, as a land grant university with a career focused mission, viewed professional engineering degree programs as a logical extension of its engineering technology curriculum and as an unfulfilled part of its mission.

According to ACE Fellow Karen Frair in *Now Is the Time* (1989) FAMU claimed in its mission statement to be

> … a residential multipurpose university whose principal role is to provide professional education for career oriented students whose aim is for entry level professional positions in business, industry, and the professions.

Karen Frair also writes that in 1989 FSU claimed in its mission statement to be

> … a comprehensive graduate-research institution with state-wide responsibilities offering diverse undergraduate, graduate, advanced graduate and professional studies, and, generally, undergraduate preparation for advanced study.

The expressed ambition of these two Tallahassee institutions to offer engineering programs was never uniformly supported. Perhaps this fact, perhaps Title VI of the Civil Rights Act of 1964, or perhaps the wisdom of the leaders of the two universities led to their collaboration in proposing to establish joint engineering programs. On February 11, 1982, the Board of Regents approved the establishment of the Joint College based on the agreement entitled "Proposed Guidelines and Agreements for FAMU and FSU Developing a Single Engineering School in

Tallahassee," signed by Presidents Walter Smith (FAMU), Bernard Sliger (FSU) and Chancellor Barbara Newell (Board of Regents). Although operational information was not included in the agreement and was left to be specified, the agreement did formally establish the FAMU/FSU Institute for Engineering.

Inherent in the establishment of the FAMU/FSU Institute was the notion of oneness - a single engineering institution in Tallahassee. Since the Institute began without facilities and faculty and since the presidents decided to begin in August 1982, the Institute had to rely on the two universities for resources. Thus, from the beginning the concept of twoness emerged and it has not dissipated.

The academic engineering programs at the BS level that were initially approved for the Institute were:

- Electrical and Computer Engineering
- Chemical Engineering
- Civil Engineering
- Industrial Engineering
- Mechanical Engineering.

The FAMU/FSU Institute for Engineering sought to offer excellent undergraduate and graduate programs in engineering subjects, to increase the number of women and minority engineering graduates, and to achieve national and international recognition for excellence in engineering research.

In 1982 courses in civil engineering and in the electronics option of electrical engineering were taught at FAMU by FAMU faculty. Courses in the computer engineering option of electrical engineering were taught at FSU by FSU faculty. In subsequent years, chemical engineering and mechanical engineering courses were taught at FSU by FSU faculty. Industrial engineering courses were delayed until 1986 and by that time the name of the institution had changed to the FAMU-FSU College of Engineering (1985).

Specificity about the administration of the Joint College (Institute) was resolved over a period of five years, culminating in the 1987 Agreement of March 31, 1987 and as amended, August 31, 1987. The division of responsibilities between the two universities for the management of the Joint College and their respective time differences for the processing of requests for services led to criticism of the management structure. This resulted in a revision of the Joint Management Agreement of 1987 in May 2005.

Following initial accreditation by the Engineering Accreditation Commission of ABET of civil, electrical and mechanical engineering in 1986 and chemical engineering in 1987, approval was given by the Board of Regents in 1987 to establish masters programs in these fields. The baccalaureate degree program in industrial engineering was not implemented until 1988, although it had been specified in the initial agreement of 1982. Doctoral programs in chemical and mechanical engineering were implemented in 1988. The doctoral program in electrical engineering was established in 1994 and doctoral programs in civil and industrial engineering were established in 1997. In 2000, the Joint College was approved to establish masters and doctoral programs in biomedical engineering.

During the 32 years of its existence the Joint College has been the focus of many contentious issues. The histories of its current location, the delay in implementing the industrial engineering program, and the demands made by students from FAMU that the College should have more African American faculty members are notable examples. In spite of many expressed differences and openly contested issues, the Joint College has continued to serve the citizens of Florida. The history of the Joint College of Engineering is an exploration into development and change in higher education in the South following the passage of Title VI of the Civil Rights Act of 1964. This history reveals successes in proportion to the interests, passions and commitments of the political and educational leaders.

2. Administrative Structure

The administrative structure around and within the Joint College is multi-layered and complicated. Faculty members are appointed through either FSU or FAMU with some appointed on funds within the Joint College, managed through FAMU, and some appointed on funds entirely within FSU. See section II.A.5 for details.

Faculty members and staff report to the Dean of the Joint College. The dean, by agreement, is always an FSU faculty member. An Associate Dean, by agreement, is always a FAMU faculty member. The dean reports jointly to the provosts of FAMU and FSU. The provosts report to their respective presidents, who in turn report to their respective institutional boards. The Board of Governors is the constitutional governing board for the State University System of Florida, which, under Article IX, Section 7 of the Florida Constitution, establishes the duties and responsibilities of the institutional boards. The members of the Board of Governors are appointed by the Governor and interact closely with the Governor and the Florida Legislature.

The dean works closely with the Joint Management Council that consists of the provosts, presidents and CFOs of the two parent organizations. Prior to the dissolution of the Board of Regents, the Chancellor also sat on the Council. Many Joint College faculty members contend that issues were dealt with in a timely manner when the Council included the “tie-break” vote of the Chancellor. We note that recently the provosts of FAMU and FSU have been meeting

together with the Dean of the Joint College on a monthly basis and it is felt that this is improving the ability to communicate with the parent organizations and accomplish needed changes.

The February 1982 memorandum of agreement between the two universities laying out the management of the Joint College prohibits the development of an, "autonomous administrative structure, which is not responsible to the two universities." (Division of Operational Responsibilities Between FAMU and FSU, March 31, 1987) This has been interpreted as requiring the joint college to use administrative support structures from one of the two universities. The Memoranda of Agreement (1982, 1987, 2005) separate the responsibilities to the two parent universities. For example, FAMU is responsible for building maintenance, while FSU is responsible for security.

This admonition against the Joint College developing its own administrative structures has had many unintended consequences that reduce the effectiveness of the staff and faculty, and hence the student experience. For example, each term, a senior administrator enters roughly 176 courses into the FSU registration system so that the FSU matriculated students can register for them. She/he then enters the same 176 courses into the FAMU registration system so that the FAMU matriculated students can register for those courses. We heard tales of many administrative tasks that take much longer within the Joint College than in any other units due to duplicated efforts.

Since FSU is assigned security for the building of the Joint College, FSU identification cards allow entry into appropriate secure areas. FAMU identification cards do not. The solution for this situation was that FSU guest cards were issued to all FAMU students each term so that they could enter the appropriate areas. Besides being a hassle for the FAMU students that FSU students do not encounter, some FAMU students report that it made them feel like "second class citizens" in the College. While the administration reports that this issue has been remedied in the past few years, it was relayed to us by multiple focus groups as a lingering issue.

We heard stories that for some period when FSU began establishing research facilities around the Joint College, only engineering faculty with FSU affiliations were admitted to the laboratories. A faculty member appointed at FAMU could not use the facilities, even if he or she was working on a grant supporting work in those laboratories. We do not know if this was a policy issue or security issue. It was resolved after some period, but is another example of the constant barriers that some faculty, staff, and students face within the Joint College that others do not.

While it appears efficient to use FSU and FAMU administrative services in all places, faculty and students of the Joint College suggest that the ability to develop Joint College integrated services in keys areas would significantly aid the quality of teaching and research within the College.

The organizational structure facing the Dean of the Joint College is intimidating. As an example, consider Building C. The third building of the Joint College campus was described in the original plan. It was finally approved for planning in 2009. Yet the project has not progressed. This is a major issue within the Joint College as lack of classroom and laboratory space precludes growing the student body or faculty to attain some of the FSU goals. As it was described by the administration, to move anything forward requires getting the attention of the provost and president at one university, and then the other. It requires that both universities have sufficient funding or bonding capacity to move the project forward. As each university prioritizes its building requests for each legislative session, they may tend to rank projects wholly within their university above those of the shared college. The result is a negative feedback loop in which the Joint College is under resourced, leading to underperformance, which is again the reason it is under resourced. It was suggested by senior faculty members in the Joint College that this complexity of reporting and resolving issues is a barrier for hiring senior leadership.

3. Academic Programs

The Joint College currently offers bachelor, masters and Ph.D. degrees in Civil and Environmental Engineering (Not Ranked), Chemical and Biomedical Engineering (Not Ranked), Electrical and Computer Engineering (102 out of 137 ranked), Industrial and Manufacturing Engineering (65 out of 78 ranked), and Mechanical Engineering (88 out of 142 ranked). In the latest US News rankings of graduate engineering programs (public and private) the Joint College is ranked 102 out of 176 ranked. Parentheticals above show US News specialty rankings. US News does not rank disciplines such as engineering at the undergraduate level. Overall, FSU undergraduate programs are ranked 95 (publics and privates) out of 202 ranked and FAMU undergraduate programs are not reported. The Mechanical Engineering Department, using the NRC-S research ratings (PhDs.org), is 26th in research output per faculty among all mechanical engineering departments, and 13th among publics.

We talked with a number of alumni of the College who spoke very highly of the preparation they received. They hold a number of important roles in industry and the academy. Nonetheless, this impact is dulled by the enrollment trends.

Table 2D in the appendix shows enrollments and student diversity in each department over the past 10 years. Overall, the Joint College enrollments have been nearly flat for the past 10 years where other engineering schools in Florida have seen significant increases. The FSU enrollments in engineering have increased 36% over the past 10 years where FAMU enrollments have decreased 45%. During this same period, the FSU enrollment of African-American students has decreased 36%, while FAMU's enrollment of African-American students is down 46%. Education of African-American students is a key element of the Joint College mission so these numbers indicate a reduction in mission attainment.

Table 2D shows that approximately 24% of enrollments at the Joint College (UG + Grad) are women. These numbers, that have not changed significantly over the past ten years (Table 2D), and are about equal to the University of Florida engineering enrollment profile, and higher than all other SUS universities. Given the prominence of educating women in engineering within the Joint College mission, we might expect more national leadership in this aspect. To achieve such prominence would require about 40% women.

4. Research Programs

Research programs associated with the Joint College are complicated to describe. Like FSU, the Joint College considers itself to have a strong research mission. While FAMU sees research as part of its mission, it has not emphasized research to the extent of FSU or the Joint College. This is reflected in the statements of the presidents and the promotion and tenure criteria. We do know that the most recent Work Plan from FAMU states a mission with more emphasis on research than past documents. This appears to be a recent change.

Both FSU and FAMU faculty within the College are part of the Joint College's research culture, participate in the research mission, and frequently intertwine their research. For example, FAMU faculty members oversee FSU Ph.D. students and vice versa. FSU and FAMU faculty members participate in the same grants as co-principal investigators. FSU faculty members can submit research proposals through FAMU and vice versa. One issue raised by both FAMU and FSU faculty members is that the research administration office is more effective at FSU than at FAMU, leading many faculty to submit proposals through FSU simply to avoid complications. Alternatively, faculty members from both schools submit proposals through FAMU to access research funds designated for HBCUs. As a result, any separation of the research done by FSU faculty and FAMU faculty within the Joint College would be an artifact of accounting. As it should be, it is an integrated, cross-disciplinary, cross-university research endeavor.

Outside the college both universities have established research institutes in locations close to the Joint College. Examples include the Center for Advanced Power Systems (FSU), the National High Magnetic Field Laboratory (joint FSU, UF, and Los Alamos), the High Performance Materials Institute (FSU), the Center for Intelligent Systems Control and Robotics (FSU), and the Center for Plasma Science and Technology (FAMU). Due to the complexities of the Joint College funding model, FSU has invested in research programs outside the Joint College. That is, funding remains within the parent university even though the functions within the center/building are engineering related and involve FSU and FAMU engineering faculty and Ph.D. students. Most of these research laboratories are affiliated with FSU, though faculty and students from both FSU and FAMU participate in the research programs.

The measured research funding brought in by faculty in the Joint College is shown in Table 2H.

In fiscal year 2013, the Joint College reported to the American Society for Engineering Education (ASEE) research expenditures around $10 million, or around $14 million if we include research run through FSU research centers. To put this in perspective, considering FSU's goal to be a top 25 public research university, and the fact that the engineering programs in the institutions currently ranked 23-27 average $70 million per year as reported to ASEE, an FSU engineering college would have a long way to go. The University of Michigan, ranked fifth among publics, reports $234 million. Hence, it appears that the Joint College is underperforming according to the goals for its research mission by a considerable margin.

There are many reasons for this lack of performance. The five institutions ranked 23-27 average 201 engineering faculty members in engineering according to ASEE reports. The Joint College reported a faculty count of 84. Hence, the size of the college does not reach the desired level. Joint College faculty growth is hindered by budgetary and space constrictions. Graduate student enrollment in the five universities ranked 23-27 averages 1,809. The Joint College reports 279 students. Research funding per engineering faculty member in the "around 25" institutions averages $348K per faculty member. For the Joint College the current average is $119K per faculty member, according to 2013 ASEE submissions. Hence, the output per faculty member as well as the number of faculty members would need to significantly increase to achieve numbers typical of a public institution ranked near the top 25.

Our sense of the faculty of the Joint College is that they are committed to research and teaching, and doing what is possible in an understaffed and cramped environment. Spires of excellence such as the Mechanical Engineering NRC-S rankings show that there are many excellent faculty members at the college. However, the organizational structure, budget limitations, and space limitations are significant barriers to growth.

5. Faculty

Faculty within the Joint College can be appointed in a variety of ways. Approximately 24 members of the faculty are appointed through FAMU and paid from the Joint College budget. They are distributed across the departments. Approximately 24 members of faculty are appointed through FSU and paid through the Joint College budget. They are also distributed across the departments. Approximately 38 members of the faculty are appointed through FSU, but paid on FSU funds that are maintained outside of the Joint College. These faculty members are also distributed across the departments.

In the early days, the faculty was roughly equally divided between FAMU and FSU faculty and all were paid from the Joint College Budget. Since the departure of President Humphries in 2001, FAMU has not grown its support of the Joint College in line with FSU's increased support. This appears to have been due to a combination of differing financial resources available to FAMU and FSU, but also a deemphasizing of engineering within FAMU. From quotes and a conversation with President Mangum, it seems that in her administration FAMU will once again support the Joint College. However, it will be hard to catch up with the level of the FSU investment.

During this period of differential support, some open FAMU faculty positions became available but were not filled due to lack of funding for market competitive salaries and start-up packages. We were told that some of these salary lines were transferred to graduate student support. FSU desired to grow engineering, but FAMU was not able to participate. Hence, FSU allocated funds to hire needed faculty entirely from its own funding. Had this funding been contributed to the Joint College budget, it would have been transferred to FAMU accounts according to the Memorandum of Agreement (1987). We presume that to retain control of its funding, FSU set up accounts outside the Joint College, but inside FSU, to administer these funds.

During this period FSU faculty members had higher start-up packages and better salary increases than did FAMU faculty members within the Joint College. Partly this is because faculty members belong to different unions that negotiate different compensation packages with their respective universities. This has caused significant strain within the College as faculty members in adjacent offices, doing essentially the same quantity and quality of work, were compensated differently based on the university that initially employed them. In data provided by the Chancellor's Office, the budgeted start-up package for a FAMU faculty member hire in the Joint College for FY15 was roughly half of the budgeted start-up package for a FSU faculty hire in the Joint College. It is our understanding that President Mangum is aware of these discrepancies, feels that these differences are inappropriate, and has allocated funds to begin to equilibrate support for FSU and FAMU faculty members. However, given the vastly different financial resources available to the two universities, we posit that this strain will continue to be a challenge for the foreseeable future unless there are significant organizational changes within and around the Joint College and funds are found/provided/raised to move toward equity in compensation and financial support, independent of the employing university.

FSU affiliated faculty members are administered through the FSU HR processes including promotion and tenure. FAMU affiliated faculty members flow through the FAMU HR processes including promotion and tenure. As a result, two faculty members in adjacent offices, in the same department, may encounter significantly different evaluation processes. The evaluation

processes at FSU, and within the Joint College, tend to weight research more heavily than does the FAMU process. We were told of a faculty member who received negative P&T recommendations from the department, college and dean, presumably due to a weak research record, only to be tenured by FAMU based on the strength of the teaching record. We should note that we did not verify this case with FAMU and do not know the identity of the faculty member. But the case is often discussed within the College. Conversely, we have been told of faculty members with negative recommendations from the Joint College that were tenured by FSU. We do not argue that the right way to promotion and/or tenure is either the FSU or the FAMU approach. We do argue, simply, that a single set of expectations must be developed for the Joint College so that faculty there will face a fair and transparent evaluation system.

The fact that nearly half of the engineering faculty members are appointed on FSU funds outside the control of the Dean could lead to organizational control issues. Who do those faculty members ultimately report to, the Dean of the Joint College, or the FSU administration that controls their salaries? We saw no evidence of manifestation of these potential organizational difficulties. Nonetheless, it should be seen as a weakness in organizational structure.

Whichever model is eventually chosen, continued joint college or differentiated colleges, it is important that faculty and staff hiring, mentoring and promotion processes be changed so that faculty members within a college, doing essentially the same work, have the same financial and promotion opportunities. This equity should be institutionalized and not allowed to vary with changes of administrations and financial conditions.

6. Staff

The Joint College is supported by 40 staff members with 18 assigned to FAMU as employees and 22 assigned to FSU. Eighteen of these staff members are assigned to the academic departments. In focused discussions with CBT UC these staff members expressed their dedication to the Joint College and all displayed a high degree of professionalism. They did complain about the difficulty of working in a situation in which the staff must learn the policies and procedures of two different institutions.

They also indicated frustration with extraordinary time delays in receiving responses from FAMU for services and/or the processing of documents. Additionally, low morale has been produced at the college by the fact that employees assigned to FSU have received salary increases when staff assigned to FAMU did not receive salary increases or did not receive equivalent increases.

The staff contended that the major problem at the Joint College is the fact that the college does not operate with any degree of administrative autonomy. The representation of the Joint College as a symbol of unity between FAMU and FSU in engineering education is not consistent with the experience of faculty, students or staff. That fact is evident in the dual policies, procedures, and practices followed.

7. Funding of the College

The Joint College budget has been fairly steady at about $11 million per year for some time. Within the faculty there is a great deal of folklore that the College funding comes from a line item in the state budget. The Joint College administration has repeatedly looked for such and found none. The Joint College administration reports that the funds are just allocations for each partner university, broken down roughly for the current year as, $5.6 million for FSU and $5.2 million for FAMU. It is our understanding that in the beginning, both the funding and the student counts and faculty counts were relatively even. In the past decade, the student and faculty counts have become substantially skewed in favor of FSU. However, the funding of the Joint College budget has not varied proportionately.

In a joint science center reporting to three colleges in California, the three administrations agree on a total budget for the center, and then these costs are allocated to the three parents pro rata with the number of students enjoying the center from each respective school. Were the Joint College run this way, the contributions of FSU and FAMU would have changed dramatically over time.

The budget is administered by FAMU as agreed in the 1987 Memorandum of Agreement. As a result, when FSU has wanted to increase funding of the Joint College unilaterally, it has designated funds within the FSU budget but not transferred them into the Joint College. Presumably, this is to retain control of the funds in the event that they need to pull some back. Hence, there is another roughly $6 million within FSU that supports Joint College faculty and research. Beyond that, FSU has established a number of research laboratories in the vicinity of the Joint College that support faculty in the College but report to the Vice President of Research at FSU. Funds in those centers, we presume, are not credited to the Joint College.

Hence, coming up with a clear picture of the total resources of the Joint College is difficult. It includes the obvious funding within the College, plus funding held in FSU, and in the research laboratories. In any case, both operating budget and research expenditures significantly lag numbers reported by engineering colleges within universities currently ranked in the top 25 publics, as discussed in II.A.4.

Two direct impacts of the budgeting structure are 1) that research and budget numbers reported by the Joint College to ASEE and accreditation agencies may underreport the real level of activity; and 2) the Dean of the Joint College may not control a substantial subset of these resources. As noted in the faculty section, II.A.5, the fact that roughly 38 of the faculty in the Joint College are paid from FSU funds brings into question the dean's authority to run the college. For any dean, this would be a very difficult environment within which to operate.

Equally threatening is the perspective, apparently held by FAMU that the Joint College funds are FAMU funds rather than FAMU serving as a custodian of joint funds. For example, we were told that if a FSU assistant professor is promoted to associate professor he/she receives a 12% increase. If a FAMU assistant professor is promoted to associate professor he/she receives a 9% increase. This creates inequities. But since FAMU views the joint dollars as FAMU funds, the Joint College is not allowed to use its own funds to ameliorate the inequities.

In another example, the Society of Women Engineers (SWE) wanted its corporate partners to fund the Joint College in support of female engineering students. Since the Joint College does not have a foundation, the gift needed to be routed through either the FSU or FAMU Foundations. Once the funds were received, FAMU presumed that they were FAMU funds rather than joint funds and limited use of the funds to only FAMU registered students within the Joint College. This was not SWE's intent. One of the two parent universities must be custodian of the Joint College funds, but these funds should be administered through an agreed upon policy that is an amalgam of FSU and FAMU policies designed to further the success of the Joint College students and faculty. The perspective that FAMU has taken, that the Joint College funds should be administered as if they were FAMU funds, has been very divisive.

8. Enrollments

Beginning in the fall of 1982 with 35 students, the Joint College grew each year until 1992 when the total enrollment stood at 1,961. The total enrollment reached 2,107 in 1994 and then declined until 2000. Since 2000 the total enrollment has shown modest increases with some small fluctuations. In the fall of 2013 the total enrollment stood at 2,217. These numbers include students at all degree levels that declared engineering as their academic discipline of study.

During the first two decades of the Joint College the undergraduate enrollment from FAMU comprised a significant fraction of the total enrollment. In 2004, undergraduate enrollment from FAMU in the Joint College was 29.4 percent. In 2013, the undergraduate enrollment from FAMU in the Joint College was 14.5 percent of the total undergraduate enrollment. In the fall of 2013, the total undergraduate engineering enrollment from FAMU was 321, which represented a 42.3 percent decrease from the enrollment in 2004 (582). During the same

period the undergraduate engineering enrollment of FSU students showed a 35.6 percent increase (from 1,398 to 1,896). Since the FAMU enrollments are roughly 90% African-American, this decreasing participation by FAMU enrollees also indicated a significant loss in diversity.

Significantly, the largest headcount increase in undergraduate enrollment in engineering from 2003 to 2013 occurred at the University of Central Florida, with an increase of 2,192 students, or 77.1 percent. The second largest increase was at Florida International University, with an increase of 1,067 students or 55.5 percent. The institutions with the highest ten-year percentage increase were University of North Florida (179.9 percent) and University of Central Florida (77.1 percent).

At the graduate level, enrollment in the Joint College from FAMU increased from 10 in 1990 to 36 in 2003. Subsequently, the graduate enrollment from FAMU in the Joint College decreased each year until 2008 when it stood at 29. After increasing to 35 for the next two years, the number continued to decrease. In the fall of 2013 it was 24, of which 22 are African Americans. At the graduate level, the decline in enrollment of FAMU students suggests that the Joint College has not been a priority at the University. Enrollment data can be found in Tables 1A and 2D.

9. Degrees Awarded

In 1985 the first set of baccalaureate degrees in engineering were awarded by the Joint College. Six of the graduates were from FAMU and seven were from FSU. The next year 16 of the graduates were from FAMU and 30 were from FSU. During the following six years the graduates from FAMU annually constituted less than 20 percent of the graduates produced by the Joint College.

From 1993 through 1996 the number of BS degree graduates in engineering from FAMU increased and represented a substantial number of the total number of BS degrees awarded by the Joint College. For example in 1995 30.5 percent of the BS degree graduates from the Joint College were from FAMU and in 1996 35.8 percent were from FAMU. In 2000, 137 students from FAMU received the BS degree from the Joint College, representing 48.9 percent of the baccalaureate degrees awarded by the Joint College.

After 2000, the number of BS degrees awarded to FAMU students declined, but remained above 30 percent of the total number of degrees until 2005. From 2005 the number of BS degrees awarded to FAMU students declined, reaching a low of 29 for 2011-12, a number comparable to the productivity of the college in 1992.

The number of BS degrees awarded to students from FSU increased from seven in 1985 to 205 in 1995. The number then slowly declined to 140 in 2003 before increasing again. The number has varied, showing increases and decreases between 2004-05 and 2012-13. The largest number of BS degrees awarded by the Joint College to FSU students occurred in 2011-12 when 305 degrees were awarded.

At the graduate level the first MS degrees were awarded in 1989 and the first Ph.D. degrees were awarded in 1991. In 1989 one student from FAMU received the MS degree and five students from FSU received the MS degree. In 1991 the two doctorates awarded went to students from FSU. The largest number of MS degree recipients from FAMU was 18 in 2003-04. The largest number of MS degree recipients from FSU was 65 in 2003-04. The number of MS degrees received by students from FAMU has remained relatively low, from 18 in 2003-04 to three in 2007-08. In 2012-13 the number of FAMU students who received the MS degree in engineering was five. At the doctorate level the largest number of recipients from FAMU in any given year has been four. The largest number of recipients from FSU was 24 in 2006-07. Data on degrees awarded by the Joint College for the last ten years are displayed in Table II.

Table II. Degrees Awarded by the FAMU-FSU Joint College of Engineering

	Enrollment Years									
Institution and Degree	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**
FAMU B.S.	87	72	65	47	54	46	34	31	29	33
FSU B.S.	187	221	240	230	266	253	253	233	305	257
FAMU M.S.	18	10	5	6	3	4	9	5	13	5
FSU M.S.	65	51	43	42	54	52	43	61	52	55
FAMU Ph.D.	1	2	3	4	4	4	2	4	1	2
FSU Ph.D.	10	17	17	24	22	18	15	21	20	15

The differences in the number of degrees awarded by the Joint College at the undergraduate and graduate levels to students from the two universities strongly suggest differences in the missions of FAMU and FSU. Some perspective about these numbers is afforded by examining the productivity of other engineering colleges in the state, as indicated in Table III. At the undergraduate level the University of Central Florida (UCF) has almost pulled equal to the University of Florida (UF) in enrollment. UCF, however, continues to lag behind UF in BS degrees awarded. At the graduate level in both enrollment and degrees awarded UF is without peer in the state.

Table III. Comparison of Undergraduate and Graduate Degrees Awarded in Florida Public and Private Institutions, 2012-2013

	Degrees			
Institution**	**Bachelor's**	**Master's**	**Doctorates**	**Total**
Florida A & M University	34	5	2	41
Florida Atlantic University	214	48	9	271
Florida Gulf Coast University	67	0	0	67
Florida International University	352	210	42	604
Florida State University	257	55	15	327
University of Central Florida	786	251	75	1112
University of Florida	1038	1000	192	2230
University of North Florida	102	19	0	121
University of South Florida	458	215	49	722
University of West Florida	51	0	0	51
Embry-Riddle Aeronautical University	268	79	0	347
Florida Institute of Technology	210	151	4	365
University of Miami	182	61	19	262
**Private institutions in green				

B. FAMU's Role in Engineering

From the inception of the joint endeavor in engineering FAMU's senior leadership team made engineering prominent in its plans and the use of its resources. Under the leadership of President Frederick Humphries scholarships were strategically used to recruit academically well prepared African American students for engineering studies. This resulted in FAMU students comprising an increasing fraction of the undergraduate student population from 1985 through 2003. President Humphries retired in 2001; however, the momentum from his efforts sustained student enrollment in engineering through the tenure of his successor.
The decline in the undergraduate student enrollment in engineering that started in 2004 has continued and in the fall of 2013 the FAMU undergraduate student enrollment in engineering stood at 321. It should be noted that Florida State University's student enrollment is about 3.79 times the student enrollment at Florida A & M University and that during many of the years that Frederick Humphries was its president FAMU undergraduate students had greater than a 26 percent presence in the undergraduate population at the Joint College.

The views of FAMU students at the Joint College should prove instructive to those who are interested in once again achieving a growing population of FAMU students at the Joint College. Based on interviews with undergraduate students from FAMU at the Joint College, the FAMU Department of Mathematics should assess the adequacy of the courses taken by pre-engineering students to ensure good preparation for upper division engineering courses. At a minimum the students need Calculus, through Stokes' Theorem and the Divergence Theorem, and courses in Linear Algebra, and Differential Equations.

At the graduate level the enrollment of FAMU students at the Joint College has not been commensurate with the enrollment of undergraduate students. This is indicative of the emphasis that FAMU has given to the preparation of undergraduate students for successful professional careers. It is also consistent with the expressed mission of FAMU during the 1980's, 1990's and the first decade of the twenty-first century.

The decline in FAMU's undergraduate enrollment in engineering reflects that the agendas of the FAMU leadership during the last ten years included, at most, a declining interest in engineering. The recent appointment of Dr. Elmira Mangum may lead to a reversal of this trend. President Mangum has indicated that the Joint College is valued and has a significant role to play for FAMU students, faculty, and staff. Indeed, in an interview with President Mangum and her senior leadership team, she expressed an understanding of the resources required to achieve world-class engineering programs.

FAMU has a unique role to play in engineering education in Florida. Only FAMU has the license within SUS to provide the remedial mathematics and science education necessary to empower

a bright student from a disadvantaged preparation to access engineering as a career path. Some critics of the Joint College point out that FSU now sends more minority students to the Joint College than does FAMU. This simply reflects the fact that today there are many minority students that have access to the privilege of quality high school preparation. These students can gain entrance to FSU or UF or Georgia Tech or many other universities. However, there are still many bright students without this opportunity of quality preparation. Only FAMU provides them access to an engineering career.

Further, FAMU is a land grant school. "The mission of these institutions as set forth in the 1862 (Morrill) Act is to focus on the teaching of practical agriculture, science, military science and engineering...." (http://en.wikipedia.org/wiki/Land- grant university). As such, there is a Morrill imperative, whichever model is selected, that FAMU maintain programming in engineering. Many faculty and staff within the Joint College expressed fear that, under a two-college model, the small number of current FAMU engineering students and faculty would lead to a nonviable engineering program within FAMU, at least without significant additional state resources.

Like FSU, FAMU has solid, mission-based reasoning behind its perspectives on the choice between a joint or two-college model of engineering in Tallahassee.

C. FSU's Role in Engineering

FSU recently gained status as a preeminent university in the State University System of Florida. Only two universities initially passed the thresholds for this designation, FSU and UF. Other schools in the systems are moving closer to this achievement. Our understanding is that designation includes a funding supplement of $15 million per year. Criteria for the designation focus on research and graduate education.

FSU has also articulated a goal of ranking within the top 25 public universities, and of being "AAU-ready." We take this to mean that they wish to have the research and graduate student output signature consistent with universities within this invitation-only organization. FSU cannot control whether or not they are invited to join AAU, but can control if they deserve to be invited.

Achieving this goal will have a positive impact on the economy and quality of life in Florida. AAU schools drive economic development with the formation of intellectual property, spin-off companies and high-tech graduates. All of this is necessary to fuel a high tech economy. High-tech businesses often prefer to locate near major research universities for several reasons. Firstly, tech companies need STEM workers to flourish and clustering near major research universities ensures a pipeline of such talent.

Secondly, major research universities create the potential for commercialization of products and technologies. To exemplify the link between research and economic development, statistics provided by the Association of American Universities indicate that almost 300 start-up companies were initiated in the United States in connection to university technologies in 2011,

72 percent of which operated in the same state as the licensing institution.[1] At this time the Big Bend region of Florida does not have a substantial high tech component to its economy. Establishment of FSU as an engineering research powerhouse would enable attracting and building such an industry. It would attract intellectual firepower into the state including faculty, researchers, and excellent students. FSU is certainly serving this role now, but upping its game in engineering may help to expand those contributions markedly.

[1] Association of American Universities, "Economic Impact of AAU Universities". https://www.aau.edu/research/article.aspx?ID=9266. Accessed 11/11/2014

Florida ranks fourth in the US in population and is nearly tied with New York for third. The states of California, Florida, New York and Texas are significantly larger than any others. Yet an assay of top research universities, AAU members, counts:

California	9 (CalTech, Stanford, Berkeley, UCD, UCI, UCLA, UCSD, UCSB, USC)
Texas	3 (UT, Texas A&M, Rice)
New York	6 (Columbia, Cornell, NYU, Stony Brook, Buffalo, Rochester)
Florida	1 (UF)

Hence, there is ample reason to augment the excellent contributions being made to the state at the University of Florida by expanding the impact that Florida State can have in the economy-driving field of engineering. Floridians deserve more than one AAU school.

As part of this goal, FSU has recognized that a vast majority of the AAU members have active research programs in engineering and medicine. The University of Oregon is the only school in the AAU without an engineering school, medical school or agricultural school. Hence, the recent moves to expand FSU's footprint in engineering are entirely consistent with its goals.

As is clear in (Table Top 25), the Joint College currently falls far short of the research and graduate student numbers of the schools now holding the US News Graduate rankings 23-27 (around 25). FSU has tried to augment the output of the Joint College by investing in faculty and research facilities on the periphery of the College. Despite these efforts, the Joint College has not made significant gains on schools currently in the top 25.

D. State University System Governance Structure

Changes in the governance structure of the State University System over the past 15 years have played a significant part in the development of the status quo at the Joint College. From the inception of the Joint College until 2001, the Chancellor and the Board of Regents played an important role in the governance and development of the Joint College. The original Memorandum of Agreement caused the formation of a Joint Management Council that consisted of the president, provost and CFO of each partner university, plus the Chancellor. In this structure, the Chancellor was able to mediate differences between the universities.

Many long-term faculty members report that the environment in the Joint College changed substantially in 2001 when the Board of Regents was abolished by the legislature. The Joint Management Council remained, but without the balancing involvement of the Chancellor. The perception of some faculty members was that there was less need to compromise. Needed changes could no longer be resolved in the Council. This does not imply that things ground to a halt. But the faculty members report that the personalities of leadership in the two universities became a critical issue. When leadership at FAMU and FSU wanted to move the college forward, compromises could be reached. At other times, it just did not happen.

As the Regents were dissolved, the legislature created separate boards of trustees for each institution, which in turn, reported to the Florida Board of Education. The Florida Board of Education ratified the presidential selections made by the boards of trustees.

Shortly after the demise of the Board of Regents, a constitutional amendment created the Board of Governors as the governing body for the State University System and constitutional boards of trustees responsible for administering their respective institutions pursuant to the powers and duties delegated to the university boards by the Board of Governors. This change was not simply a replacement of the Board of Regents, as the individual university boards of trustees now participate in governance. We simply do not understand the distribution of authority between these two layers of governance. What is clear is that the first layer of mediation for issues of contention between the two parent universities of the Joint College is one layer further removed than under the Board of Regents. It does not appear that the Chancellor under the Board of Governors sits on the Joint Management Council as the Chancellor did under the Board of Regents.

We do note that recently the provosts of FAMU and FSU have been meeting together with the Dean of the Joint College. Reports are that this process is beginning to resolve some of the backlog of issues.

In conclusion, many within the Joint College feel that the dissolution of the Board of Regents had a significant, deleterious effect on the Joint College. Further, they feel that the complex organizational structure of the SUS disproportionately affects them due to the two-parent issues and the increased number of layers in the organizational structure.

III. Critical Factors

A. Origin of the College and Title VI of the Civil Rights Act of 1964

As discussed in Section II. A. 1., Historical Overview, the FAMU-FSU College of Engineering owes its origin to several factors. The most prominent of these is Title VI of the Civil Rights Act of 1964. Without the existence of Title VI, it is highly unlikely that the Joint College would have been established. The closing of the law school at FAMU in 1965 and the establishment of a law school at FSU in the same year by the Florida legislature are both instructive and supportive of this contention. In 2000, 35 years later, the legislature voted to reestablish the FAMU law school in Orlando and to establish a law school at Florida International University. Among the factors that support the continued existence of the Joint College, Title VI is preeminent.

During the last three decades of the twentieth century several states in the South were challenged using Title VI by the United States in federal court for maintaining segregated systems of higher education. During that period the standards for evaluating new educational programs or changes in existing educational programs in those states through the lens of Title VI emerged from many court decisions. The standards were firmly established in the court findings in U. S. vs. Fordice (1992). Although the courts have exacted an interpretation of these standards that is not broad, our perspective is that a dissolution of the Joint College that meets the standards stated below is most likely to be well received by FAMU, FSU, their respective alumni, and the citizens of Florida. Admittedly, the standards as presented do not constitute a legal opinion, nor a legal interpretation, but one that would render a legal challenge unlikely if followed. These Fordice standards require:

1. That any new degree program at a state college/university must not foster the development of a dual system of higher education or be derived from or relate to the former dual system. (No connection to segregation)

2. That any new degree program or program change at a state college/university not duplicate a program that is already available within the geographic region at a public HBCU. (No duplication)

3. That any new program or program change at a state college/university must aim toward the realization of a unified educational system. (Achieving unity)

4. That any new program at a state college/university cannot diminish the educational opportunities available at the public HBCU in the given state. (Preserving the public HBCU)

These standards, that are interrelated, constrain the possible changes that could be made to the Joint College. Any change made at this stage would have to make FAMU more attractive to white students in order to meet Fordice # 1. The no duplication requirement (Fordice # 2) means that two public engineering colleges could not be established in the same city, one at a public HBCU and the other at a public HWCU. The FAMU-FSU College of Engineering has encountered a broad spectrum of problems; however none of them are without antecedents and many simply derive from inherent differences in the two universities. The Joint College aims at unity and any separation of the college that best represents an endeavor by the State of Florida to achieve unity would be difficult to defend (Fordice #3). The Joint College is now, independent of any management defects, an integral part of both FAMU and FSU. To separate the Joint College might diminish what FAMU currently has in terms of educational opportunities available to its students and potential students (Fordice #4). Notably, the courts have consistently held that policies and practices violate Title VI only if they are traceable to prior, de jure segregation. In this regard, program duplication, which has a segregation history, poses the greater challenge to the separate-engineering-schools option.

If the decision to separate is made and FAMU receives all extant resources, buildings, equipment, laboratories, and faculty and FSU then establishes a new engineering college, could it be located in Tallahassee? Or stated differently, what type of separation arrangement would obviate a legal challenge?

It should be noted that other facts persuade our perspective that Title VI is a critical factor in the analysis of alternatives to the Joint College.

1. The letter from Assistant Secretary for Civil Rights Catherine E. Lhamon to The Honorable Rick L. Scott, dated April 25, 2014, in which Secretary Lhamon expresses concern that the dissolution of the Joint College "would directly impede the likelihood of Florida realizing the commitments it has made in the Agreement to strengthen academic programs at FAMU and avoid unnecessary program duplication."

2. In August we met with Dr. Cynthia G. Pierre, Regional Director, Region IV, Atlanta, Office for Civil Rights (OCR) and Attorney Martin Chen, OCR at the Sam Nunn Atlanta Federal Center. We learned directly of the concern expressed in the previously cited letter from Assistant Secretary Catherine E. Lhamon. The OCR expects the State of Florida to fulfill its Agreement concerning the avoidance of unnecessary program duplication.

B. Mission Shear

Historically, the missions of Florida A & M University and Florida State University have not been aligned. They have shared some overlap; however, they have been divergent in the visions that they buttressed. It is instructive to consider the first sentence of the respective mission statements found in the catalogs of the two universities.

> The mission of Florida Agricultural and Mechanical University (FAMU), as an 1890 land-grant institution, is to provide an enlightened and enriched academic, intellectual, moral, cultural, ethical, technological and student-centered environment, conducive to the development of highly qualified individuals who are prepared and capable of serving as leaders and contributors in our ever-evolving society.

> The Florida State University preserves, expands, and disseminates knowledge in the sciences, technology, arts, humanities, and professions, while embracing a philosophy of learning strongly rooted in the traditions of the liberal arts.

The first sentence of the FAMU mission statement informs the reader that the University aims at a certain environment that supports the preparation of leaders and contributors to society. The first sentence of the FSU mission statement informs the reader that the University aims at expanding knowledge in all fields based on a liberal arts philosophy of learning. The first sentence of the FAMU mission statement informs the reader that the University also aims to produce "highly qualified individuals," while the FSU sentence addresses contributing to knowledge.

The FAMU mission statement also addresses the kind of faculty and staff that it supports and that is needed to provide outstanding academic preparation for students. The mission does indicate that FAMU is committed to "exemplary research." In other portions of the respective mission statements found in the catalogs of the two universities one can find similar language. This does not negate the polar opposite directions of the past aims of FAMU and FSU, which are best represented by their published vision statements.

> Florida A & M University will provide the citizens of Florida, the nation, and the world with inspirational teaching, relevant research, and meaningful service by offering opportunities to enhance humankind.

> The Florida State University will be one of the world's premier institutions of higher education, devoted to transforming the lives of our students, shaping the

> future of our state and society, and offering programs of national and international distinction in a climate of inquiry, engagement, collegiality, diversity, and achievement.

These vision statements capture divergent aspirations. When the two universities agreed to collaborate in establishing the Joint College, FSU did not aim at becoming one of the "world's premier institutions." At that time their missions were different but not divergent. Their missions did not interfere with creating the Joint College.

The current mission of the Joint College shows considerable overlap with the mission of FSU and some overlap with that of FAMU as found in the current catalogs.

> The mission of the College of Engineering is to provide an innovative academic program of excellence at both the undergraduate and graduate levels, judged by the highest standards in the field and recognized by national peers; to attract and graduate a greater number of minorities and women in professional engineering, engineering teaching and research; and to attain national and international recognition of the College through the educational and research achievements and the professional service of its faculty and students.

The aim to achieve national and international recognition through educational and research achievements is congruent with the FSU vision of becoming "one of the world's premier institutions of higher education." Significantly, other public universities in the state are currently more productive in the graduation of women and African Americans in engineering.

The establishment of the Joint College by FAMU and FSU gave rise to the expectation that it would become a major source of women, African American, and other minority graduates in engineering. The mission addresses this expectation: "To attract and graduate a greater number of minorities and women in professional engineering, engineering teaching and research." During the first twenty years of the Joint College the enrollment of African Americans from FAMU in engineering increased each year and in a few years these students comprised more than 40 percent of the enrollment. This meant that the influence of engineering was disproportionately greater at FAMU than at FSU for those particular years. The aim to graduate a greater number of women and minorities, while modestly successful, has not resulted in the Joint College leading the state in graduating minorities in engineering. In fact, during the last five years Florida International University, the University of Florida, the University of Central Florida, and the University of South Florida have consistently produced more baccalaureate-degree graduates than the FAMU-FSU Joint College. Additionally, the

dramatic decline in the enrollment in of FAMU students in the last five years threatens the foundation of the Joint College.

In a focus group discussion with FAMU engineering students the CBT UC team was informed that FAMU students are not well prepared in mathematics when they arrive at the Joint College. The students described many problems with mathematics instruction at FAMU, which they believed placed them at a disadvantage when compared with their peers from FSU. It is recognized that the two universities have different criteria for admissions, and that FAMU subscribes to extending opportunity. FAMU accepts the challenge of admitting students with less than stellar academic preparation, and then developing them into academically competitive students. The comments of the FAMU students suggests that an assessment of the adequacy of the mathematics program for preparing pre-engineering students to enter the Joint College should be undertaken.

The catalog missions of the two universities, FAMU and FSU, are analogous to forces acting on the Joint College (faculty, staff, students, curriculum, research, philosophy, and mission). The misalignment of these forces and their opposite pulls on the Joint College in selection of faculty, start-up-funding, investment in research, and administrative processes and services have placed it under a shearing stress. It is a shear that must be removed if the college is to serve effectively the citizens of Florida.

According to the 2014-15 Work Plans for the two universities the missions and visions are now more aligned than at any point in the past. According to the FAMU 2014-15 Work Plan:

> FAMU is an 1890 land-grant institution dedicated to the advancement of knowledge, resolution of complex issues and the empowerment of citizens and communities. The University provides a student-centered environment consistent with its core values. The faculty is committed to educating students at the undergraduate, graduate, doctoral and professional levels, preparing graduates to apply their knowledge, critical thinking skills, and creativity in their service to society.
>
> FAMU ‘s distinction as a doctoral/research institution will continue to provide mechanisms to address emerging issues through innovative research, engaging cooperative and public service. While the University continues its historic mission of educating African Americans, FAMU embraces persons of all races, ethnic origins and nationalities as lifelong members of the university community.

The vision statement for FAMU now indicates that:

> FAMU will be internationally recognized as a premier land grant and research institution committed to teaching, research, and service preparing transformational graduates with high ethical values dedicated to solving complex issues impacting our global society.

The FSU mission and vision statements presented in the FSU 2014-15 Work Plan remain unchanged, *i.e.,* they are the same as found in the most recent catalog. The FAMU mission statement as presented in the 2014-15 Work Plan is closer to the FSU statement while also embracing past mission statements. The new FAMU mission statement essentially adds the advancement of knowledge for practical reasons to the published catalog statement. The vision to be a premier institution is similar to the vision of FSU.

Therefore the mission shear evident in the catalog mission statements is expected to become less acute as FAMU pursues the new mission. The shear will not completely disappear because FAMU will remain faithful to its historic mission of providing educational opportunity to students who are not academically well prepared. This aspect of the mission does not have to pose any difficulty for the operation of the Joint College, which is a challenge that FAMU has accepted in the past.

C. Engineering Research Trends

Between World War II and the end of the Cold War in 1989 engineering research in the United States was largely funded federally by the National Science Foundation (NSF), National Institutes of Health and the Department of Defense. It was predominantly single investigator, competitive funding with a well-developed peer evaluation system. Faculty researchers considered their customers to be their peers (who served on proposal ranking panels) and the federal funding agencies. This system grew the most powerful basic and applied research machine that the world had known consisting of the large science and engineering research universities, the national laboratory system, and a number of private, classified research organizations.

At the close of the Cold War, with the demise of the Soviet Union, the nation received the "peace dividend" as the Department of Defense, with its vast research dollars, scaled back to reflect the reduced threat from a second super power. The engineering research machine needed a new mission and new customers. The solution was largely commercialization of technology developed in the defense and space programs to enhance the economy and solve large, complicated societal problems.

Single investigator grants, while still important, were reduced to make funding available for large, multidisciplinary, mission-oriented research carried out by substantial teams of researchers from a variety of engineering and science backgrounds. For example, the Engineering Research Centers (and Science Research Centers) became a centerpiece of NSF funding beginning in the mid-1980's. An excellent example is the National High Magnetic Field Laboratory jointly run by Florida State University, the University of Florida and the Los Alamos National Laboratory. For a listing of the early and emerging engineering centers see (http://en.wikipedia.org/wiki/Engineering_Research_Centers). The customer base has broadened to include major corporations and society in general.

Approximately 10 years later, the large center approach evolved again to attack large societal problems that required a combination of technical and sociological approaches. MIT labeled this movement "macro-engineering" and combined large multi-disciplinary engineering research with business, political science, sociology and other fields to create integrated solutions for complex problems. They developed the Engineering Systems Division (http://esd.mit.edu) that houses these highly multidisciplinary teams.

Charles Vest stepped down as MIT President (1990-2004), served as scientific advisor to the President of the United States, and then became President of the National Academy of Engineering (NAE) (2007-2013). He brought this macro-engineering thinking to the NAE.

Although he has passed away, the movement continues to grow. In 2008 the NAE released a set of Grand Challenges (see Appendix NAE). These Grand Challenges are still very important NAE activities and many engineering programs have now incorporated aspects of the Challenges into their undergraduate curricula.

This evolution is important to the decision facing the Joint College as it informs what will be necessary for FSU to achieve a top 25 public university goal. The current Joint College is quite a distance from the metrics characteristic of universities currently achieving this ranking (see Table Top 25). To substantively advance in the rankings, FSU will need to acquire a great deal of federal funding in the forms of grants and center funding. The NAE Grand Challenges may well be a guide to providing direction for this source of funding, especially for larger, multidisciplinary centers, over the near term future. In particular, they may suggest an alternative model of "differentiated colleges."

As we have noted, Tittle VI of the 1964 Civil Rights Act and the related Fordice Supreme Court Decision might present a barrier for duplicate engineering programs in Tallahassee - one predominantly white, and the other predominantly black. One suggested path around this barrier is distributing the engineering disciplines across FAMU and FSU colleges of engineering.

Examples of such distributions include 1) one presented by FAMU administration that separated Mechanical Engineering from Aerospace Engineering and 2) one suggested by FSU faculty within the Joint College that separated Electrical Engineering from Computer Engineering. Any such separation is very inefficient. Most faculty and alumni of the Joint College stated that such a distribution would weaken both universities. We concur. Within any such distribution that we have seen, we do not believe that it is feasible to achieve the goals of either FAMU or FSU.

An alternative suggested by the Grand Challenges would be to create one college organized around traditional disciplines that contained all of them. The second college would be organized around a set of selected grand challenges. For example, rather than a Department of Electrical Engineering, it might have a Program on Energy that included mechanical engineers, electrical engineers, chemical engineers, sustainable business faculty and public policy faculty. Students would study an interdisciplinary curriculum that would give them all disciplinary perspectives on the world's energy issues. Some engineering colleges have a mixed model that includes an Energy Systems Program (Wyoming) along with traditional departments. We are not aware of any engineering colleges that have exclusively challenge-based programs. A group of science faculty at the University of Oregon has designed a potential School of Applied Sciences along these lines.

Another important dimension to the future of engineering research in Tallahassee is alignment with the Florida economy. As engineering programs expand their customer base, industrial sponsors are increasingly important. They provide internships, jobs for graduates, research projects and data. Engineering programs based on industrial relationships have grown dramatically since 1990. For example, in 2011, over 70% of the 296 start-up companies operated in the same state as the higher education institution from which they received a license. The RFP did not request an analysis of technology based industrial trends in Florida, however such a study might provide directions for development of programs such as the Tauber Institute for Global Operations (http://www.tauber.umich.edu) at the University of Michigan.

D. Multidisciplinarity

As described in section III.C, engineering in the 21st century is a team-based, multidisciplinary adventure. Over the past 20 years, the major federal funding agencies have reduced their reliance on single-investigator grants and invested heavily in large, mission-based research such as Engineering Research Centers. This multidisciplinarity transition is not limited to simply crossing from mechanical engineering to electrical engineering. It also encompasses contextualized engineering. That is, doing engineering research while considering the business,

political, social and environmental impacts of the new technologies under consideration.

Both models proposed for engineering in Tallahassee present significant challenges to multidisciplinarity. In the current joint model, engineering disciplines and research centers are co-located and cooperation among them is easily visible. However, they are distant from both main campuses making study of the contextualizing fields quite difficult. Students from the Joint College complained to us that the transportation issues in moving from the engineering campus to either of the main campuses significantly detract from their experience.

A differentiated model poses its own challenges. One model of differentiated schools of engineering would put electrical engineering at one university, and computer engineering at the other. These disciplines interact daily. Their separation would significantly reduce the effectiveness of both programs.

Many institutions face the challenges of co-location. The Michigan College of Engineering is nearly three miles from the Ross School of Business. The distances can be overcome with mission-oriented planning and investment. At Michigan, an extensive bus and calendaring system integrates the central and north campus to reduce the impact of geography.

A critical factor is barriers to multidisciplinarity erected by any of the model options, and the cost to remediate them. Left unresolved, such barriers make faculty teams less competitive for large system based grants such as Engineering Research Centers, and hence less likely for the Joint College to support FSU's aspirations to become a top 25 public.

E. Engineering Workforce Needs in Florida

Summary of Analysis

Whether the Joint College is maintained or split, both FSU and FAMU would like to increase research capacity and funding for research. In efforts to improve metrics, it is easy to lose track of the fact that greater levels of research necessarily require greater numbers of graduate students. As such, it is critical to understand whether Florida's labor market warrants a greater number of individuals with master's degrees and PhDs in engineering. When a university achieves world-class status it becomes less bound to its local labor market conditions, as former students are availed of opportunities across the nation and world. However, this does not mitigate the responsibility of a university to be a wise steward of resources given to it by local taxpayers. Students who are educated locally but who work out-of-state do not generate the same economic benefits to Florida's economy as those who remain. Secondarily, even graduates of first-rate universities compete on the national and global scale with graduates from countless other institutions - so having a first-rate name attached to one's diploma does not guarantee success or even employment. As such a university should always be mindful of students' employment opportunities within the institution's own "backyard" prior to setting sights on nationwide employment opportunities.

Industrial Engineering is the discipline that exhibits the largest education gap at all degree levels (156 at bachelor's, 112 at master's, and 102 at PhDs). Programs at the bachelor's degree level exhibit two more significant education gaps: General Computer Engineering (70) and Mechanical Engineering (46). These three program areas could expand output of graduates to meet regional demand. At the bachelor's degree level, surplus of graduates in relation to regional jobs are found in Electrical & Electronics Engineering, Civil, Chemical, and Bioengineering & Biomedical Engineering.

At higher degree levels, the program with the greatest education gap remains Industrial Engineering, which at the master's level has a 112 unfilled job gap and at the PhD level, 102.) Educational surpluses are most keenly found in Electrical and Electronics Engineering (332 at bachelor's; 622 at master's; and 698 at the PhD level.)

To achieve noteworthy national status, the Joint College has a long way to go, not only in terms of research and funding, but also in terms of degree output. Over the past three years FSU and FAMU have generated only 8% of the state's engineering graduates within the Joint College's core disciplines. Institutions such as the University of Florida, the University of Central Florida, and the University of South Florida own the lion's share of this output.

The past ten years have been rocky for engineers in the state of Florida. Most disciplines have not recovered the large amounts of employment lost during the Great Recession of 2007-2009. However, some of the largest individual engineering occupational categories have recovered modestly well in recent years, including Civil Engineers and Industrial Engineers. The bigger story is among up-and-coming categories such as Environmental Engineers, Biomedical Engineers, Nuclear Engineers, and Computer Hardware Engineers. These all experienced notable job growth over the prior ten years and are projected to continue doing so over the next ten years. The Joint College does not address all of these emerging occupational categories, but FSU and FAMU should consider doing so based on employment growth trends.

The Tallahassee Metropolitan Statistical Area (MSA) does not currently possess a supportive high-tech industry structure, but if research and education are expanded, more companies could crop up nearer to the universities. Currently, Tallahassee ranks tenth among Florida's nineteen MSAs in terms of engineers currently employed, and ranked 16th in job change over the prior ten years. On a more positive note, in nearby Panama City MSA, demand for engineers of all types is rapidly expanding. Panama City was one of only four MSAs that experienced a net increase in engineering employment between 2004 and 2014.

1. Workforce Gap Analysis

Review of Prior Research

The Florida Board of Governor's (BOG) conducted an analysis of supply and demand for baccalaureate degrees in 2013 titled *Aligning Workforce and Higher Education for Florida's Future.* The BOG carefully considered the best approach for approximating supply and demand and arrived at a method that accounts for dynamic changes to educational level requirements. This methodology removes the possibility of "double-counting" that can occur due to multiple programs being mapped to the same occupation.[2] In this analysis, employing tools available through Economic Modeling Specialists International or EMSI, we utilize a similar method of adjusting for educational level requirements and eliminating the possibility of double counting. Our analyses differ from the BOG report in that they examine not just baccalaureate degrees but master's and PhD degrees as well, and in that they focus exclusively on engineering, thereby allowing us to take a deeper-dive into data that was not highlighted in the prior BOG report.

[2] This methodological outline for the BOG report is detailed in Appendix A of the report. http://www.flbog.edu/Search/?q=gap+analysis&x=0&y=0. Accessed 11/11/2014

Introduction

The results that appear in this section present a focused view of the engineering educational groups offered by FAMU and FSU that are projected to have a gap or surplus in the state of Florida. In particular, analyses are provided for the core engineering disciplines offered at the Joint College, namely: Agricultural, Biomedical, Chemical, Civil, Computer, Electrical, Mechanical and Industrial. Programs are analyzed at the three-degree levels: bachelor's, master's, and PhD, as each level includes a unique pool of employment opportunities and graduates.

Each table includes the CIP code and title, the average annual openings associated with that program (which have been de-duplicated using the process outlined in the "About the Gap Analysis" section), the average annual completers between 2011 and 2013, and finally the gap or surplus figure. If the numbers are positive, there is a shortage or "gap" of completers—*i.e*., there are more job openings in those occupations than there are graduates or completers. If the numbers are negative, then there is a "surplus" of completers for those program groups compared to annual job openings.

Interpreting Gap/Surplus Analysis Results

The gap analysis is intended to serve as a starting point for the Joint College of Engineering as the Florida Board of Governors discusses regional workforce needs. A surplus or deficit of workers in a particular category does not necessarily indicate a problem for the region, and it is important that each occupational group be evaluated on a case-by-case basis. Other information should also be considered when evaluating these surpluses and gaps.

For example, only the education supply pipeline is considered in this analysis because these numbers can be tracked at the county and school level. However, other sources of supply exist as well—unemployed workers, on-the-job training, in-migrators, and job changers from other occupational categories. These types of considerations are useful when evaluating specific types of occupations.

Lastly, it is important to keep in mind that the labor market is not so simple or efficient that one could expect supply and demand to be at perfect equilibrium for any extended period of time. As a general rule of thumb, only programs with considerable gaps or surpluses should be considered long-term strategic issues worthy of closer examination. Given the size and characteristics of the State of Florida any gap or surplus within 10 jobs either above or below zero should be considered within the normal range of labor market fluctuations. Once evaluated internally, specific implications should be considered for programs with substantial surpluses or gaps. These implications include:

1. **Brain Drain:** Oversupply of specific education completers may lead to higher attrition rates (*i.e*., brain drain). In other words, the region is educating a workforce that is leaving after program completion because of a lack of jobs.[3]
2. **Growth Hindered**: Undersupply of specific program completers may lead to missed opportunities for economic growth and put stress on local businesses to find necessary human capital elsewhere. In other words, the region's education institutions are not providing the necessary workforce for the region and thereby shifting the burden on the industries to find workers in other economies to fill the needed occupations. This translates into higher human resources costs and decreased efficiencies in the economic system. This also provides an opportunity for institutions to develop new programs to meet the local workforce needs.

Educational Output by Institution

Beyond the Joint College, there are multiple educational institutions in the state of Florida that offer engineering degrees similar to those offered by FAMU and FSU. Hence graduates from the Joint College will be competing for some jobs with graduates from other regional institutions. We determined education output by Classification of Instructional Program (CIP) codes and identified the number of completers for every award level within those CIP codes. Degree completion data were sent directly to us from colleges supervised by the Board of Governors and member institutions of Florida's Independent Colleges and Universities (ICUF), but regarding all other public and private education institutions in the state, data were obtained from the Integrated Postsecondary Educational System (IPEDS).[4] Graduate data were averaged for a three-year period, 2011 through 2013, to smooth out any bumps in enrollment that may be unique to a particular academic year. Detailed data by bachelor's, master's and PhD levels are available in Tables 7.9 through 7.11 of Appendix VII.B.

Table 3.1 displays three-year averages of degree output at the bachelor's, master's, and PhD level for all educational institutions in Florida that educate students in any of the Joint College's core disciplines, which have been previously mentioned. As indicated FSU and

[3]In the analysis of the Florida Region where the neighboring population density is very high, a surplus of completers may indicate the need for service region residents to commute outside of the service region to find job opportunities.

[4] IPEDS data come with inherent weaknesses. First, numbers are only available for institutions that participate in or are applicants for any federal financial assistance program authorized by the Higher Education Act (HEA). Also, IPEDS does not account for the fact that some people may receive multiple degrees or certifications, so when the number of degrees awarded exceeds the number of people receiving the degrees, the number of completers can be overstated. Nevertheless, this system is the best source for collecting data regarding a broad range of educational institutions.

FAMU are contributing a reasonable share of graduates in these disciplines (8% of all degree output over the past three years), but this output pales in comparison to the University of Florida, the University of Central Florida, and the University of South Florida. Particularly large areas for either FSU or FAMU include FAMU's Agricultural Engineering program (100% of all output), the Joint Colleges' program in Industrial Engineering (14% of all output), Civil Engineering (12% of all output), and Chemical Engineering (11% of all output).

TABLE 3.1: AVERAGE GRADUATES IN ENGINEERING DISCIPLINES OFFERED BY FAMU AND FSU, ALL DEGREE LEVELS, AY 2011/12 THROUGH 2013/14

Row Labels	Agricul-tural	Bio and Bio-medical	Chemical	Civil	Computer	Electrical and Electronics	Indust-rial	Mech-anical	Total
University of Florida		40	147	288	315	334		351	1,475
University of Central Florida				169	86	184	144	247	830
University of South Florida-Main Campus		12	66	151	73	144	45	151	642
Florida International University		52		123	50	122		74	421
Florida State University		***4***	***25***	***118***	***12***	***61***	***32***	***88***	***339***
Florida Institute of Technology			25	36	17	78		61	217
University of Miami		57		29	10	25	48	34	202
Florida Atlantic University		6		64	37	45		46	197
University of North Florida				49		35		43	127
Embry-Riddle Aeronautical University-Daytona Beach					12	6		48	66
Florida Agricultural and Mechanical University	***2***	***0***	***5***	***12***	***2***	***7***	***6***	***8***	***43***
Florida Gulf Coast University		7		25					33
The University of West Florida					5	20			25
Polytechnic University of Puerto Rico-Orlando				7	2	8			18
Bethune-Cookman University					5				5
Grand Total	**2**	**178**	**268**	**1,071**	**625**	**1,068**	**275**	**1,152**	**4,639**

Source: Florida Board of Governors, Florida Independent Colleges & Universities, IPEDS and EMSI

Bachelor's Degree Level Gap Analysis

Figure 3.1 provides an illustration that summarizes the top gaps in bachelor's degree programs offered in Florida. Table 3.2 lists supply and demand for all bachelor's degree programs in the state of Florida, along with completer data for the Joint College separated by individual university.

Industrial Engineering faces the largest gap of 156 unfilled regional positions (296 combined graduates for 140 open positions.) Of the state graduates in Industrial Engineering, FAMU graduated an annual average of five and FSU 22. A distant second is General Computer Engineering with a gap of 70: two graduates from FAMU and 12 from FSU. The remaining undersupplied program for which the Joint College is providing education at the bachelor's level is Mechanical Engineering with a gap of 46. Four Joint College programs are associated with surpluses: Electrical Engineering, General Civil Engineering, and Chemical Engineering indicate that graduates of these programs are pursuing further education, working in other fields, or migrating out of state for work.

Figure 3.1: Labor Market Gaps and Surpluses for Bachelor's Degree Programs in Engineering Programs offered at FAMU and FSU

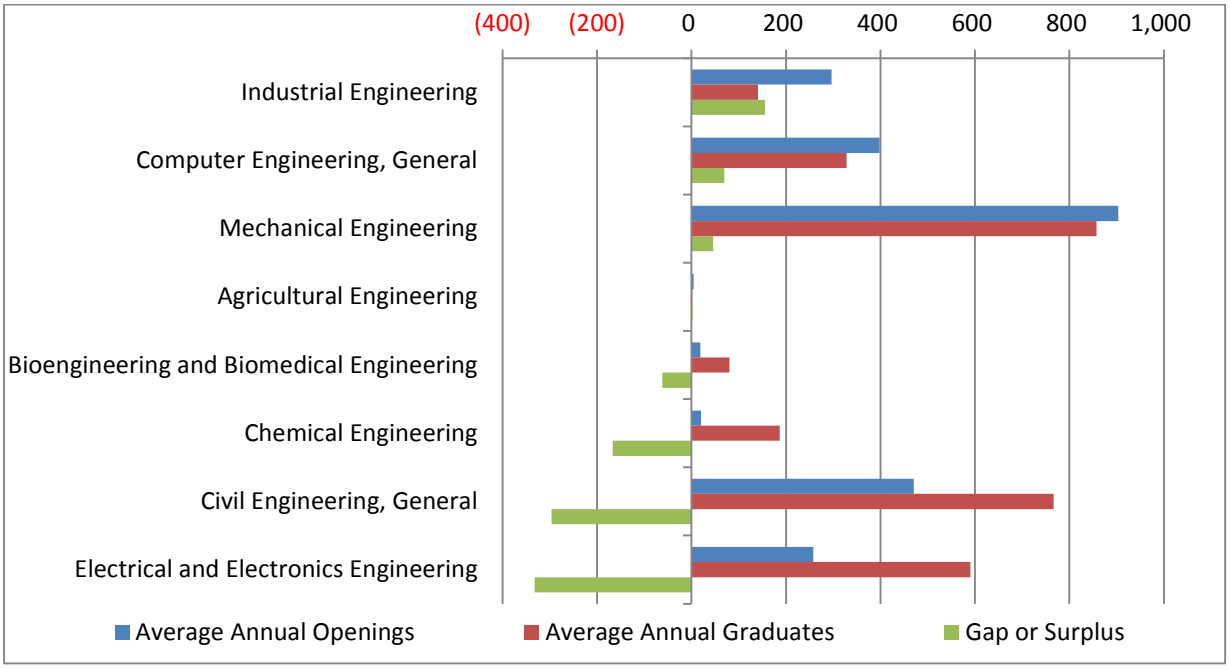


TABLE 3.2: SUPPLY AND DEMAND FOR ENGINEERING BACHELOR'S LEVEL PROGRAMS OFFERED BY FAMU AND FSU

CIP	CIP Title	Average Annual Openings	Average Annual Graduates	FAMU Graduates	FSU Graduates	Gap or (Surplus)
14.3501	Industrial Engineering	296	140	5	22	156
14.0901	Computer Engineering, General	398	328	2	12	70
14.1901	Mechanical Engineering	903	857	6	69	46
14.0301	Agricultural Engineering	4	2	2	0	2
14.0501	Bioengineering and Biomedical Engineering*	19	81	0	0	(62)
14.0701	Chemical Engineering	20	187	4	22	(167)
14.0801	Civil Engineering, General	470	767	8	102	(296)

Source: EMSI Gap Analysis Model. *The Joint College offers graduate degrees in this discipline.

Master's Degree Level Gap Analysis

Figure 3.2 and Table 3.3 below provide information of the labor market gaps and surpluses associated with master's degree level programs offered by the Joint College. There is only one program associated with a notable gap: namely Industrial Engineering. (Gap of 112 as a result of 369 annual openings compared with 257 annual graduates, 2 from FAMU and 7 from FSU.) Programs associated with labor market surpluses include all other programs with the exception of Agricultural. In order of magnitude they are: Electrical & Electronics Engineering (622), Civil (402), Chemical (221), Bioengineering & Biomedical Engineering (121), and Mechanical Engineering (96).

Figure 3.2: Gap for Master's Degree Level Programs Offered by FAMU and FSU

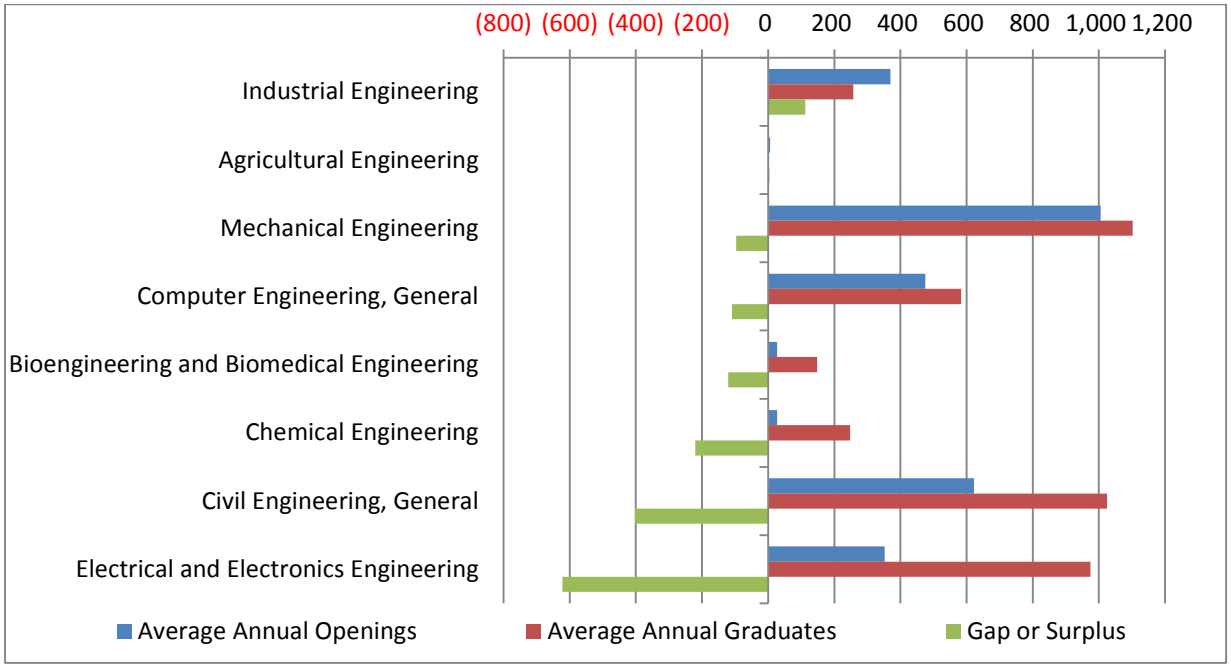


TABLE 3.3: SUPPLY AND DEMAND FOR ENGINEERING MASTER'S LEVEL PROGRAMS OFFERED BY FAMU AND FSU

CIP	CIP Title	Average Annual Openings	Average Annual Graduates	FAMU Graduates	FSU Graduates	Gap or (Surplus)
14.3501	Industrial Engineering	369	257	1.67	6.67	112
14.0301	Agricultural Engineering*	6	2	0.00	0.00	4
14.1901	Mechanical Engineering	1,006	1,102	1.00	13.00	(96)
14.0901	Computer Engineering, General*	475	584	0.00	0.00	(109)
14.0501	Bioengineering and Biomedical Engineering	27	148	0.33	2.33	(121)
14.0701	Chemical Engineering	27	248	0.33	1.67	(221)
14.0801	Civil Engineering, General	623	1,025	3.00	14.33	(402)
14.1001	Electrical and Electronics Engineering	352	974	1.33	17.67	(622)

Source: EMSI Gap Analysis Model. *The Joint College offers an undergraduate degree in this discipline.

PhD Degree Level Gap Analysis

Figure 3.3 and Table 3.4 below provide information of the labor market gaps and surpluses associated with PhD degree level programs offered by the Joint College. At this level the most notable educational shortages where the Joint College has a program are once again related to Mechanical Engineering, Civil Engineering, and Industrial Engineering. Mechanical Engineering represents a notable issue for the state of Florida, as on an annual basis there are 1,003 jobs available and only 539 new graduates eligible for those positions. Of those graduates a small number are educated at the Joint College (one at FAMU, and six at FSU). Computer Engineering, while not offered by the Joint College, is another area of large educational gap at the PhD level with 485 positions statewide for 311 graduates.

Figure 3.3: Gap for Engineering PhD Degree Level Programs Offered by FAMU and FSU

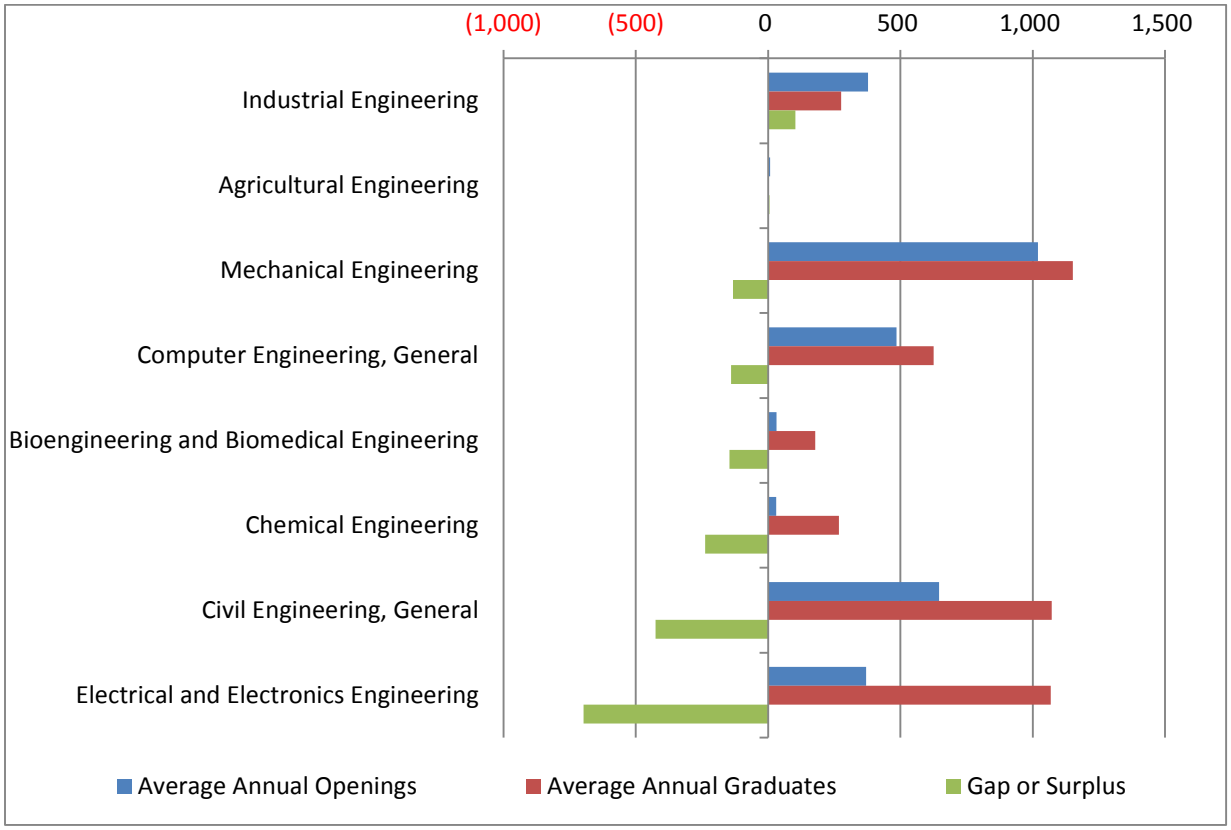


Table 3.4: Supply and Demand for Engineering PhD Level Programs Offered by FAMU and FSU

CIP	CIP Title	Average Annual Openings	Average Annual Graduates	FAMU Graduates	FSU Graduates	Gap or (Surplus)
14.3501	Industrial Engineering	378	275	0.00	2.67	102
14.0301	Agricultural Engineering*	7	2	0.00	0.00	5
14.1901	Mechanical Engineering**	1,019	1,152	1.00	6.33	(133)
14.0901	Computer Engineering, General*	485	625	0.00	0.00	(140)
14.0501	Bioengineering and Biomedical Engineering	31	178	0.00	1.67	(146)
14.0701	Chemical Engineering	30	268	0.67	1.33	(238)
14.0801	Civil Engineering, General	646	1,071	0.33	2.00	(425)

Source: EMSI Gap Analysis Model. *The Joint College offers an undergraduate degree in this discipline.

** Demand for mechanical engineering graduates appears larger in this analysis than would be expected if just mechanical engineers were analyzed. As noted in Table 7.1 of the appendix, two other occupations are associated with mechanical engineering programs in addition to mechanical engineers, namely, cost estimators and stationary engineers and boiler operators. Cost estimators is a relatively large occupational category that comprises roughly 60% of demand for graduates of this program at each of the educational levels highlighted in this analysis. If cost estimators and stationary engineers and boiler operators were disassociated with this educational program there would be a significant surplus of mechanical engineering graduates at all three educational levels.

2. Engineering Employment Trends

The gap analysis from the previous section is helpful for understanding supply and demand dynamics for academic programs offered by the Joint College. But it can also be helpful to see past and projected job change for individual engineering occupations, as this provides a lens through which total employment for particular engineering categories may be viewed. It provides the trajectory of demand for these occupations. Figure 3.4 displays how employment in engineering occupations changed between 2001 and 2014, and how it is projected to change between 2014 and 2024. The grey bars in this chart indicate years during which a recession occurred. Table 3.5 breaks down the growth rates for nineteen different engineering occupations during distinct periods of time (Pre Great Recession, During Great Recession, Post Great Recession, and Forecasted to 2024).

In 2014, engineering occupations with the largest employment in Florida included civil engineers, industrial engineers, architectural & engineering managers, and electrical engineers. Some of the largest employment categories including civil engineers and mechanical engineers were particularly hard hit during the recession. Civil engineering employment decreased 6.7% per year between 2007 and 2009, and mechanical engineering employment decreased 7.6% (see Table 3.5). However, other occupations were less vulnerable, including biomedical engineers and agricultural engineers. In aggregate, engineering occupations have increased at a rate slower than the overall labor force in Florida, including periods before during and after the Great Recession. This trend is not uncommon throughout other parts of the United States, since low-level service occupations power a large part of the labor force rather than highly skilled STEM workers. Interestingly, certain occupations have demonstrated remarkable growth since the end of the recession in 2009, namely agricultural engineers, biomedical engineers, and nuclear engineers.

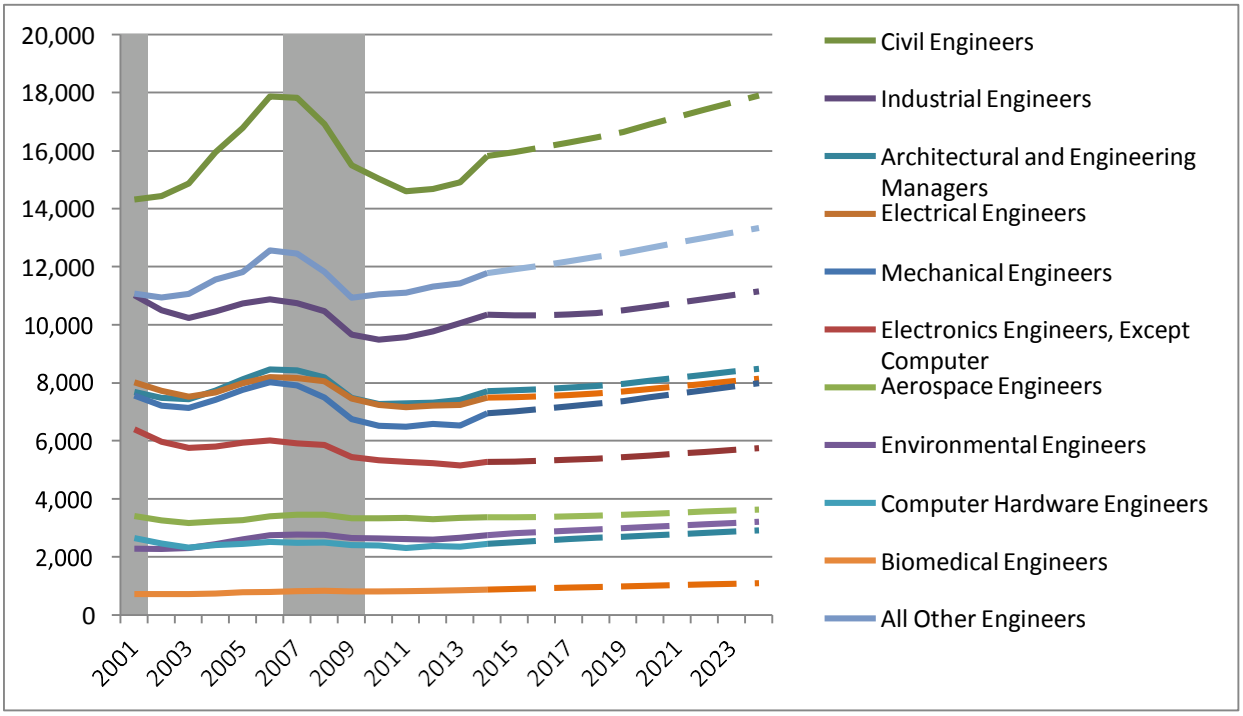
According to forecasted growth between 2014 and 2024, the largest occupational categories are mostly projected to experience pedestrian growth rates less than 1 percent per year, except for civil engineers which are projected to expand by 1.2% per year (see Table 3.5). Alternatively, some of the smaller categories are projected to see exceptional growth, including biomedical engineers, chemical engineers, and computer hardware engineers, to name a few.

TABLE 3.5: GROWTH RATES FOR ENGINEERING OCCUPATIONS IN FLORIDA

	Pre Great Recession (2001-2007)	Great Recession (2007-2009)	Post Great Recession (2009-2014)	Forecast (2014-2024)
All Engineering Occupations in Florida	1.2%	-5.4%	0.7%	1.1%
Architectural and Engineering Managers	1.5%	-5.7%	0.6%	1.0%
Aerospace Engineers	0.2%	-1.7%	0.2%	0.8%
Agricultural Engineers	2.3%	-0.7%	2.1%	1.0%
Biomedical Engineers	2.1%	-0.4%	1.7%	2.2%
Chemical Engineers	1.1%	-6.4%	-0.8%	2.0%
Civil Engineers	3.7%	-6.7%	0.4%	1.2%
Computer Hardware Engineers	-1.1%	-1.6%	0.4%	1.7%
Electrical Engineers	0.3%	-4.4%	0.1%	0.8%
Electronics Engineers, Except Computer	-1.3%	-4.1%	-0.6%	0.8%
Environmental Engineers	3.2%	-2.2%	0.8%	1.5%
Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	1.9%	-7.2%	0.9%	1.3%
Industrial Engineers	-0.4%	-5.2%	1.4%	0.8%
Marine Engineers and Naval Architects	3.2%	-5.3%	1.2%	0.6%
Materials Engineers	-0.7%	-5.9%	0.2%	1.4%
Mechanical Engineers	0.8%	-7.6%	0.6%	1.4%
Mining and Geological Engineers, Including Mining Safety Engineers	3.8%	-6.4%	0.0%	1.3%
Nuclear Engineers	2.1%	-3.8%	1.6%	1.7%
Petroleum Engineers	1.8%	-16.0%	-2.5%	1.4%
Engineers, All Other	2.1%	-6.0%	2.1%	1.2%
All Occupations in Florida	2.6%	-3.4%	2.1%	1.4%

Source: EMSI Complete Employment, 2014.3

Figure 3.4: Change in Engineering Employment in Florida, 2004-2024



As indicated in the gap analysis section of this report in certain fields of engineering the state of Florida is overproducing graduates relative to the state's labor market demand, including bachelor's level graduates in Chemical Engineering and Electrical and Electronic Engineering. Though some of these graduates are going on to obtain higher levels of education, it is likely that some of these graduates will move out of state to find employment. Some of the most likely recipient metropolitan statistical areas (MSAs) include: Atlanta (GA), Virginia Beach (VA), Huntsville (AL), Charlotte (NC), and Raleigh (NC) which each are projected to require over 400 engineers each year between 2014 and 2024 (see Table 7.5 of Appendix VII.B).

Geographic Distribution of Employment

Demand for engineers is spread across many of Florida's MSAs, but the areas employing the largest number are Miami, Tampa, Orlando, and Palm Bay-Melbourne. These four MSAs account for more than two out of every three engineers employed within the state. Few MSAs expanded employment of engineers over the prior ten years; the exceptions being Orlando, Jacksonville, Crestview-Fort Walton Beach, and Panama City (see Figure 3.5). On the other end of the spectrum is Palm Bay-Melbourne, which decreased in employment of engineers by 717 or 10% of the 2004 total. Looking forward from 2014 to 2024, all but one of the state's MSAs is projected to increase in employment, the exception again being Palm Bay-Melbourne (see Figure 3.6).

Figure 3.5: Change in Engineering Employment by MSA, 2004-2014

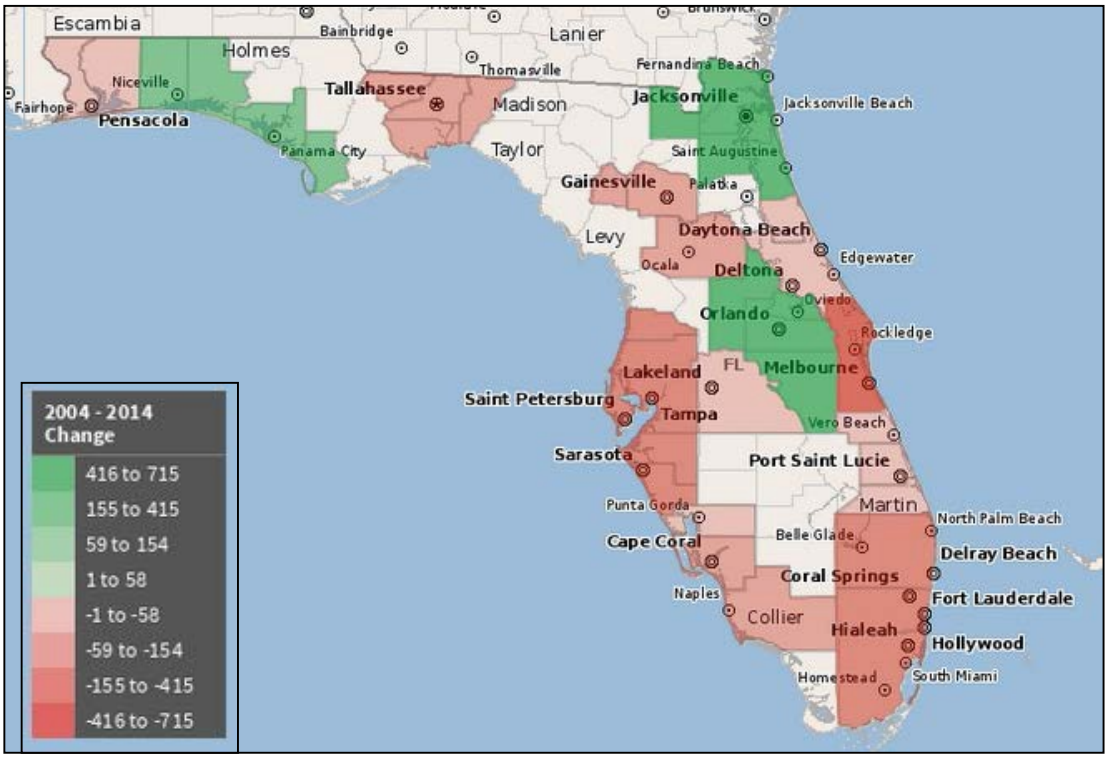
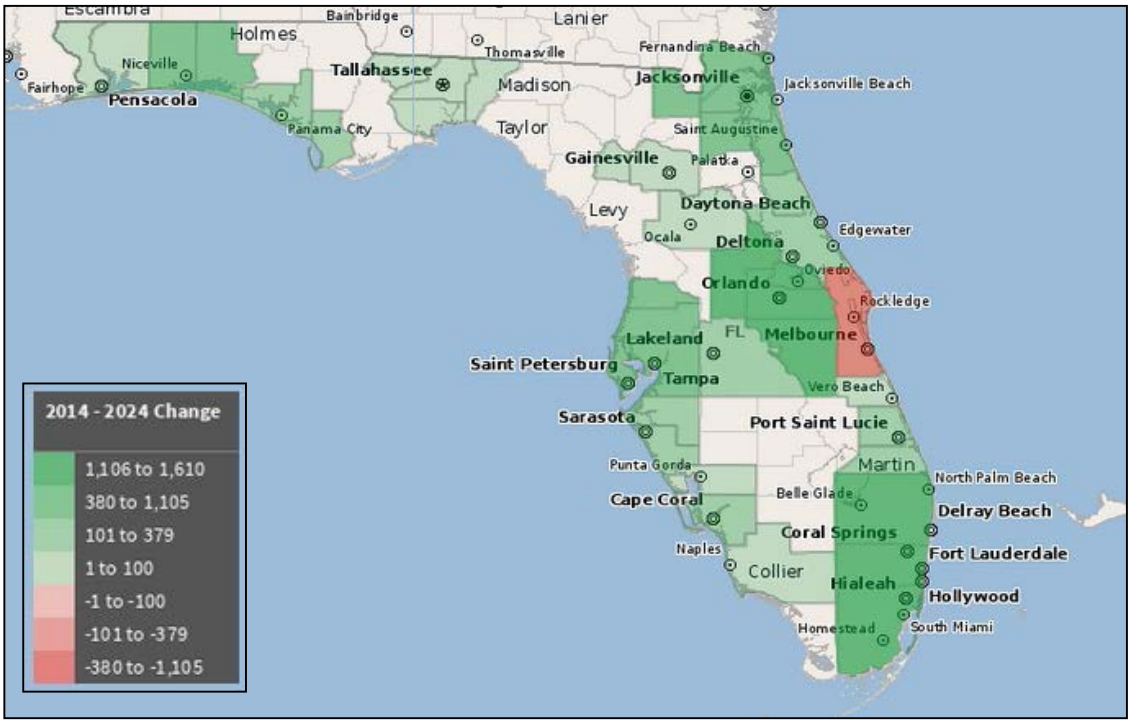


Figure 3.6: Forecasted Change in Engineering Employment by MSA, 2014-2024



Since students frequently look for work near where they attended college, it is also helpful to understand demand in the Tallahassee MSA. Among Florida's nineteen MSAs, Tallahassee ranks tenth in terms of number of engineers employed. Over the next ten years, growth is projected to be stagnant, increasing by only 5% between 2014 and 2024. Alternatively, the nearest MSA, Panama City, is projected to see 10% growth and more than double Tallahassee's net new job growth.

Engineering Industry Analysis

Figure 3.7 and Table 3.6 show the top industries for employing engineers in 2014. The industries are categorized by 4-digit North American Industrial Classification System (NAICS) codes. We selected the 4-digit industry group as it explains the basic function of differing industries, but is not overwhelmingly detailed.

Unsurprisingly, Architectural, Engineering and Related Services is the top industry employing engineers in Florida, staffing over 21,000 engineers in 2014. This is distantly followed by the Civilian Federal Government, which employs over 4,200 engineers. The third top employment category by industry is Aerospace Product and Parts Manufacturing, (3,656 jobs) reflecting the importance of the Kennedy Space Center in Titusville, FL to the engineering industry in Florida.

Focusing specifically on the Tallahassee MSA, the majority of engineers are employed in State Government (Excluding Education & Hospitals), along with Architectural, Engineering & Related Services, with a small presence in production industries such as Other General Purpose Machinery Manufacturing, and Semiconductor & Other Electronic Component Manufacturing (see Table 7.7). The nearby Panama City MSA also has a strong concentration in Architectural, Engineering & Related Services but also has a uniquely strong presence in Ship & Boat Building and Scientific Research & Development Services (See Table 7.8).

Figure 3.7: Top 15 Industries Employing Engineers in Florida in 2014

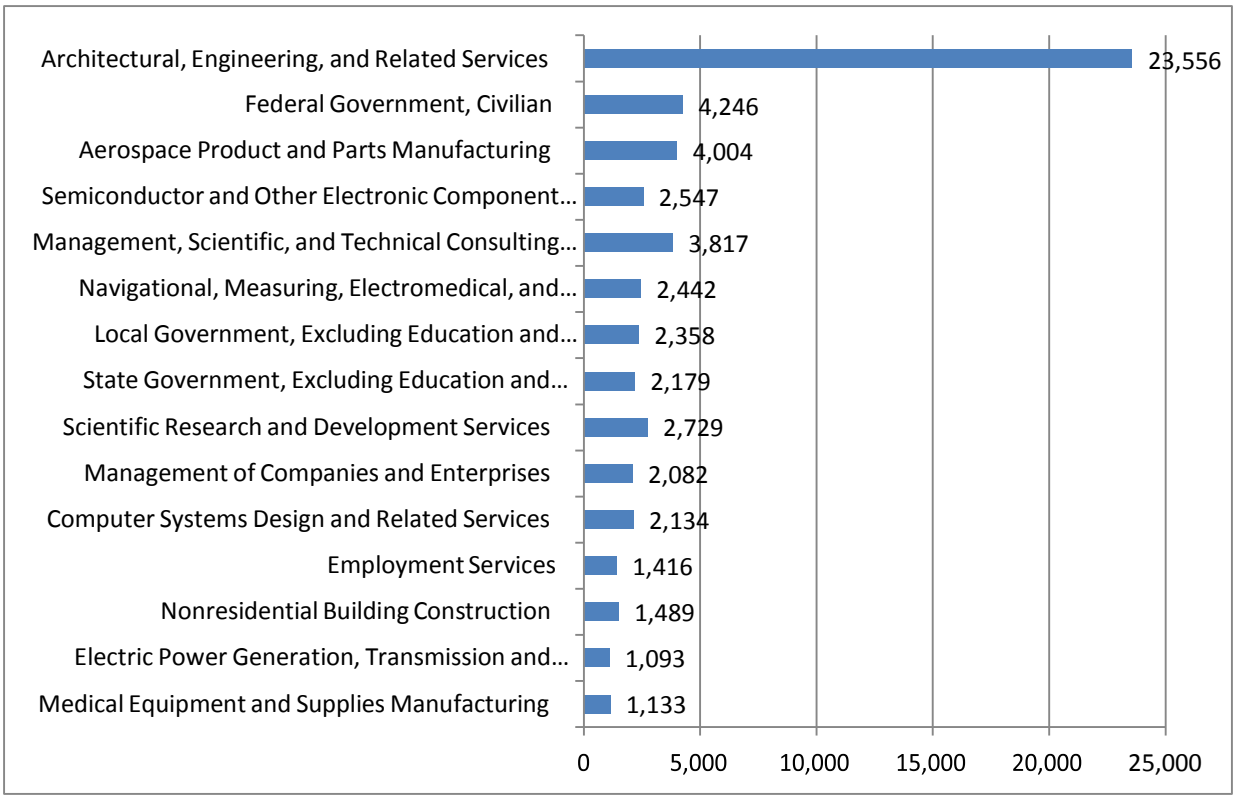


TABLE 3.6: TOP 15 INDUSTRY GROUPS FOR FLORIDA ENGINEERS BY 2014 EMPLOYMENT

NAICS	Industry	Engineers Employed in Industry (2014)	Engineers Employed in Industry (2024)	Change (2014 - 2024)	% Change (2014 - 2024)	% of Engineers in Industry (2014)	% of Engineers in Industry (2024)
5413	Architectural, Engineering, and Related Services	21,039	23,556	2,517	12%	31%	31%
9011	Federal Government, Civilian	4,255	4,246	(9)	(0%)	6%	6%
3364	Aerospace Product and Parts Manufacturing	3,656	4,004	348	10%	5%	5%
5416	Management, Scientific, and Technical Consulting Services	2,739	3,817	1,078	39%	4%	5%
3344	Semiconductor and Other Electronic Component Manufacturing	2,597	2,547	(50)	(2%)	4%	3%
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	2,232	2,442	210	9%	3%	3%
9039	Local Government, Excluding Education and Hospitals	2,111	2,358	247	12%	3%	3%
9029	State Government, Excluding Education and Hospitals	2,092	2,179	87	4%	3%	3%
5417	Scientific Research and Development Services	1,976	2,729	753	38%	3%	4%
5511	Management of Companies and Enterprises	1,729	2,082	353	20%	3%	3%
5415	Computer Systems Design and Related Services	1,670	2,134	464	28%	2%	3%
5613	Employment Services	1,290	1,416	126	10%	2%	2%
2362	Nonresidential Building Construction	1,121	1,489	368	33%	2%	2%
2211	Electric Power Generation, Transmission and Distribution	1,014	1,093	79	8%	2%	1%
3391	Medical Equipment and Supplies Manufacturing	985	1,133	148	15%	1%	2%

Source: EMSI Complete Employment, 2014.3

About the Data Analyses

EMSI generated data were used to calculate the projected number of annual job openings from 2013 to 2023. These projections take into account openings due to job growth and openings due to replacement needs. In order to capture a complete picture of industry employment, EMSI-type analyses gather and integrate economic, labor market, demographic, and education data from over 90 government and private-sector sources, creating a comprehensive and current database that includes both published data and detailed estimates with full coverage of the United States.

More specifically, we developed this data by combining covered employment data from Quarterly Census of Employment and Wages (QCEW- produced by the Department of Labor) with total employment data in the Regional Economic Information System (REIS-published by the Bureau of Economic Analysis or BEA). This is augmented with County Business Patterns (CBP) and Nonemployer Statistics (NES) published by the US Census Bureau. Projections are based on the latest-available EMSI industry data, local trends for the past 15 years in each industry, growth rates in statewide, sub-state area industry projections published by individual state agencies (where available), and in part, growth rates in national projections from the Bureau of Labor Statistics.

Through this combination of data sources, we were able to fill gaps in individual sources (such as suppressions and missing proprietors). This yields a composite database that leverages the strengths of all its sources. Finally, EMSI's database is updated quarterly, providing the most up-to-date integrated information possible.

About the Gap Analysis Model

This section focuses on describing and understanding the methodology used in the program gap analysis. EMSI's gap analysis requires data on both occupational demand (*i.e*., annual job openings) and educational supply (*i.e*., number of postsecondary degree completions). These are then compared through an education "gap" analysis to determine whether an education program is potentially producing a surplus or shortage of workforce talent relative to the number of job openings. In this way, it is possible to see how the institution's current programs are satisfying regional workforce needs.

The first step in an EMSI gap analysis involves mapping the linkage between annual openings for a SOC code and the number of completions for an education program CIP code. The BLS provides information on the occupations that completers of specific CIP codes are more likely to enter. Specific connections have been refined through previous engagements with educational institutions and state departments of labor.

Some programs have direct occupational ties. For example, a chemical engineer is a specific occupation that requires specialized university education. In this case, one CIP code (Chemical Engineering) maps to only one SOC code (Chemical Engineers). This provides an easy comparison of annual openings for chemical engineers to the number of people completing the relevant program to see whether a talent shortage or surplus exists. Unfortunately, this is not always the case. More often than not an educational program maps to multiple occupations and an occupation maps to multiple educational programs. For this reason, EMSI system employs a pioneered method of de-duplicating completers, such that the potential sources of supply are not double-counted for any occupation.

Most educational programs are designed to train people for multiple occupational types, many of which are simultaneously linked with other educational programs, presenting a complexity when comparing supply and demand for any particular educational program. For instance, the Computer Systems Networking & Telecommunications program is mapped to three different occupations: computer support specialists, information security analysts, and computer systems analysts. If we focus on just one of the occupations for this list—computer support specialists—it is also mapped to 10 different educational programs, spanning program titles such as Computer Systems Analysis and Medical Office Computer Specialist.

To ensure that no double counting occurs, it is necessary either to realign the program groupings to eliminate the mapping of occupations to multiple programs or to determine what proportion of demand should be compared with supply numbers from each program. Through the EMSI system we took the second approach in this analysis, which has the advantage of maintaining the program titles and descriptions in roughly the same format that data are reported to BOG, ICUF and IPEDS. The EMSI system uses a formula that favors program types with the largest number of completers, attributing a greater proportion of demand to these than the programs that produce a smaller number of completers. This method utilizes the assumption that the higher output educational programs are likely feeding a higher degree of demand within the service region.[5]

One possible criticism of this methodology is that it assumes, all else being equal, that students from higher-output programs are more likely to obtain a job than students from lower-output programs, whereas in reality students are judged more by their skills and merits than their educational program of study. The intention of the analysis is not to rate students' capability of competing for jobs, but rather to capture the unique dynamics of the local labor market. For example, in a region where a unique program such as Commercial and Advertising Art is more prevalent than Graphic Design, it can safely be assumed that the graduates of the Commercial and Advertising Art program will be offered a larger number of local openings than are students from the Graphic Design program. If such were not the case, it would be unlikely for the Commercial and Advertising Art program to remain the producer of local talent in the long-term, as the program would yield students to a program with a more successful job placement rate. This process is highlighted in more detail in the appendix, but one key point to note is that the analysis at each educational level is cumulative. Therefore, when the analysis is performed at the PhD level, we are actually examining supply and demand at *all* educational levels between bachelor's degrees and PhDs. The analysis is performed in this way because it would be overly restrictive to assume that employment opportunities are strictly limited by discrete educational categories.

[5] Note this adjustment is performed on a program-by-program basis without consideration of individual colleges or training providers. Therefore, a single program offered at one large institution has no advantage over a group of similar programs offered a number of smaller educational providers provided that the aggregate output of the smaller schools is near the output of the single larger school.

To capture occupational demand, we used the EMSI proprietary employment dataset that reflects total employment (*i.e*., employment covered by unemployment insurance as well as proprietor employment). The employment data reflect jobs for the second quarter of 2014. Within this dataset, we calculated the number of regional annual job openings for engineering occupations that require three different levels of postsecondary training.[6] The BLS also provides educational attainment data of current workers for each SOC code, broken out by their highest level of education attained. The data is presented as the percentage of workers in the SOC code with educational attainment ranging from less than a high school degree to an associate's degree. Using these data, we used the EMSI methodology to adjust the annual opening estimates for each SOC code to only incorporate the percentage of workers for three different educational levels that correspond with the 14.xxx level CIP codes and those corresponding occupations. Not taking into account the educational attainment dynamics in this way would bias the result by over-counting potential job opportunities for completers.[7]

[6] See Appendix 1 for a description of the sources and processes of EMSI data.

[7] Given the changing dynamics and need for more education in the existing workforce (*i.e*., skills-biased technology change in many occupations and industry sectors), this assumption is considered conservative.

F. ABET Accreditation

DISCLAIMER

The information presented here represents the collective experience of the team members and does not represent any endorsement or opinions by either ABET, Inc., or the Engineering Accreditation Commission.

The Florida A&M University/Florida State University (FAMU-FSU) joint engineering program currently has six programs accredited by the Engineering Accreditation Commission (EAC) of ABET, Inc. They and the year of initial accreditation are: Civil Engineering, Electrical Engineering and Mechanical Engineering (1986), Chemical Engineering (1987), Industrial Engineering (1992) and Computer Engineering (2004). In addition, FAMU hosts a separate EAC accredited Biological and Agricultural Systems Engineering (BASE) program (2004). All seven programs are scheduled to receive their next general review during the 2015 fall semester.

All engineering programs are reviewed for compliance with eight general criteria plus discipline specific program criteria. Regardless of whether the joint program is continued in some modified form or separately accredited programs are developed, the likely most critical criteria affecting accreditation will be Criterion 6 Faculty, Criterion 7 Facilities and Criterion 8 Institutional Support. These three criteria are listed below:

Criterion 6. Faculty

The program must demonstrate that the faculty members are of sufficient number and they have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student- faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students.

The program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes for the evaluation, assessment, and continuing improvement of the program. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching effectiveness and experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and licensure as Professional Engineers.

Criterion 7. Facilities

Classrooms, offices, laboratories, and associated equipment must be adequate to support attainment of the student outcomes and to provide an atmosphere conducive to learning. Modern tools, equipment, computing resources, and laboratories appropriate to the program must be available, accessible, and systematically maintained and upgraded to enable students to attain the student outcomes and to support program needs. Students must be provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories available to the program.

The library services and the computing and information infrastructure must be adequate to support the scholarly and professional activities of the students and faculty.

Criterion 8. Institutional Support

Institutional support and leadership must be adequate to ensure the quality and continuity of the program.

Resources including institutional services, financial support, and staff (both administrative and technical) provided to the program must be adequate to meet program needs. The resources available to the program must be sufficient to attract, retain, and provide for the continued professional development of a qualified faculty. The resources available to the program must be sufficient to acquire, maintain, and operate infrastructures, facilities, and equipment appropriate for the program, and to provide an environment in which student outcomes can be attained.

Although the separately accredited FAMU BASE program is not a part of the Joint College, the program currently requires seven engineering courses that are offered by the Civil, Electrical and Mechanical Engineering departments. These include: EGM 3512 Engineering Mechanics, GWR 3201 and GWR 3200L Hydraulics and a Laboratory, EEL 3003 and EEL 3003L Introduction to Electrical Engineering and Laboratory, courses for non-electrical engineering majors, and EML 3100 Thermodynamics.

Consequently, regardless of the form that eventually evolves from the current Joint College, it will be crucial that the current needs for non-BASE engineering offerings be accommodated.

The comparative analysis of the effect of the two options on potential accreditation actions is described in Section IV.

G. Costs

Cost is a significant factor in the choice between a joint college of engineering, and two differentiated colleges. Given that there are no specific models of either a rejuvenated joint college, or differentiated colleges derived from the joint college of engineering, we cannot present detailed cost estimates. The only indications of scale that we have been provided is that FSU would like to be ranked as a top 25 public, national university, and would like to have the output signature appropriate to be invited into the Association of American Universities (AAU). We present the cost signature of a fictitious college of engineering that has characteristics similar to real colleges of engineering that are ranked about 25 among publics by US News, and are "AAU ready." There is no implication that an FSU college of engineering would need to attain all of these measures. As you can see in the table "FAMU-FSU Top25," there are a variety of paths to accomplish that goal. However, it is fair to assume that if a new college of engineering failed to look like top 25 colleges in most aspects, they would fail to reach their overall goal.

Note that FSU's goal is to reach the top 25 at the university level. This does not necessarily imply that their engineering college reaches that level. However, the metrics for AAU members are highly weighted towards competitive federal grant funds and doctoral student production resulting from that funding. Engineering and medicine are the primary engines for these outputs. For FSU to gain invitation to the AAU would likely mean that its engineering college would need to exceed the standards described below.

Table 2 (FAMU-FSU Top 25 Comparison) in the Appendices (abbreviated below as Table IV for reader convenience) shows the numbers typical of the current top 25 public engineering colleges. To avoid an outlier effect, rather than compare with just the school ranked 25, we averaged the five schools centered at 25. Coincidentally, that includes number 23, the University of Florida.

To estimate the one time and recurring costs associated with this fictitious top 25 college of engineering we rely on real costs encountered by real engineering colleges. We scale these values to fit our top-25 model. It is important that we use values that we understand and hence take data from the Joint College (sourced from institutional research during this study), Michigan (http://www.engin.umich.edu/college/about/facts), Oregon (personal knowledge) and Florida (sourced from the Chancellor's Office of the SUS) in this process. Note that there is no expectation all of these costs are born by state funding allocations. Most engineering colleges are funded predominantly by tuition, external grants and gifts.

Table IV. FAMU-FSU Top 25 Comparison

			ASEE Numbers[1]			
US News Rank Publics	**AAU Member**	**Institution & Averages**	**Faculty**	**UG**	**Grad**	**Research Exp.[2]**
5	yes	Michigan	381	5,923	3,180	$234
23	yes	U Florida	270	5,990	2,633	$64
24	no	Arizona State	231	7,939	3,282	$78
25	yes	U Pittsburgh	120	2,625	981	$84
26	yes	Iowa State	242	7,272	1,161	$80
27	yes	Rutgers	143	3,427	989	$45
		Average 23-27	201.2	5450.6	1809.2	$70
51	no	U Central Florida	140	7,009	1,264	$37
67	no	FAMU-FSU	90	2,316	279	$10/14[3]
77	no	U South Florida	110	3,739	865	$31
		Ratio Joint College/(Avg. 23-17)	0.4175	0.4249	0.1542	0.1425

[1]Data from the American Society for Engineering Education (ASEE), 2013 database
[2]Annual Research Expenditures, 2013 fiscal year
[3]The higher number includes research done by Joint College faculty within the FSU Laboratories

Faculty and Staff Salaries

Michigan Engineering reports that it annually spends $199.6 million on its faculty and staff members' compensation, including benefits. They report to ASEE (Profiles of Engineering and Engineering Technology Colleges-Fall 2013 edition) that they have 381 faculty members, while the average of the five schools ranked about 25 among publics average 201 faculty. Hence, we might prorate compensation costs to $105 million. However, we assume that salaries at the rank-25 level will not equal those at the rank-5 level (Michigan).

Although faculty salaries in Florida appear to be below the national market, to grow a top 25 engineering college will require faculty salary offers and start-up packages that are competitive in a market of other top 25 holders and aspirants. Maintaining a top-25 program is cheaper than building one. FSU would need to convince a good number of senior faculty to uproot and move to Tallahassee. To do this they will need to outbid the current employers. They would be competing in a far more expensive market than the Joint College has traditionally engaged. Balancing the reduction from top-5 to top-25, and the increase necessary to bid into the top-25, we estimate that salaries will average 90% of Michigan salaries. To create high, medium and low estimates of cost, we select 85%, 90% and 95% of Michigan salaries. Hence, we scale our

salary estimate down to LOW = $89 million, MEDIUM = $95 million, HIGH = $100 million. This is a recurring cost.

Faculty Startups

Faculty start-up packages are a major challenge in science and engineering faculty hires. In an experimentally oriented discipline, typical packages run one million dollars for a junior faculty member, and closer to two million dollars for a senior faculty member. These numbers were developed in a University of Oregon study of start-up costs for experimental scientists. Theoretical engineers are much less expensive. They still need computers and summer/graduate student support, but little experimental equipment. The table below shows a potential breakdown for the fictitious top-25 college. Other values can be entered to get a variety of estimates.

Often these costs are ameliorated by existing equipment. That is, a potential hire provides a list of equipment necessary for her/him to be successful. If some of that equipment is already available, then fewer immediate purchases are required. However, in the instance of growing a new top-25 college, one would expect to buy most everything. Even if only half of the new faculty hired are experimentalists, and 75% of those are junior faculty, the estimate for hiring 201 faculty is about $138 million. This would be spread over some years, but if done too slowly, the desired rankings impact will be delayed. A good estimate on timing is five to ten years. We use this as our MEDIUM estimate.

	Fraction of Faculty	**Out of 201**	**Average Startup ($M)**	**Expected Startup**
Senior Experimentalist	12.50%	25.125	2	$50.25
Junior Experimentalist	37.50%	75.375	1	$75.38
Senior Theorist	12.50%	25.125	0.2	$5.03
Junior Theorist	37.50%	75.375	0.1	$7.54
Total	**100.00%**	**201**		**$138.19**

To determine LOW and HIGH estimates we note that the number of faculty in the five colleges ranked around 25 range from a low of 120 faculty members to a high of 270 faculty members. The value of 120 for the University of Pittsburgh corresponds to the highest research expenditure per faculty member among the five colleges. This likely reflects substantial interaction with the medical center at Pitt. We will take 150 and 250 as the LOW and HIGH estimates for faculty. The estimates for faculty startups is LOW = $103 million, and HIGH = $173 million.

Facilities Creation

The University of Florida College of Engineering, ranked 23 by USNews, operates in approximately 1.5 million gross square feet (gsf) of classroom, office and laboratory space, according to data provided by the Chancellor's Office. A new engineering college could effectively operate in less space. Undoubtedly, all older engineering colleges have some space dedicated to antiquated technologies. For example, Michigan still runs a large tow tank for evaluation of drag from large models of warships and tanker hulls. This facility would not likely be replicated in a new college. To develop low, medium and high estimates, we look at facilities of 750,000, 1,000,000 and 1,250,000 gsf. Note that these values are all substantially higher than the 217,000 gsf in Buildings A and B of the Joint College.

In its web presentation for the 30th Anniversary of the Joint College, dated June, 2014, FAMU represents that Building C has been detailed at $38 million for 96,000 gsf. We presume that this building, like Building A and Building B, is a mixed office, classroom, laboratory space. Simple arithmetic shows about $400/sf construction cost. We will take this number as representative of the construction costs for such an academic building in the Tallahassee market. In actuality, it is likely an underestimate since it was developed in the tail of the Great Recession. Now that construction firms are much busier, cost estimates are coming in much higher in many parts of the country.

Then the cost estimates for facilities build out would be LOW = $300 million, MEDIUM = $400 million, HIGH = $500 million. Clearly, this would be done over a number of years.

Facilities Operation

Michigan Engineering books facilities operations at $20 million/year. For half the gsf of the Michigan complex, we will estimate LOW = $7.5 million/year, MEDIUM = $10 million/year, HIGH = $12.5 million/year in operations.

Graduate Student Support

Our fictitious top 25 school would have over 1,800 graduate students. Table 2 show significant variation on numbers of graduate students in the top 25 schools reviewed. The smallest is about 1000. While the largest is over 3200, the University of Florida is approximately 2600. Hence, we will estimate graduate students support varied over a LOW of 1000 students, MEDIUM of 1800 and HIGH of 2600. To be consistent with other top engineering schools we

presume that these students will be 40% doctoral students and 60% master's students (Michigan distribution). We assume that all doctoral students are fully funded and master's students are half funded, although this latter estimate may be low. Presume that the graduate students are 75% out-of-state. Current FSU graduate tuition rates are $11,830 per year for a Florida resident and $27,288 per year non-resident (http://financialaid.fsu.edu/apply/cost_grad.html). Then their effective tuition is $23,400 per student. Assume that a full stipend for a doctoral student is $20,000/year, plus 30% benefits. Then each doctoral student costs approximately $50,000/year to support. This is virtually identical to numbers calculated at Michigan ten years ago, and at the University of Oregon recently. The 1,800 graduate students would cost about $63 million per year to financially support. If one assumes that master's students are not financially supported, then this reduces to about $36 million. However, that would be inconsistent with other universities ranked at this level. Hence, our MEDIUM estimate is $63 million. The LOW estimate corresponds to 1000 graduate students and equals $35 million. The HIGH estimate corresponding to 2600 students is $91 million. These costs are typically born by federal grants, endowed fellowships and teaching assistantships.

Equipment Supplies and Services

Michigan budgets $57.2 million for this catch-all category. Since our virtual college has half the faculty and facilities, and much of the equipment will be purchased by start-up costs already accounted, we estimate one-third of that number here, or $19 million. Michigan also budgets "other" at $62.8 million. We estimate $10 million additional equipment, supply and service costs.

Summary

We establish our fictitious college of engineering at roughly the average of the five universities ranked 23-27 in US News. These form our MEDIUM estimate. LOW and HIGH estimates are created based on the variance among the five colleges ranked 23-27.

	LOW estimate (millions)	MEDIUM estimate (millions)	HIGH estimate (millions)
One-time Costs (funded over 5-10 years)			
Faculty start-ups	$103	$138	$172
Facilities construction	$300	$400	$500
Total	**$403**	**$538**	**$672**
Recurring costs (per year)			
Salaries	$89	$95	$100
Facilities operations	$7.5	$10.0	$12.5
Student support	$35	$63	$91
Equipment supplies and services	$19	$19	$19
Other	$10	$10	$10
Total	**$161**	**$197**	**$233**

Caveats

The estimates above look at LOW, MEDIUM and HIGH estimates for costs associated with a fictitious college of engineering with characteristics similar to the colleges currently ranked about top 25 by USNews. If the Board of Governors chooses differentiated colleges, a FSU College of Engineering would discover costs directly related to many design choices yet unknown. Certainly, if the new college were built on existing facilities and/or faculty from the Joint College, the net costs would be partially offset.

While we show a range of low to high costs for each line item, if the new college were on the low end of each category, it is unlikely that it would create the productivity to achieve the desired ranking goal or AAU profile. Note that even at the HIGH scenario of facilities gsf and number of faculty, the virtual college described here is smaller, and has fewer faculty members, than the University of Florida College of Engineering has currently.

In the differentiated colleges' case, it is our understanding that the Fordice Supreme Court decision related to Title VI of the Civil Rights Act might imply that at least as much must be spent on a FAMU College of Engineering as is spent on a FSU College of Engineering.

IV. Analysis of the Proposed Engineering Education Options

The Situational Analysis and the Critical Factors discussed in Section II and Section III, respectively, set the stage for the analysis presented in this section. Two models for engineering education in Tallahassee were considered, the current Joint College Model, and the Two-College Model with Differentiated Programs. Beginning with the Joint College factors favoring it and factors disfavoring it are presented. Then the same thing is done for the Two-College Model with Differentiated Programs. The pros and cons cited for each model become the basis for a comparison of the two models.

A. The Joint College of Engineering Model

1. Factors Favoring the Joint Model (Pros)
    - It exists and requires no start-up funding.
    - It is a model of cooperation between a public white majority university and a public HBCU.
    - It represents the kind of educational innovation that is consistent with Title VI.
    - It is regarded as consistent with the Agreement between the Office of Civil Rights and the State of Florida. (See Letter from Assistant Secretary Catherine E. Lhamom)
    - Mission addresses the production of women and minority graduates in engineering.
    - FAMU senior administrators are supportive of the Joint College and view it to be consistent with FAMU's mission.
    - It has graduated more than 5,000 engineers at the BS level, more than 1,000 engineers at the MS level and more than 200 engineers at the Ph.D. level.
    - Its organizational problems are known and this provides the means of improving the model.

2. Factors Disfavoring the Joint Model (Cons)
    - Renovations are needed in addition to the construction of Building C. Building C was part of the facilities plan for the Joint College.
    - Inefficiencies in the processing of requisitions and administrative operations of the Joint College.

- Enrollment from FAMU has declined by 46 percent between fall 2003 and fall 2013.
- Mission is not being achieved. Other Florida institutions are outperforming the Joint College.
- FSU senior administrators are dissatisfied with the Joint College and view it as an impediment limiting the University's pursuit of world class standing.
- Differences in time taken to complete administrative processes at the two universities have contributed to morale problems in the Joint College.
- The management agreement that guides the operation of the Joint College is cumbersome, ineffective, and interferes with the pursuit of the mission of the Joint College.
- Mission shear between the universities is a realty that is rooted in different histories and philosophies.

B. The Two-College Model with Differentiated Programs

1. Factors Favoring the Two-College Model (Pros)
    - It would allow FSU to manage its own engineering college and to pursue its vision.
    - It would circumvent the management inefficiencies at the Joint College.
    - FSU senior administrators believe that a separate college would aid the University in breaking into the Association of American Universities.
    - It is likely that FSU faculty and staff would strive to achieve the goal of reaching world class distinction.
    - The mission shear would be removed.
    - Faculty and staff in the respective colleges would be subject to only one set of policies and procedures.

2. Factors Disfavoring the Two-College Model (Cons)
    - Requires major investment and construction of new facilities.
    - Cannot have duplication of programs without encountering a Title VI challenge.
    - Engineering programs at the two universities must be comparable in resources and facilities.

- The Office of Civil Rights may use Title VI and Fordice to challenge the separation of the Joint College.
- FAMU senior administrators oppose the Two-College Model and contend that it would result in a reduction in opportunities for FAMU students.
- The costs to establish two separate engineering colleges and to pursue the goals that FSU advocates are substantial.

C. Comparison of the Models

Based on the focus group discussions conducted by CBT UC with students, faculty, staff, alumni and the Advisory Board of the Joint College, the Joint College model has many supporters. Also, based on communication received from students, faculty, and alumni, the two-college model has many supporters. The two-college model supporters believe that FSU will be better able to pursue first tier status with the AAU, if it has its own engineering college. The Joint College supporters believe that any change in the college will result in a loss to FAMU and leave it less competitive.

The factors that disfavor the Joint College model involve the shared management model through which FAMU and FSU have divided the management responsibilities. The faculty and staff who work at the Joint College must understand and follow FAMU policies and procedures and FSU policies and procedures as appropriate for the given task. Staff members at the Joint College have openly expressed frustration with the dual administrative systems they must master. In focus group discussions with staff from the Joint College the time taken by FAMU to respond to any request or process was criticized and thought to fuel the noise in the environment about having separate engineering colleges. The management council reflects a turf struggle and does not aim at efficiency and competitiveness. The current management model may at one point in time have seemed rational; however, the evidence is that it cannot now serve the best interest of engineering in Tallahassee.

The difference in resources between FAMU and FSU is significant. According to *The Chronicle of Higher Education* the endowment for FSU in 2012 stood at $497,709,000 while the FAMU endowment was $107,743,000. The FSU endowment in 2013 for engineering was $6,207,212 and that of FAMU was $1,224,573. Notably, the endowment for engineering for the University of Florida was $88,105,671. The difference in resources between the two universities means that FSU is in a position to exert influence on the direction of research at the Joint College. With most of the faculty, 62 out of 83 (fall 2013) being FSU employees, the Joint College could be argued to be a unit of FSU.

The Joint College model does not limit or interfere with the quality of teaching. Prior to the 2014-15 year the different missions of the two universities caused them to value different backgrounds and potentials in prospective faculty. Although the new mission of FAMU is closer to that of FSU, the commitment to opportunity and developmental education means that some mission shear will persist. The Joint College possesses the potential to become a greater producer of women and underrepresented minorities with BS, MS, and Ph.D. degrees in engineering. Those who work at the college proudly accept this dimension of its mission. In fact, we learned that some faculty members were attracted to the Joint College because of its mission. According to faculty at the Joint College the enrollment of students from FAMU exactly parallels the interest and support of its presidents. The data support this contention.

The Joint College model does not limit the development of an outstanding research program. The mission shear, while thought to be a source of difficulty by the FSU senior administrators, could be a source of strength by maintaining a balance in the emphasis given to teaching and research.

The constraint of Title VI of the Civil Rights Act of 1964 appears to favor the Joint College since as Assistant Secretary for Civil Rights Catherine E Lhamon pointed out in correspondence to Governor Rick L Scott (dated April 25, 2014):

> The very creation of the FAMU-FSU engineering program developed directly out of the State's 1978 desegregation plan to OCR, "Plan for Equal Access and Equal Opportunity in Public Higher Education" (1978 Plan), which provided for the resolution of unnecessary program duplication by such methods as program elimination/realignment and cooperative joint programs. Building upon the related programmatic strengths of these two institutions to affect the cause of unnecessary program duplication, the State established the joint FAMU-FSU Institute of Engineering in the spring of 1982.

She also wrote in the same letter:

> I am deeply concerned that the legislative plan to split the FAMU-FSU College of Engineering would violate the State's federal legal Responsibilities pursuant to Title VI, Fordice and the Agreement. (Partnership Agreement with OCR signed in 1998 by Governor Lawton Chiles to strengthen and improve academic programs and facilities for FAMU students).

The two engineering education options proposed included differentiated programs for the Two-College model. This may have been motivated by the recognized need to avoid program duplication. Moreover, it was pointed out that duplication of engineering programs in the same city existed in Baton Rouge, LA and in Norfolk, VA.

In Baton Rouge, engineering programs are offered at Southern University, a land-grant HBCU and Louisiana State University, a land-grant HWCU. Engineering was taught at LSU A & M College from its establishment in 1876. The College of Engineering was created in 1908 with programs in civil, chemical, electrical, and mechanical engineering. Subsequently, in the ensuing years six additional engineering disciplines were added including biological engineering, construction management, computer engineering, environmental engineering, industrial engineering, and petroleum engineering. Although Southern University (SU) owes its origin to 1880, the College of Engineering at SU was not established until 1956. It began with programs in civil, electrical, mechanical, and electronics engineering technology. Thus, both colleges of engineering predate Title VI of the Civil Rights Act of 1964.

In Norfolk, engineering programs are available at Norfolk State University and at Old Dominion University. Old Dominion was established in 1930 as the Norfolk Division of The College of William & Mary. A year later it also became an extension of the Virginia Polytechnic Institute. During the first three decades of Old Dominion's operation it offered the initial two years of programs in education and engineering. Old Dominion became independent in 1962. Today it offers primarily a standard curriculum in engineering and uniquely a coastal engineering program. The engineering program at Norfolk State University is quite recent and is probably the most recent engineering program established at a public HBCU. The institution that would become Norfolk State University was established in 1935 as a private unit of Virginia Union University. A few years later it became a state institution and a division of Virginia State University. In 1956 it started to award baccalaureate degrees and in 1969 it became an independent institution. The engineering program was created in 2006. It is not a traditional program and does not duplicate any program at Old Dominion University. Norfolk State University offers the BS and the MS degrees in electronics engineering and optical engineering.

Therefore, in both cases, Baton Rouge and Norfolk, one does not find a contradiction of the Title VI and Fordice constraint against duplication, since in Baton Rouge the engineering programs were in place prior to 1964 and in Norfolk the engineering programs that were approved for Norfolk State University did not duplicate the programs at Old Dominion.

Differentiated programs at FAMU and FSU would mean that neither institution would have a full complement of engineering programs. A limited set of engineering programs at FSU would probably pose a greater challenge in achieving the AAU distinction that it plans to pursue.

Additionally, the transition from the joint model to the differentiated model is likely to encounter a legal obstacle brought by parties with standing. An example is found in the case, The Coalition for Equity and Excellence in Maryland Higher Education, et al. v Maryland Higher Education Commission, *et al*. 2013. This particular case involved a group of former and current students who in 2006 formed the Coalition and sued the State of Maryland, the Maryland Higher Education Commission and its officers for failure to desegregate Maryland's system of higher education. The Coalition sued under Title VI of the Civil Rights Act of 1964 and the Equal Protection Clause of the Fourteenth Amendment. The suit, which extended over several years, resulted in a six-week bench trial in January 2012. Oral argument was held in October 2012. The court issued findings of fact and conclusions of law on October 7, 2013. The U. S. Supreme Court in Fordice established the law that guided the findings. United States District Judge Catherine C. Blake wrote:

> I find the plaintiffs have prevailed in establishing current policies and practices of unnecessary program duplication that continue to have segregative effects as to which the State has not established sound educational justification. Remedies will be required. The plaintiffs have not, however, made that showing as to the current operational funding policies and practices put in place by the State.

Although the judge acknowledged that the State had been guilty of underfunding the HBCU in Maryland in the distant past, the judge found that current funding of the HBCU could not be traced to the de jure era of segregation. This was not the case with program duplication. We find this particular case instructive.

V. Conclusion

The two options for engineering education and research in Tallahassee have been examined by assessing factors that favor and factors that disfavor each option. In the analysis conducted, which consisted of interviews and focus group discussions with all primary constituents, many arguments were advanced in favor of one of the models based on unsubstantiated assumptions. In the focus group discussions with faculty, staff, students, and alumni from both universities, we found a misunderstanding of the constraining force of Title VI of the Civil Rights Act of 1964 concerning program duplication in higher education in states that were found to have operated dual systems of education based on race in 1969 – 1970. If the Joint College is maintained, it will not, without major organizational changes, become an example of administrative efficiency, nor will it, without a unified commitment of the leaders of the two universities, play a leadership role in increasing diversity among engineering graduates in our nation. The Two-College model with differentiated engineering programs will not likely propel FSU into AAU's set of first tier research universities if it includes only a subset of disciplines. Such a goal, which is commendable, will likely require a ten-year plan supported by greater than a ten-fold increase in financial resources in order to recruit and employ outstanding faculty, and to significantly increase the enrollment at the graduate level. The Joint College has research faculty, the majority of whom are FSU employees. In fact, because of financial resources, FSU exerts a greater influence over the scholarly pursuits at the Joint College. The Joint College, admittedly, has a dysfunctional management model; however, it cannot be completely blamed for the productivity of FSU faculty members, especially since many of them operate through FSU controlled research institutes. The argument that separation of the Joint College will better allow FSU to pursue its vision is largely conjecture.

Interestingly, the uniqueness of the Joint College with its diverse partners has not been advanced as an asset that could contribute toward world class standing of either or both universities. According to the FSU mission statement, the University values diversity. If that is the case, it would seem that FSU would seek the enhancement of the Joint College, and given the history of FSU, it would seem that its leadership would have pushed the Joint College to enroll and graduate more women. Diversity and opportunity in higher education are tenets whose values have been demonstrated. Many alumni from both universities have applauded the opportunity that the Joint College provided them.

The decline in the enrollment of FAMU students at the Joint College has been used to support the argument for separation. President Frederick Humphries demonstrated that academically well-prepared African American students, who can succeed in engineering, can be recruited, retained, and graduated. This proof of principle should be instructive to the leaders of FAMU, FSU, and the Joint College. We did not learn of any successful program at the Joint College for

recruitment and marketing. Nor did we find that the two universities treat the Joint College as a centerpiece in the recruitment of students. It appears that the retirement of President Humphries marked the end of aggressive efforts to market the Joint College.

If the decision is made to establish separate engineering colleges, then in order for them to be true to their missions they must strive to increase women and other underrepresented minority graduates in engineering. The diversity dimension of the missions of the Joint College, FAMU, and FSU is a strength that should not be lost. Institutions such as the Georgia Institute of Technology, North Carolina A & T University, and the University of Central Florida should follow and not lead the Joint College in this area.

The notion of becoming a premier university cannot be criticized. We should advocate and embrace high aim; however, the pursuit must be realistic and characterized by reasonable benchmarks. To become a first tier AAU institution means that the parameters that characterize the universities in that list of twenty-five institutions should be numerically close to the same parameters for the aspiring institution. If the parameters are not close, then there should be other educational and/or research achievements that distinguish the university among AAU's first tier members.

As discussed in Section II, Situational Analysis, the Joint College, with most of its faculty members being FSU faculty members, is not close to many of the leading engineering schools (Georgia Tech, MIT, and University of Michigan) in terms of research productivity, research funding, number of faculty, or, number of graduate students. Therefore, establishing separate engineering colleges would not, via engineering, propel FSU into AAU's top twenty-five public research universities.

If the proposal to separate the Joint College and create separate engineering colleges with differentiated programs is pursued, it will likely become a Title VI issue for the Office of Civil Rights of the U. S. Department of Education. The likelihood of this occurring is based on the fact that the Joint College is an integral component of the State of Florida's commitment to enhance programs at FAMU and to pursue changes in higher education that would move the SUS toward unity. Assistant Secretary for Civil Rights Catherine Lhamon's letter to Governor Rick Scott, dated April 25, 2014, should be recognized as an early warning that separation of the Joint College will require a strong educational justification and it must avoid the educational program duplication. Any change in the Joint College, whether involving differentiated programs or not, will receive intense scrutiny. It could easily become a case study for law school students and/or graduate students in higher education administration programs.

The CBT team received a proposal from a subset of the FSU appointed faculty in the Department of Mechanical Engineering (11 out of 21 of the full-time, tenured or tenure-track faculty) at the Joint College. These faculty members proposed to replace the Joint College with separate differentiated colleges of engineering, one at FAMU and one at FSU. Students in one university could access a program in the college of engineering at the other university as a dual-degree engineering student. The students complete the pre-engineering courses and the general education courses at the home institution prior to transferring to the university with the programs of interest. The student might pursue a major at the home institution such as chemistry before transferring to the other university to pursue studies in chemical engineering. Upon completing all requirements at both universities, the student receives two degrees. This type of model usually operates between an engineering college and a liberal arts college. The program normally takes five years for the well-prepared student.

The difficulty with this model is that it cannot leave both institutions whole. If FAMU is diminished or FSU is made more attractive, then a Fordice challenge is likely to be made. Certainly the argument may be made that Florida has not lived up to the Partnership Agreement it made with the Office of Civil Rights. Moreover, with FSU not offering a full complement of engineering fields, it becomes more difficult to pursue first tier AAU standing. If two separate engineering colleges are established, then the Fordice standard on duplication may result in one of them being located in another city as the FAMU Law School was placed in Orlando and not in Tallahassee. If the Joint College is maintained, the dysfunctional management arrangement, which is abetted by dual policies and procedures must be addressed. An organizational structure and mode of operation must be established that facilitate the efficient pursuit of the mission. The extant skew in financial support for start-up research funding and for salary increases from FSU should not be allowed to persist.

It is in the interest of the State and the pursuit of excellence at the two universities to achieve an equilibrium in faculty support per university, enrollment, and financial support. Although in size FSU is about four times larger than FAMU, an equilibrium enrollment at the Joint College will require an enrollment of FAMU students above 30 percent at all degree levels. The equilibrium number must be above 30 percent because of the mission of FAMU. Additionally the mission requires that the presence of women in the Joint College must be between 33 and 50 percent. These numerical targets would allow the FAMU-FSU College of Engineering to become one of the leading producers of women and African American engineers at the baccalaureate level. Whatever model is pursued an increase in enrollment in engineering will be required to be competitive in Florida and in the nation.

Finally, we must reiterate that any consideration of pursuing the Two-College model must examine the legal challenges that likely will be made. Advocates of the Two-College model would be well served to seek the support of the FAMU leadership team in moving forward. It would also be wise to confer early with the regional office of the Office of Civil Rights, prior to taking actions that could be challenged. If the Joint College is maintained, a new agreement, reflecting a new approach to management, is absolutely essential. The two universities must present a unified front in seeking renovations, repairs, and construction of Building C.

Engineering has a bright future in Florida. It is a future that will be enriched by the cooperation and commitment to excellence in education on the part of the Presidents of FAMU and FSU and their respective leadership teams.

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Table Titles (**Appendices**)

Tables 1A-2L