

# Creating Economies of Scale: The Development of a 3+2 Degree

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**ABSTRACT** - *Computer Graphics Technology at Purdue University recently created a combined M.S. and B.S. program that allows outstanding students to obtain both degrees in five years. Benefits for the students include the ability to (1) reduce their time at the university by one year; (2) leave the university with a second degree that increases their earning power; and (3) permits them to begin their research endeavors earlier in their academic careers. For CGT the degree allows the department to (1) attract higher quality undergraduate students to the program; (2) increase the number of qualified graduate students; (3) help the department increase its research agenda; and (4) identify outstanding talent early. This paper outlines the background on the need and rationale for the program, its curricular aspects (the combined plan of study, policies, and admission plans), the process used at Purdue for its approval, and early results of its implementation at the West Lafayette campus.*

## **I. Introduction**

The College of Technology (CoT) at Purdue University has a 45 year history of offering degree programs in Technology, Management, and Applied Engineering. During its early development, the degree programs offered were at the associate and

baccalaureate degree levels primarily focused on providing terminal experiences designed to meet the technical managerial workforce needs of Indiana and the Midwest region. The CoT has been known for providing outstanding state-of-the-art technology education that emphasizes teaching and learning. More recently, the CoT has made significant investments in growing its research and graduate education programs. This investment has been made to enable the college to more fully participate in, and contribute to, the full range of activities within the academy. As a result, the college has grown its graduate offerings, research profile, and sponsored programs significantly.

The Department of Computer Graphics Technology (CGT) is one of eight technical departments in the college and has offered a B.S. in Computer Graphics Technology since the early 90's. CGT has also offered an area of specialization in Applied Computer Graphics in the M.S. degree program administered by the college for over a decade. CGT has participated in the Ph.D. in Technology administered at the college level since the degree was approved in 2004. Recently, the Purdue University Board of Trustees approved a stand-alone M.S. degree in Computer Graphics Technology that was spun off from the college level master's degree.

With the department's increasing commitment to applied research and graduate education, building a pipeline into graduate degrees has become a priority, in addition to its longstanding commitment of producing applied computer graphics baccalaureate graduates. Most recently, CGT developed a combined B.S. and M.S., "3+2" program to provide a fast-track for its most qualified undergraduate students who commit to completing the combined degree plan within five years from undergraduate admission. This paper presents the background behind the development of the 3+2 program and the department's expectations for its implementation.

## **II. Indiana Commission of Higher Education Plan**

The college and university system in the State of Indiana has been the subject of significant study conducted through the Indiana Commission for Higher Education (ICHE). This work has been a direct result of the goal of the State government for improving the quality of education, from Kindergarten to graduate school, for the citizens of Indiana. The ICHE report titled *Reaching Higher* (2007) stressed the need to provide an Indiana higher education system designed to "effectively and efficiently maximize opportunities for students and consist of components whose missions complement one another and work in concert to fulfill the vision, goals and strategic directions" (p.6). The report also challenged the State's higher education institutions to "continually seek institutional efficiencies that contribute to holding down the costs of postsecondary education" (p. 10). Part of this desire for economy across all institutions included defining the roles of the various colleges and universities in Indiana. ICHE clearly identified the expectations for the three public State supported campuses that qualify as major research universities (Purdue University West Lafayette, Indiana University Bloomington, and

Indiana University-Purdue University Indianapolis). One interpretation of the ICHE plan is the desire to provide the majority of the initial access to higher education to the State's Community College system and the Regional institutions, thereby restricting admissions to the research universities to only the most highly qualified high school graduates. Such an approach permits these three institutions to focus resources on growing their research portfolio and graduate education programs.

Subsequently, the Commission issued the report titled *Reaching Higher with Major Research Universities-Strengthening Indiana's Major Research Universities* (2008) that among other issues, charts the expectations for Purdue University-West Lafayette and Indiana University-Bloomington. These flagship State supported institutions were charged "to develop strategies to be among the top public research universities in the country for institutions with similar missions" (p. 18). Metrics for meeting quality and student learning expectations includes the number and percentage of undergraduates involved in research, completing honors components, and pursuing graduate education following baccalaureate degree graduation. Clearly, the Commission challenged Purdue University and Indiana University to employ more competitive admissions criteria, increase sponsored research, and expand professional master's, doctoral, and professional degree programs.

## **III. Purdue's New Strategic Plan**

Colleges and universities that offer Technology degree programs exist within the mission and vision of their particular institutions. Purdue University recently developed the strategic plan *New Synergies* (2007) to articulate its vision for implementing the institution's unique contributions to the State of Indiana, the

**Table 1. New Synergies (Purdue University, 2008).**

Launching Tomorrow's Leaders	Promote excellence in learning experiences and outcomes, fostering intellectual, professional, and personal development to prepare learners for life and careers in a dynamic, global society.
Discovery with Delivery	Advance the frontiers of knowledge, innovate technologies that address the grand challenges of society to serve humanity, and improve the quality of life around the world.
Meeting Global Challenges	Address the critical needs of society, and catalyze economic development and entrepreneurship consistent with a public research university of the 21st century with global impact.

Midwest region, the Nation, and its global constituents. This plan was intended to articulate the University's vision for its learning, discovery, and engagement mission based on the foundation of three major elements (see Table 1).

These three elements (Launching Tomorrow's Leaders; Discovery with Delivery; and Meeting Global Challenges) can be helpful in articulating a vision for much of what we seek to accomplish in the undergraduate and graduate degree programs in the College of Technology. With the proper undergraduate and graduate experiences, alumni of our programs are challenged to become tomorrow's leaders. Our programs seek to innovate and apply technologies and engage in use inspired research for the benefit of our economy and society. Our graduates will need to address the world's grand challenges with a global perspective if they are to have fulfilling lives and successful careers. Providing gateways to graduate education is an important factor needed for undergraduate degree programs at a research intensive university campus to reach its full potential. Recognizing this challenge the CoT has set a goal of increasing graduate enrollment to 15 percent of its student capacity in the recently developed college strategic plan.

#### **IV. Improving Undergraduate Education**

Imperatives for undergraduate and graduate technology education on research-intensive campuses include reaching stated goals for the scholarship of discovery, integration, application, and teaching in the technology environment for their students and faculty. The 3+2 program in Computer Graphics Technology was designed to maximize the interaction of these elements among the undergraduate and graduate programs in Computer Graphics Technology. The desire to create innovation in undergraduate education is not new. Attempting to chart a course of program improvement on research-intensive university campuses, the Boyer Commission (1998) identified 10 key elements for improving undergraduate education. These elements are helpful in justifying a combined B.S. and M.S. degree program. These elements are defined in Table 2.

**Table 2. Improving undergraduate education.**

Make Research-Based Learning the Standard
Construct an Inquiry-based Freshman Year
Build on the Freshman Foundation
Remove Barriers to Interdisciplinary Education
Link Communication Skills and Course Work
Involve Undergraduates in the Research Process
Use Information Technology Creatively
Culminate With a Capstone Experience
Educate Graduate Students as Apprentice Teachers
Change Faculty Reward Systems
Cultivate a Sense of Community

The 3+2 program was designed with many of the above elements in mind by providing a gateway to graduate education built on a contemporary vision for delivering undergraduate programs in a research-intensive university. Because the CGT department continually seeks to increase the quality of its undergraduate program, providing the incentive of a 3+2 B.S. to M.S. degree designed to be completed in five years, should assist the department in attracting highly qualified and motivated students for both its undergraduate and graduate programs. Development of a 3+2 degree program that can be completed in five years should also assist the department in growing its research and graduate education potential, including incentives for additional students to continue their development by enrolling in the college's Ph.D. program following the 3+2 experience.

#### **V. The CGT 3+2 Development Process**

Five year combined B.S. and M.S. degree programs exist at various universities around the country, including Arizona State University, Ohio-State University, and Rochester Institute of Technology. Such institutions are identified as peer institutions by the Purdue University College of Technology. In such programs, students with excellent undergraduate academic performance records (GPA's) are allowed to enroll in a combined Bachelor of Science – Master of Science degree program. In addressing the desire to increase graduate enrollment and the department's research production, programs in the College of Technology have decided to offer the five year combined degree program option. Aviation Technology was the first CoT program to pursue this option, with CGT following.

The Department of Computer Graphics Technology has 17 graduate faculty members who work in related areas of computer graphics that include

computer animation, construction graphics, interactive media, and virtual product integration. Members of the graduate faculty in the department developed the CGT 3+2 degree proposal in the spring of 2009. Because CGT's stand alone M.S. degree proposal was in pending status at that time, the CGT 3+2 degree was developed as a combination of the existing CoT M.S. degree and the CGT B.S. degree. Following State approval of the stand alone CGT M.S. degree, the CGT 3+2 will be modified such that it includes the CGT M.S. degree.

Proposals for 3+2 degrees at Purdue are advantageous because the only required approval is by the participating department, the Dean of the Graduate School, and the University's Provost. Such proposals do not require State approval because they are considered to be combinations of already existing degrees. At the time of this writing, the CGT 3+2 degree program proposal has been approved by the department and the college dean and is awaiting final approval. The department expects the program to be approved prior to the beginning of the fall 2009 semester and students are ready to apply for admission consideration.

#### **VI. Overview of the CGT 3+2 Degree**

The demand for CGT graduates, particularly for those with graduate degrees, appears quite promising for the foreseeable future. Various sources, including the Bureau of Labor Statistics, the Indiana Department of Workforce Development, and the Occupational Supply and Demand System project a nationwide increase in demand for graduates with computer graphics skills to have an anticipated increase of 10 to 23 percent by 2014. Average expected compensation is projected to be between 50,000 and 60,000 dollars. Given these statistics, the outlook for CGT graduates with a 3+2 degree is quite favorable.

Students currently enrolled in CGT at Purdue University may apply to the 3+2 degree program after completing 93 of the B.S. degree's required 123 credit hours (typically at the end of their sixth semester). Any student who maintains a 3.5 GPA in CGT courses (on a 4.0 scale) and a 3.2 overall Purdue GPA may apply. In addition to an application form, students must submit a statement of interest, a portfolio or demo reel, three letters of recommendation, transcripts, and a tentative plan of study. The graduate committee of the department reviews applications and either accepts or rejects students based upon availability and alignment between student and faculty research interests. This accelerated 3+2 degree program is designed for the most academically gifted students. It is anticipated that approximately 10 to 15 students will be selected for this program each year. Because recent CGT baccalaureate graduating classes have been averaging approximately 80 students per year, it is anticipated that 10 to 15 percent of the undergraduate students will opt to participate in the 3+2 program. The 3+2 option and the traditional M.S. degree admissions process will help the department meet its goal for growing its research and graduate degree productivity.

### **VII. Plan of Study**

The plan of study for the 3+2 degree includes two primary assumptions. The first, as shown in Table 3 (*see next page*), is that during the students' seventh and eighth semester three of their courses are shared between the B.S. and M.S. degrees. The CoT M.S. degree allows up to nine credit hours to be used from 300- and 400-level courses toward the M.S. degree. Similarly, the B.S. degree has a sufficient number of technical electives and free electives to allow the student to take 500-level courses if they so desire. Regardless of the courses used for the shared three course requirement, the student is able to satisfy the

requirements for both degrees. The second assumption is that the student will attend summer school between the eighth and ninth semesters, taking two M.S. courses in order to complete the 3+2 in 5 years. This does not preclude them from attending summer sessions at earlier points in their studies if they so choose.

### **VIII. Program Administration and Retention**

To assure a smooth transition into graduate studies, each student admitted in this program is assigned a graduate committee chair, prior to beginning the graduate program in semester seven. The 3+2 program students are monitored by both their undergraduate advisor and their graduate committee chair. The undergraduate advisor, committee chair, and the student work jointly in documenting and monitoring student progress each semester until completion of the accelerated graduate degree program. At least one 3-credit hour course at the 500- or 600-level must be taken each semester after students are accepted into the 3+2 degree program.

Students are not permitted to continue in the joint program, if: (1) they are unable to complete both degrees in five years, or (2) they are not following the plan of study allowing them to complete both degrees in five years. Students unable to continue in the dual degree program lose their graduate student status and cannot use any courses for both degrees. The CGT Graduate Curriculum Committee may grant exceptions to these policies for compelling or extenuating circumstances. Undergraduate students meeting the requirements of the 3+2 program are not required to take the GRE General Test as do students applying directly for the graduate program. Student admitted to but who do not complete the dual degree in five years must reapply for graduate school if they desire to pursue the master's degree later.

**Table 3. CGT 3+2 Plan of Study**

First Semester		
CGT 111	Design for Vis & Com	3
CGT 112	Sketching for Vis & Com	3
CGT 101	Intro to CGT	3
	English Selective	3
MA 159	Precalculus	3
<i>Total</i>		<i>17</i>

Second Semester		
CGT 116	Geo Model For Vis & Com	3
CGT 141	Internet Fdtn Dev & Tech	3
COM 114	Speech Communications	3
MA 221	Calculus for Tech I	3
C&IT 175	Visual Programming	3
<i>Total</i>		<i>15</i>

Third Semester		
CGT 211	Raster Imaging for CG	3
	CGT Selective	3
	Liberal Arts Elective	3
PSY 120	Elem Psychology	3
PHYS 218	General Physics I	4
<i>Total</i>		<i>16</i>

Fourth Semester		
CGT 216	Vector Imaging for CG	3
C&IT 267	Intro to C++ Prog	3
	Science Elective	3
ECON 210	Principles of Econ	3
	Elective	3
<i>Total</i>		<i>15</i>

Fifth Semester		
	CGT Selective	3
	CGT Selective	3
	Technical Elective	3
	English Selective	3
	Com Selective	3
<i>Total</i>		<i>15</i>

Sixth Semester		
	CGT Selective (300 or >)	3
	Technical Elective	3
	Liberal Arts Elective	3
	Statistics Elective	3
OBHR 300	Mgmt of Human Res	3
<i>Total</i>		<i>15</i>

Seventh Semester		
CGT 450	Professional Practices	3
CGT 411	Contemp Prob in CGT	3
MGMT 455	Leg Backgrd for Bus I	3
	Technical Elective	3
	<i>Elective(BS) CGT Primary / Related Course (MS)</i>	3
<i>Total</i>		<i>15</i>

Eighth Semester		
	CGT Selective (400 or >)	3
	Liberal Arts Elective	3
	Management Elective	3
	<i>Elective(BS)CGT Primary / Related Course (MS)</i>	3
	<i>Elective(BS) CGT Primary / Related Course (MS)</i>	3
<i>Total</i>		<i>15</i>

Summer School		
	<i>CGT Primary/Related Course (MS)</i>	3
	<i>CGT Primary/Related Course (MS)</i>	3
<i>Total</i>		<i>6</i>

Ninth Semester		
	<i>CGT Primary/Related Course (MS)</i>	3
	<i>CGT Primary/Related Course (MS)</i>	3
	<i>CGT Primary/Related Course (MS)</i>	3
<i>Total</i>		<i>9</i>

Tenth Semester		
	<i>CGT Primary/Related Course (MS)</i>	3
	<i>CGT Primary/Related Course (MS)</i>	3
	<i>CGT Primary/Related Course (MS)</i>	3
<i>Total</i>		<i>9</i>

## **IX. Program Intended Benefits**

This program was developed to benefit the students, the department, and the college. The college and the department have identified the goal of increasing graduate enrollment to 15 percent of the combined undergraduate-graduate student capacity. Providing incentives for the most qualified undergraduate students to complete both degrees in five years should not only increase M.S. degree enrollment, but it should also help increase the number of students continuing in their development by pursuing a Ph.D. The students' ability to receive both a Bachelor and Master degree in five years provides a great economic incentive. In addition, students are exempt from taking the GRE and are eligible for graduate scholarships and assistantships upon being admitted to the program. Students in the 3+2 program will have opportunities to participate in research earlier in their studies and will have access to higher level courses than their regular baccalaureate degree counterparts. The CGT department and the College of Technology also have a goal of attracting more highly qualified students directly out of high school and for providing challenging experiences for honors students. The 3+2 degree in CGT should help the department attract the most qualified undergraduate students and encourage the brightest students to enroll into the graduate program. The combined degree program is also designed to offer an enhanced academic environment with an accelerated learning opportunity.

## **X. Plans for Evaluating the Program's Success**

Any attempt at innovation in higher education would be remiss if plans for evaluating the success of the program's impact are not undertaken. In evaluating the efficacy of the 3+2 program the following metrics will be considered:

- Quality indicators of students admitted as freshman in CGT
- Number of students applying for the 3+2 option
- Number of students completing the 3+2 program in 5 years
- Number of scholarship opportunities in the form of conference presentation or papers published as a result of student and faculty work
- Number of sponsored programs proposed and awards as a result of student and faculty work
- Number of 3+2 graduates that go on to a Ph.D. at Purdue or another institution
- Job placement demographics of 3+2 students going into the job market after graduation
- Student and faculty program satisfaction

Because the University, College, and department employ outcomes-based strategic planning, the metrics listed should provide the data needed for requesting future resources to support the CGT department's desire for creating economy of scale in delivering its learning, discovery, and engagement mission.

## **XI. Summary**

This contribution has outlined the process used by the CGT department in developing a combined 3+2 M.S. and B.S. program. It is believed that this degree program provides myriad benefits to students, faculty, the department and college. For the students the program provides an accelerated path of study that retains the rigor of the individual degrees, helping those that qualify go farther faster. For faculty, the program assists in transitioning from a total focus on undergraduate programs to one that places equal emphasis on undergraduate and graduate education. By combining 3+2 program admissions with the

department's traditional M.S. degree admits, the department will enjoy the same benefit as students, growing its graduate program more quickly. And, both the department and college will reap the benefit of increasing graduate program admissions, stronger undergraduate admissions, and the potential for an expanding research portfolio.

## XII. References

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