

Special Graduate Faculty Meeting February 25, 2009

A special graduate faculty meeting was held at 3:30 pm in the Turner room at the Havener Center. Three items were included on the agenda for this special meeting. The first item concerned a special form for allowing graduate certificate students to change their calendar year. Prof. Kelvin Erickson moved to accept the form (included here as Appendix A). Prof. Samaranke seconded the motion and after a brief discussion the motion was approved with 13 votes in favor, no votes opposed, and no abstentions. The second item concerned a master degree program in explosives engineering. Information regarding this program was distributed to the graduate faculty along with the agenda. A copy of this information is attached as Appendix B. A motion to approve this program was made by Prof. David Summers and seconded by Prof. Erickson. The program was briefly described by Prof. Worsey and was approved by a vote of 13 in favor, 1 opposed, and 0 abstentions. The final item of business was a request to allow up to 12 credit hours of transfer courses. A copy of the proposal is attached in Appendix C. A motion was introduced as follows: "For organizations in which a memorandum of understanding is executed (see attachment\*), up to 12 hours of graduate credit may be accepted (if the courses meet the standards of the S & T graduate program, as assessed and documented on Graduate Form I)." The motion was introduced by Prof. Erickson and seconded by Prof. Summers. The motion was approved by a vote of 14 in favor, 0 opposed, and 2 abstentions. The meeting was adjourned at 4:15 pm.

Respectfully submitted,

Richard E. DuBroff  
Chair of the Graduate Faculty.

\*Note: The attachment refers to the sample memorandum of understanding starting on the fourth page of appendix C.

APPENDIX A  
New Graduate Certificate Form to Change Catalog Year



University of  
Science & Technology

## AUTHORIZATION TO CHANGE REQUIREMENT TERM

(GRADUATE CERTIFICATE PROGRAMS)

Name \_\_\_\_\_ Student ID \_\_\_\_\_

Date \_\_\_\_\_

Graduate Certificate Program \_\_\_\_\_

### AUTHORIZATION TO CHANGE TO A NEWER REQUIREMENT TERM

The rules for the graduate certificate program I am pursuing have changed since my initial enrollment. I therefore submit the following petition to have the requirements for my graduate certificate changed to comply with the revised requirements as described in the graduate catalog year listed below.

Change Requirement Term From \_\_\_\_\_ To \_\_\_\_\_

\_\_\_\_\_  
Student Signature

\_\_\_\_\_  
Date

APPENDIX B  
Master of Science in Explosives Engineering

**Graduate Catalog Description:****Explosives Engineering  
Master of Science**

The Explosives Engineering program offers an M.S. degree for students with bachelor's degrees in engineering, science and technology. Due to the age profile of the explosives industry and attrition of personnel and the rapid change in technology, there is an immediate and growing need for highly trained explosives professionals in both the civilian explosive, mining and civil excavating fields and government and the defense industry. Employers are looking for engineers and scientists with sophisticated skills in the integration of explosives technology into complex systems in a wide range of applications. Employers are also seeking M.S. graduates because they can move quickly into managerial positions.

Faculty involved in a variety of explosives related research programs teach and direct the program in conjunction with instruction by industry specialists in a wide range of applications. Students will have opportunities to assist these faculty, both in research and teaching, as well as working alongside faculty and graduate students in other engineering and science fields. The explosives engineering faculty and students will be active in the leading professional societies such as the International Society for Explosives Engineers and those in a wide range of associated areas.

The program requires a minimum of 30 hours of graduate credit and includes a thesis. A core of four courses is required of all students, and a module of allied courses in departments outside of explosives engineering is encouraged. A security background check is required.

**Degree Requirements**

M.S. with Thesis: The M.S. degree with thesis requires the completion of 24 hours of graduate course work and six hours of research (ExpE 490), and the successful completion and defense of a research thesis.

Four of the following core courses are required of all M.S. students in Explosives Engineering:

ExpE 307/MiEng 307	Principles of Explosives Engineering
ExpE 350/MiEng 350	Blasting Design and Technology
ExpE 351	Demolition of Buildings and Structures
MiEng 383	Tunneling and Underground Construction Techniques
ExpE 402	Environmental Controls for Blasting
ExpE 406	Scientific Instrumentation for Explosives Testing and Blasting

**Master of Science in Explosives Engineering**

Students select 12 hours of ExpE electives. For out-of-department courses in the M.S. Degree in Explosives Engineering candidates are advised to group these courses into a module that fits their special interest.

**Faculty**

Faculty involved in the program are based around existing faculty from the Department of Mining and Nuclear Engineering at Missouri S&T and instructors from industry augmented by faculty from the Department of Civil Engineering at Missouri S&T and faculty from UMC, University of Kentucky and Texas Tech.

**Professor**

Paul Worsey, Ph.D., University of Newcastle upon Tyne (S&T)  
 Richard Bullock, D. Eng., Missouri School of Mines – Emeritus (S&T)  
 Sam Kiger, Ph.D., University of Illinois at Urbana (University of Missouri Columbia)

Bruce Freeman, Ph.D., University of California Davis (Ktech, formerly at Texas A & M) \*

**Associate Professor**

Jason Baird, Ph.D., University of Missouri Rolla (S&T)  
 John Myers, Ph.D., Texas-Austin (S&T)

**Assistant Professor**

Braden Lusk, Ph.D., University of Missouri-Rolla (University of Kentucky) (ex grad) \*  
 Brandon Weeks, Ph.D., University of Cambridge (Texas Tech) (ex grad) \*

**Adjunct Industry Instructors**

Greg Shapiro	Steel Blasting
Matt Suttcliffe	Premier Pyrotechnics
Marty Gillette	Premier Pyrotechnics

We hope to broaden the scope of the program to involve professors from other disciplines on campus as the offering of courses expands.

\* Have acknowledged interest in working with the program on an adjunct basis offering distance courses (from their current locations). Subject to S&T hiring policies & procedures.

**PROPOSAL FOR A MASTER OF SCIENCE  
DEGREE PROGRAM  
IN EXPLOSIVES ENGINEERING  
(ExpEng or ExpE)**

**Department of Mining and Nuclear Engineering**

**224 McNutt Hall**

**Missouri University of Science and Technology**

**Rolla, Missouri 65409-0450**

**(573) 341-4753**

**December 2008**

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## Executive Summary

The proposed Master of Science degree in Explosives Engineering fulfills campus, state, federal and industry needs, as well as the wishes of prospective students for over a decade. The proposed degree will attract new graduate students, as well as retain students who have completed B.S. degrees at Missouri S&T. The graduate program will help the campus attract and retain quality faculty with active research programs. With the retirement of Korea and Vietnam era technical expertise in the defense base there is a critical shortage of explosives engineers. In addition, in the mining industry (the major user of explosives) there are over 5,000 engineers that will retire in the next decade, and the average age of technical personnel in explosives companies is over 50. The degree is designed to ensure that graduates will have the competencies employers are looking for, especially in their search for people with advance skills who can move quickly into managerial positions. Academic institutions and national labs also seek explosives engineers with M.S. degrees to teach in their undergraduate programs and explosives engineers perform research and engineering vital for the nation's security.

The degree is a logical outgrowth of Missouri S&T's focus as a technological university and recent expansion in explosives engineering, and is the logical step forward from the current graduate minor in explosives engineering. The degree is unique to the state, the only other university to offer graduate classes in explosives engineering, comparable to those at Missouri S&T is New Mexico Tech. The number of explosives related classes that are currently offered has steadily increased to eight (24 credit hours). The addition of a second explosives faculty in January 2008 allows further expansion of offerings and frequency of offerings, making an M.S. in Explosives Engineering sustainable.

This 30-hour program includes a thesis, explosives engineering core courses and electives, and a module of courses outside the department if appropriate. Conservative enrollment and financial projections show that the degree will produce revenue from its start.

## 1. Need for Program

The history of explosives at Missouri S&T goes back to its inception as the Missouri School of Mines (MSM). The use of explosives since the invention of dynamite by Alfred Nobel (of the Nobel Prize fame) has been a fundamental cornerstone of the mining and civil excavation industries for the excavation of rock. Over the years MSM/University of Missouri-Rolla/Missouri S&T has been one of the principal universities both in teaching explosives engineering and performing explosives research. Over the last decade it has emerged as the #1 university for explosives engineering in the nation. In 1997 it was the first to have an undergraduate explosives engineering emphasis, followed in 2005 by an explosives minor for both undergraduate and graduate degrees and in 2007 by an explosives certificate.

The emphasis on explosives education has increased enrollment in the mining engineering program, resulting in more than a doubling of the department enrollment. The advertisement of the teaching of explosive classes gained national attention, with TV coverage on The Learning Channel, the Discovery Channel, and the National Geographic Channel and even international coverage with the Canadian Discovery Channel, with programs aired throughout the world. More recently the summer explosives camp has gained national attention, published on the front page of the New York Times Science Times and the International Herald Tribune, and airing on NPR.

Since the fall of 2005 through the fall of 2007, a period of only two years, there have been two undergraduate explosives certificates, 13 undergraduate minors and 2 graduate minors conferred. In the spring of 2008, there were 32 students enrolled for minors in explosives engineering and five students are ready to enroll for the master's, three of which will continue from undergraduate majors at Missouri S&T.

After the successful establishment of the Master of Science in Explosives Engineering a Master of Engineering in Explosives Engineering will be developed. There are already four explosives engineering courses taught through the distance program but it will be necessary to convert and replace existing courses and develop new ones for distance education in this field. It is envisaged that we will begin the M.E. program one year after the M.S., due to logistics.

### Student Demand

#### Form SE

Student Demand

Table 1 contains the expected enrollment forecasts from year 1 (2009-10) to year 5 (2013-14).

Table 1: Expected Enrollment Potential from Year 1 through Year 5

Year (A/C)	1 (09-10)	2 (10-11)	3 (11-12)	4 (12-13)	5 (13-14)
<b>Full Time</b>	<b>5*</b>	<b>6</b>	<b>8</b>	<b>10</b>	<b>12</b>
<b>Part Time</b>	<b>-</b>	<b>5</b>	<b>8</b>	<b>12</b>	<b>15</b>
<b>Total</b>	<b>5</b>	<b>11</b>	<b>16</b>	<b>22</b>	<b>27</b>

\* We already have five people enrolled in graduate programs and studying explosives engineering who are waiting to transfer to the program as soon as it becomes available.

## 2. Market Demand, Societal Needs and Methodology

### Summary of Need for Program

The Master of Science degree in Explosives Engineering will fulfill the following needs:

- Satisfy current and prospective student interest in a graduate program in explosives engineering.
- Strengthen Missouri S&T's ability to recruit and retain graduate students with an interest in a technological field.
- Provide new opportunities for graduate research.
- Fulfill the market's need for explosives engineers with a specialization in one or more areas of technology.
- Strengthen Missouri S&T's ability to recruit and retain quality faculty in the explosives field and grow in this high profile subject area.
- Meet the needs of DOE and DOD personnel, including those stationed at Fort Leonard Wood.

## Employment of Graduates

The major use of explosives is in the civilian sector, with over three megatons of explosives used in the United States each year (USGS Mineral Industry Survey). Of this, an estimated 85 – 90% is used in the mining industry (for extraction of metals, minerals, fuels and construction materials) and an estimated 9 – 15% is used in the civil construction industry for road cuts, tunnels, structure basements and grading for large industrial, distribution and retail complexes. All other civilian uses of explosives combined account for less than 1%, including demolition, explosive welding, oil and gas exploration and production etc. Another important segment is government, which includes DOE, DHS and DOD and the National Laboratories.

According to the New York Times and NPR, the National Mining Association was quoted as saying five thousand mining engineers will be retiring in the next decade, and a substantial proportion of these are involved in the primary breakage of rock using blasting. In addition the average age of technical personnel at Dyno (one of the country's largest explosives manufacturers) is over 50. With the Korean and Vietnam wars the defense industry was saturated with engineers, many of whom were in the same age group, the majority of which have now retired, leaving a substantial gap in expertise, especially in the area of explosives. The Department of Mining and Nuclear Engineering, having recognized national expertise in the areas of explosives education, training and research is becoming increasingly approached by defense contractors, including Westinghouse, Alliant Technologies etc. and DOD installations (such as the U.S. Navy's facility at China Lake, CA) and National Laboratories (such as the Idaho National Laboratory) for explosives engineers. The Idaho National Laboratory is considering a memorandum of understanding with Missouri S&T for coops and education with the purpose of attracting explosives engineers from Missouri S&T and increasing the education of its employees, especially in the government sector advanced degrees are encouraged and there is significant interest in an M.S. in explosives engineering to complement our graduate minor in explosives engineering.

There is also a need for existing graduate engineers in industry and government to further their education and obtain specialized training in explosives engineering and this will provide a means of fulfilling that need. Missouri S&T stands with an excellent opportunity to fill key industry positions and dominate in the field of explosives engineering and thus increase the university's national standing in these areas of industry and government. The Master of Science or Engineering in Explosives Engineering is conceived as a specialist qualification for graduates holding accredited engineering, science and technology degrees, as is the practice in Europe and other parts of the world, paralleling the concept of an MBA.

## Societal Need

The use of explosives is extremely important to our current standard of living. Without explosives raw materials would be very expensive to extract from the ground. In fact, one of the most famous people in history, Alfred Nobel (of Nobel Prize fame) was the inventor of dynamite, the modern blasting cap and a whole host of other explosives and propellants. Explosives are not only used to break rock so that it can be removed and easily processed for the extraction of metals (from iron to platinum) and minerals (from road salt to borax) but also in the removal of overburden in surface coal mining, which produces over 50% of the coal mined in the US, which in turn is responsible for the production of one quarter of our power generation. Explosives touch almost every aspect of our modern lives. There is an adage in mining that if it can't be grown, it has to be mined and as far as explosives are concerned if the rock is tough, then generally explosives have to be used. The abundance of cheap raw materials and energy in our modern civilization is attributed to high explosives & Alfred Nobel.

In civilian excavation and construction, explosives are extremely important for rock breakage of rock. The majority of rock cannot be economically ripped using mechanical excavators, whilst explosives and blasting provide an economic solution, especially for the removal of large volumes of rock. Just in the state of Missouri one only has to drive down the highways and marvel at some of the rock cuts, not only along I44 and other highways but also at the scale at which rock excavation has been undertaken in the Branson area for example. Leveling and grading is extremely important for the construction of large industrial and retail facilities, not only for the efficient use of machinery but also for the Americans with Disabilities Act. For example, when did you last enter a Wal-Mart which was split-level? An example of the importance of blasting is the Wal-Mart distribution center located in nearby St. James, one of the largest such facilities in the U.S. Although being sited on what appears to be a flat field it actually required over 50 thousand cubic yards of rock excavation by blasting so that the facility floor could be level.

An important item in maintaining the American way of life is the ability to defend the country, and explosives are an important part of this. We have placed a number of our graduates with minors in explosives engineering with government and contractors in the defense industry, including China Lake and Applied Research Associates, Inc. There have been several recent enquires for graduates in the explosives area and requests for students with master's in the explosives area. Offering a masters in explosives engineering will allow valuable training for government and defense contractor personnel and provide a mechanism for personal advancement.

The terrorist attacks on September 11, 2001 brought home to American soil the threat of international terrorism. Before this terrorist act in the US, there had been numerous attacks on U.S. installations and personnel throughout the world using explosives but now there is an increased need for research in combating explosive terrorism including blast resistance, detection and defeat mechanisms for terrorist explosive devices including improvised explosive devices (IEDs). A substantial amount of work has been started for the protection of critical infrastructure by the Idaho National Laboratory, including highly classified work. Several research contracts are in place at Missouri S&T to address portions of this need. Currently, there is a severe lack of personnel with adequate credentials and training in the field of explosives engineering to meet critical needs.

### **Methodology of Research**

Sources investigated for employment data and societal needs included the U.S. Geological Survey (Minerals Yearbook – Explosives), NPR (All Things Considered, June 20, 2007), New York Times (Science Times Page 1, July 3, 2007), the International Society of Explosives Engineers and the National Mining Association. Sources for demand are historic numbers, polling current students, current students already enrolled for an M.S. on the basis the program will go ahead, and prior requests from prospective students. Numbers for Year 2 and out are projected based on trends and the amount of publicity that explosives engineering at Missouri S&T has been generating. This will kick into higher gear in 2009 with the airing of a new Discovery Channel series currently under production entitled “The Detonators” in which Dr. Worsey is the co-host along with a Missouri S&T Ph.D. alumnus with a graduate minor in explosive engineering. The lab portions of the series are being filmed at our Missouri S&T Experimental Mine and this is bound to increase interest in the explosive engineering programs at Missouri S&T.

### **3. Duplication and Collaboration**

The M.S. degree in explosives engineering does not involve collaboration with any external institution or organization, except for the collaboration of Profs. Lusk and Weeks at the University of Kentucky and Texas Tech University, respectively. However, the current Master’s Degree rules allow for a maximum of nine hours of course work to be transferred from universities outside the University of Missouri, which allows for future co-operation with universities offering additional courses to those offered by Missouri S&T, which would be advantageous to a master’s candidate. There is the possibility of co-operation with the University of Missouri Columbia on a course or two on the blast resistance of structures and we

will be looking at co-operation with other institutions (such as Texas Tech and the University of Kentucky) and former academics now in industry for courses in specialized explosives chemistry and other areas not covered.

What we are proposing is unique. The only other related degree that comes anywhere close at the moment is a Master of Science in Engineering Mechanics with Specialization in Explosives Engineering which is offered by New Mexico Tech. However, the requirements for this specialization are less than the requirements for the current graduate minor in explosives engineering at Missouri S&T and is more along the lines of the Missouri S&T undergraduate emphasis in explosives engineering.

## 4. Program Structure

### Form PS

#### Program Structure

A. **Total credits required for graduation:**     30 hrs

The proposed M.S. degree in explosives engineering will meet or exceed requirements listed in the Missouri S&T Graduate Catalogue. The program structure will vary according to the interests of candidates for the degree. Candidates will pursue a plan of study that emphasizes the writing of a thesis in explosives engineering.

B. **Residency requirements:**

Research work normally must be performed on the Missouri S&T campus. Exceptions may be made for persons working at government facilities, national labs, explosives industry private companies and private research facilities.

C. **Courses (general):**

With guidance from their advisor and graduate committee, each candidate will complete a plan of study to satisfy the interests of the candidate and their advisor plus requirements for the Master of Science degree, as described in the Missouri S&T Graduate Catalog:

**Master's Degree with Thesis** – minimum of 30 hrs graduate credit; at least 6 hrs to be 400 level courses; no more than 6 hrs of 200 level courses; 6 hrs minimum devoted to

**Master of Science in Explosives Engineering**

graduate research, ExpE 490; no more than 12 hrs of research, special readings and seminar.

**D. Major requirements:**

As part of this proposed M.S. degree program, candidates will complete four required courses from a list of core courses (which will be updated from time to time). If a student has already taken classes from this list as an undergraduate student (e.g. MiEng 307 which is a required mining class) other explosives engineering classes may be substituted. These core classes are:

- (3) ExpE 307/MiEng 307 Principles of Explosives Engineering
- (3) ExpE 350/MiEng 350 Blasting Design and Technology
- (3) MiEng 383 Tunneling and Underground Construction Techniques
- (3) ExpE 351 Demolition of Buildings and Structures
- (3) ExpE 402 Environmental Controls for Blasting
- (3) ExpE 406 Scientific Instrumentation for Explosives Testing and Blasting

In addition candidates will select two to four courses from the core classes and the following elective Explosives Engineering courses:

- (3) ExpE 309 Commercial Pyrotechnics Operations
- (3) ExpE 313 Stage Pyrotechnics and Special Effects (currently Min 301)
- (3) ExpE 305 Explosives Handling and Safety
- (0-6)ExpE 491 Internship
- (3) ExpE 401 Blast Mitigation
- (3) ExpE 407/MiEng 407 Theory of High Explosives

Out-of department courses may also be taken as elective courses according to a candidate's special interests. Suggested out of department elective courses include:

For those with an interest in rock blasting:

- (4) Geo 220 Structural Geology
- (3) Geo 301 Advanced Structural Geology (currently experimental)
- (3) GeEng 371 Rock Engineering

For those with an interest in demolition or blast protection:



- (3) CvEng 217 Structural Analysis I
- (3) CvEng 218 Structural Analysis
- (3) CvEng 223 Reinforced Concrete Design

For those with an interest in weapons systems design:

- (3) McEng 336 Fracture Mechanics
- (3) AeEng 251 Aerospace Structures I
- (3) McEng 320 Advanced Mechanics of Materials

### Catalog Description of Explosives Engineering Courses

#### **ExpE 301** (3) Special Topics

This course is designed to give the department an opportunity to test a new course.

#### **ExpE 305** (3) Explosives Handling and Safety (originally MiEng 305)

Basic handling and safety for explosives, explosive devices and ordnance related to laboratory handling, testing, manufacturing and storage, for both civil and defense applications.

#### **ExpE 307/MiEng 307** (3) Principles of Explosives Engineering

Theory and application of explosives in the mining industry; explosives initiating systems, characteristics of explosive reactions and rock breakage, fundamentals of blast design, drilling and blasting, regulatory and safety considerations. Prerequisites: GeEng 50; accompanied or precede by either CvEng 215 or Geo 220 or Geo 125.

#### **ExpE 309** (3) Commercial Pyrotechnics Operations (originally MiEng 309)

Provide participants with basic pyrotechnic operator certification (with passing of the PGI test) and advanced lead pyrotechnic operator training. Class work will be complemented by practical training in laboratory sessions, culminating in a full pyrotechnic show, from start to finish. Prerequisites: Chem 1, US Citizen or permanent resident (to fulfill the requirements of the SAFE EXPLOSIVES ACT 2003), resident enrollment at Missouri S&T (e.g. not distance or internet).

#### **ExpE 313** (3) Stage Pyrotechnics and Special Effects (originally MiEng 301)

Use of energetic materials in close proximity to audiences. Provide participants with training preparing for Missouri Pyrotechnics Display Operators License. Covers: close proximity, indoor and outdoor pyrotechnics and special effects. Working with stage crews and talent, safety and permitting.

**ExpE 350/MiEng 350 (3) Blasting Design and Technology**

Advanced theory and application of explosives in excavation; detailed underground blast design; specialized blasting including blast casting, construction and pre-splitting. Introduction to blasting research. Examination of field applications. Prerequisite: ExpE 307/MiEng 307. Student must be at least 21 years of age.

**ExpE 351 (3) Demolition of Buildings and Structures (originally MiEng 351)**

Provide participants with basics and solid grounding in the equipment, techniques and processes required for the demolition and remediation of mine plant and processing equipment sites and non-mining structures such as buildings, factories, bridges etc. Prerequisites: IDE 50 or 140, and IDE 110 or MiEng 232, plus US citizen or permanent resident. \*Requirement due to the Safe Explosives Act – January 2003.

**ExpE 400 (variable) Special Problems**

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

**ExpE 401 (3) Special Topics**

This course is designed to give the department an opportunity to test a new course.

**ExpE 402 (3) Environmental Controls for Blasting (originally MiEng 402)**

Advance blast mechanics; overbreak control including comprehensive coverage of perimeter and smoothwall specialist blasting techniques and geotechnical factors affecting blast vibration, including limits, analysis, monitoring and control; air blast control including limits, monitoring and atmospheric and topographic effects. Prerequisite MiEng 307.

**ExpE 406 (3) Scientific Instrumentation for Explosives Testing and Blasting (orig. MiEng 406)**

Application of scientific principles, equipment description and operation for instrumentation of explosive events including blasting. Topics: Blast chamber design, set up, high-speed photography, motion detection and measurement, explosives sensitivity testing, explosives properties testing, vibration measurement and analysis, destruction and demil.

**ExpE 407/MiEng 407 (3) Theory of High explosives**

Study of the application of chemical thermodynamics and the hydrodynamic theory to determine properties of high explosives; application of detonation theory to steady-state detonations in real explosives; application of the above to the blasting action of explosives. Prerequisite: MiEng 307.

**ExpE 490 (3) Research**

Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

**ExpE 491 (0-6) Internship**

Internship will involve students applying critical thinking skills and discipline specific knowledge in an explosives related work setting based on a project designed by the advisor and employee. Activities will vary depending on the student's background and the setting.

**E. Free Electives**

Twelve hours of core courses and six hours of research are required, leaving 12 hours to be selected by candidates in consultation with their advisor from further core courses, other explosives engineering elective courses or out-of-department courses.

**F. Requirements for Thesis, Internship or Other Capstone Experiences:**

All candidates will write and defend a thesis at the conclusion of their course work. An internship is recommended but not required. For those candidates without work experience in an explosives-related industry an internship will be strongly encouraged.

**G. Unique Features**

The main unique feature of the explosives engineering master's program is that it is the only program of its kind in the Americas. The nearest graduate program is a master's with a specialty in explosives engineering (12 hours of explosives-related coursework) at New Mexico Tech. Missouri S&T already exceeds New Mexico Tech's offering with a graduate minor in explosives engineering, available since 2005.

## 5. Financial Projections

**Pre-amble**

At present the university faces uncertainty in its financial outlook. It is expected that the projected budget will be impacted by this current financial uncertainty. This is a realistic budget proposal based on normal operating conditions. If the situation of the university

## Master of Science in Explosives Engineering

improves we ask that the proposed budget is given a top priority. Meanwhile we can proceed without support if necessary.

**Form FP** Financial Projections

	Year 1	Year 2	Year 3	Year 4	Year 5
1. Expenditures					
A. One-time					
New/renovated space					
Equipment					
Library					
Consultants					
Other			\$15,000	\$15,000	
Total for One-time Expenditures			\$15,000	\$15,000	
B. Recurring:					
Faculty			\$80,000	\$80,000	\$80,000
Staff (GTA)	\$33,300	\$33,300	\$33,300	\$33,300	\$33,300
Benefits			\$25,320	\$25,320	\$25,320
Equipment					
Library					
Other (Mining E&E)		\$10,000	\$10,000	\$10,000	\$10,000
Total for Recurring Expenditures	\$33,300	\$43,300	\$148,620	\$148,620	\$148,620
TOTAL (A + B)	\$33,300	\$43,300	\$163,620	\$163,620	\$148,620
2. Revenues					
State Aid - CBHE					
State Aid - DESE					
Tuition/Fees	\$74,833	\$124,152	\$169,839	\$231,765	\$286,127
Institutional/Resources					
Other					
TOTAL REVENUES	\$74,833	\$124,152	\$169,839	\$231,765	\$286,127

## A. Budget Justification

A detailed budget spreadsheet is given in Appendix A, which includes a breakdown of the data for in and out-of-state students. Because of the high numbers of students already taking some of the explosives engineering courses (e.g. MiEng 307, ExpE 309, MiEng 350) and the anticipated enrollment of additional M.S. students from this program, it is anticipated that one 100% FTE GTA position (broken down into 4 x 25% positions) will be required to assist faculty members with the explosives engineering course load from the beginning. One FTE GTA position costs \$33,300 for a 9-month appointment (2008-2009 rates). From Year 2 \$10,000 has been included for mining program expenditures incurred by the extra student numbers. Once numbers have increased to the level anticipated by the third year projections the current two faculty members will be unable to cope with the course load and will need to be augmented. Lab courses are difficult to teach with more than 15 students per lab and we already teach three lab sections of MiEng 307 and are approaching the need for a second lab section of MiEng 350. At this point it is anticipated that a third faculty member at the assistant or associate professor level will be required at an estimated cost of \$80,000 per year plus 31.65% benefits. A one-time expenditure of \$30,000 split between Years 3 and 4 is included for a start up package for this faculty member.

However, tuition and fees from the anticipated student numbers should cover both recurring and one-time expenses. Tuition and fee income was calculated using the 2008-2009 rates for graduate students (including the engineering supplemental fee) on a conservative basis of full-time students taking 24 hours per year and part-time students taking 9 hours per year. These rates are \$470.02 per hour for in-state students and \$840.50 per hour for out-of-state students. It was estimated that one third of the full-time students will be out-of-state and all of the part-time students will be out-of-state.

### One-time expenditures

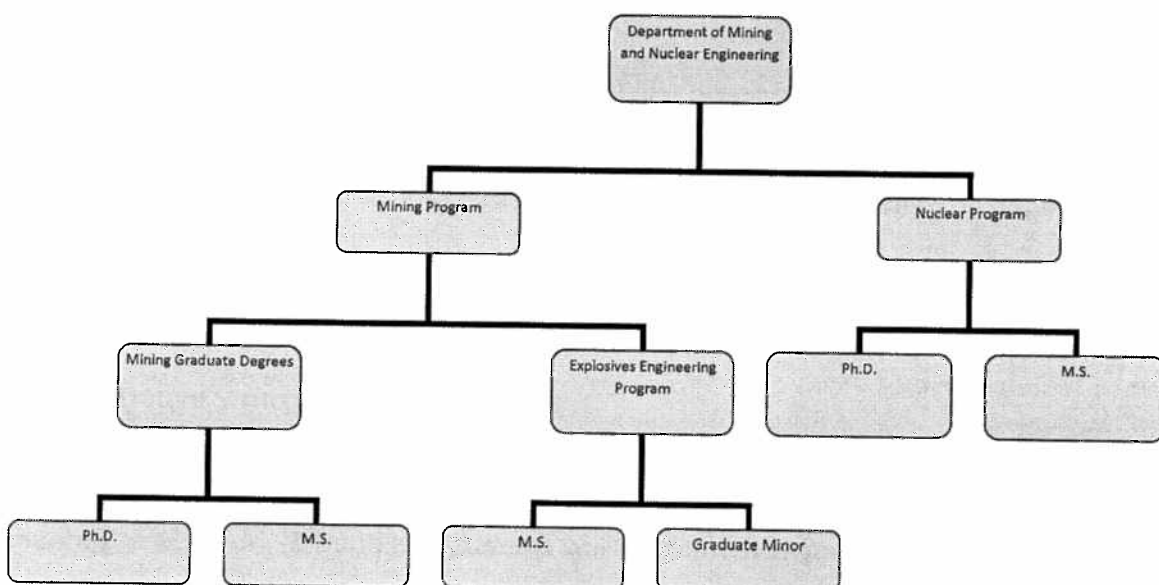
The only one-time expenditures anticipated are \$15,000 in Years 3 and 4 for a start up package for a third faculty member in the explosives engineering area.

### Recurring expenditures

The recurring expenses for faculty and staff include salaries and benefits for a FTE GTA in all five years, \$10,000 for mining program expenditures from Year 2 and for hiring a new faculty member from Year 3. The costs for E & E and new faculty are to be dependent on the projected numbers being reached, such that the program is guaranteed to be of financial benefit to the university.

### B. Administrative Structure

The M.S. degree will be an integral part of the Department of Mining and Nuclear Engineering at Missouri S&T and the students will be counted as mining program graduate students. The strengths of both mining and explosives engineering are augmented using this symbiotic relationship.



### C. Facilities and Environment

Current facilities will accommodate the explosives engineering graduate students. These facilities include modern lecture facilities at McNutt Hall equipped with an instructor station (which includes a computer, VCR and a ceiling-mounted LCD projector) linked to the campus network through a high-speed data network, the Missouri S&T experimental mine and the energetic materials research facility.

- *Underground Mine Facility:* The Missouri S&T Experimental Mine is one of only a few such facilities available on a university campus for mining engineering education. The facility is used primarily by the students and faculty of Missouri S&T for instruction and research in mining and geological engineering practices. The Experimental Mine is located on Bridge School Road, just west of Rolla, 1-1/2 miles from the Missouri S&T Campus. It consists of two underground mines, two small quarries, explosives magazines, a classroom and office facility, a shop building, and a garage on a 19-acre site. The underground mine facility is already extensively used for explosives classes and research.
- *Surface Quarry Facility:* The Missouri S&T Experimental Mine also includes two small surface quarries used for teaching and research by mining engineering faculty and students. These quarries are already extensively used for explosives classes, research, demonstrations and of course explosives camp. The facility is also being used for the filming of “extreme explosions’ a discovery channel series on explosive demolition due to air the first quarter of 2009.
- *Energetic Materials Research Facility:* The Energetic Materials Research Facility (Explosives Research Lab) laboratory is housed in a converted former U.S. Bureau of Mines research foundry (Building 4) off the new entrance to the Missouri S&T campus. The laboratory contains two blasting chambers (rated for 1 kg and 4 kg of explosives, respectively), a shop, a computing workstation running Autodyne 3D© software (an

industry standard for performing closely-coupled computational fluid dynamics/computational structural dynamics calculations), high-speed film (up to 1.25 M frames per second) and video cameras (up to 90k frames per second), gated ICCD camera (up to 55 nsec exposure), flash x-ray system, 16-channel digital data acquisition system, three high-energy pulsers, two delay generators, two initiation systems for exploding bridgewire detonators, and explosive magazines. The laboratory is currently used for teaching MiEng 301, 350, 390, 406 and 490. The facility was recently extended using funding from the Chancellor to house the new 11 ft diameter large scale blast chamber acquired from the Army Chemical Demilitarization Command in Tooele, Utah. This chamber is 84 tons and represents a major upgrade to the facility, raising the facility to the realm of world-class capabilities.

- *Facilities at Operating Mines and Quarries:* Field trips to operating mines have been used intensively to demonstrate real-world mining facilities, especially for rock blasting, the major use of explosives. In the past many explosive research projects have involved industry participation for both funded faculty, undergraduate and graduate research. It is expected that these links will continue.

During the academic year 2007-2008, eight explosives engineering classes were taught at Missouri S&T (MiEng 301, MiEng 307, MiEng 309, MiEng 350, MiEng 351, MiEng 383, MiEng 402, and MiEng 406) and the facilities can easily accommodate the extra courses anticipated for the M.S. program. MiEng 383 and MiEng 402 were taught distance only and MiEng 307 and MiEng 350 were taught distance concurrently with the on-campus classes. The mining program has two tower DVD bulk copiers to facilitate the distribution of course DVDs for distance courses. The current facilities can accommodate the explosives engineering courses, the main need for the master's program being extra personnel and graduate student help.



## 6. Program Characteristics and Performance Goals

### Form PG

#### Program Characteristics and Performance Goals

Institution Name: Missouri University of Science and Technology

Program Name: Explosives Engineering, Master of Science

Date: November 2008

#### Student Preparation:

- Students will be required to meet the standard graduate school admission requirements for the Missouri University of Science and Technology.

#### Faculty Characteristics:

- *Any special requirements (degree status, training etc.) for assignment of teaching for this degree program?* This program will be supported with a combination of existing Missouri S&T traditional faculty and adjunct industry instructors. In the future faculty from other academic institutions may teach additional courses. These academic faculty are expected to hold a Ph.D. or its equivalent in their area of specialty.
- *Estimated percentage of credit hours that will be assigned to full-time faculty:*  
  
75%
- *Expectations for professional activities, special student contact, teaching/learning innovation.* Faculty at Missouri S&T are expected to participate in teaching, research, service and outreach activities. Annual reviews, promotion and tenure, continuing membership on the graduate faculty and annual salary adjustments ensure the quality

of faculty activities. The faculty of the explosives engineering program will be located in the Department of Mining and Nuclear Engineering. The name of the department will remain to reflect its undergraduate and highest degree (Ph.D.) offerings. The tenure and promotion of the explosives engineering faculty will continue to reside for the foreseeable future with the mining engineering program.

### Enrollment Projections:

- Student FTE majoring in program by the end of five years: 20 (Form SE)
- Percent of full-time and part-time enrollment by the end of five years: 45% full-time students; 55% part-time students.

### Student and Program Outcomes

- Number of graduates per annum at five years after implementation: 11
- Special skills specific to the program:

Understanding and application of the functioning of explosives and initiation systems.

Understanding and application of explosion effects.

Understanding and application of safety as applied to explosives in field use, testing and demonstration environments.

Experience with the safe handling of energetic materials.

Understanding of the application of explosives for fragmenting rock and other materials.

Experimental design incorporating explosives.

Expertise in focused professional areas such as demolition, blast resistance, rock breakage or weapons systems design, loading and production.

Understanding of the challenges of using explosives and environmental impact.

- *Proportion of students who will achieve licensing, certification, or registration:* Graduates will become members of the International Society of Explosives Engineers and other professional organizations as appropriate. At present there are no professional groups licensing graduates from explosives engineering programs. All licensing is at the state level, which comprises a) blaster's licensing (which may be at multiple levels depending on the state, b) display fireworks operator licensing and c) pyrotechnician and special effects licensing. It is anticipated that the majority of graduates will obtain licensing in at least one of these areas.
- *Performance on national and/or local assessments, e.g., percent of students scoring above the 50<sup>th</sup> percentile on normed tests:* The only applicable tests are state explosives licensing tests. More than 80% of the students are expected to score above the 50<sup>th</sup> percentile on these tests.
- *Placement rates in related fields, in other fields, unemployed:* There will continue to be growing opportunities for explosives engineers in the defense, mining and civil construction industries and in government institutions; therefore, we expect 100% of our graduates to be employed (excluding the occasional person that is totally unemployable).
- *Transfer rates, continuous study:* The program will not only attract students with previous degrees from Missouri S&T but also attract students from other technological programs throughout the United States. We already have five full-time students signed up for a traditional master's, three of which obtained a bachelor's at other institutions. These students are temporarily housed in the mining M.S. program. Our summer explosives camp has now been running since 2004 and indications show that many of the explosives campers that enroll at Missouri S&T for majors outside of mining also currently enroll in the explosives engineering minor and we anticipate that the majority

of these students are potential candidates for the master's degree in explosives engineering. Unfortunately the Safe Explosives Act of 2003 prohibits the participation of foreign nationals (non-residents). The major exceptions to this are those currently employed by Missouri S&T and by obtaining relief from the ATFE, which can take as long as 18 months. It is therefore anticipated that this graduate program will be unusually high in U.S. nationals.

#### **Alumni and Employer Survey:**

- *Expected satisfaction rates for alumni including timing and method of surveys:*  
Missouri S&T will develop an assessment and evaluation plan for the curriculum in explosives engineering. We expect a 90% satisfaction rate of the alumni of the program.
- *Expected satisfaction rates for employers including timing and method of surveys:*  
Missouri S&T will develop an assessment and evaluation plan for gathering information from the employers of the graduates. We expect 90% satisfaction from the employers.

## **7. Accreditation**

There is no accreditation for graduate programs in explosives engineering. It is expected that the students will have B.S. degrees from programs already accredited in science, engineering or technology.

## **8. Institutional Characteristics**

The Missouri S&T is particularly well suited and equipped to support a Master of Science degree program in explosives engineering to be offered by the Department of Mining and Nuclear Engineering. Key factors include the strength of the Department of Mining and Nuclear

Engineering, the nature of Missouri S&T as a technological university and opportunities for research, internships, and co-ops.

### **Department of Mining and Nuclear Engineering**

The department has several years of experience developing and teaching courses in explosives engineering as part of its minor in explosives engineering. It has capitalized on this long history of teaching and research in the explosives engineering field in recent years, increasing its course offerings and rebuilding its faculty in this area such that a sustainable master's is now possible. Because Missouri S&T is a research university, the faculty have a strong tradition of research, teaching and service.

### **Missouri S&T as Missouri's Technological University**

Missouri S&T's strong reputation as the state's technological university and as one of the top providers of M.S. and Ph.D. graduates in engineering and science in the country, and its reputation and tradition in this field make it the logical home for an explosives engineering program. In the calendar year 2008 eight separate explosives engineering related courses (totaling 24 credit hours) were taught (excluding 390 and 490 research courses and 300 and 400 special problems courses), thirteen \$1,000 scholarships were given by the International Society of Explosives Engineers to Missouri S&T students and with the assistance of the chancellor the full time explosives faculty increased to two. In conjunction with industry instructors we have now reached a sustainable level where master's students can obtain a degree in explosives engineering with a degree of flexibility of course selection within classes offered at Missouri S&T.

## 9. Security Considerations

The importance of explosives education is vital to civilian industry, government and the defense industry, yet explosives knowledge, like that from the majority of other technical disciplines, can also be used against society. Since the terrorist attacks on September 11, 2001, U.S. academic institutions have come under increasing scrutiny. The Safe Explosives Act of 2003 expanded the number of categories of persons banned from possessing explosives to include non-U.S. residents, those with dishonorable discharges from the military and those who have renounced their citizenship. This is in addition to felons, fugitives from justice and those with who have been declared mentally defective. Not only is it illegal for these groups of people to have access to explosives but it is illegal for institutions to provide such persons with explosives without first obtaining a waiver from the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives.

The Safe Explosives Act requires background checks for users of explosives and so each prospective student will require a completed background check. Proof of an existing background check, such as holding a state blaster's license or CDL with Hazmat endorsement, being a current member of law enforcement, military, appropriate government agency or national lab or holding a security clearance will be accepted. Otherwise a prospective student will have to pay for and undergo a highway patrol background check (current cost \$9).

Dr. Henry Wiebe, Dean of Extended Learning, strongly supports the teaching of explosives courses by distance to bona fide individuals and organizations, realizing that a degree of determination of the authenticity of these groups is necessary. Distance education is becoming increasingly important, especially to degreed professionals already entrenched in the work environment who are unable because of work or family commitments and/or financial consequences to pursue conventional higher education in specialist fields. He further supports the extension of the M.S. in explosives engineering to an M.E. in explosives engineering by distance.

## Appendix A

### Income vs. New Costs for Explosives Eng Masters

Year		1	2	3	4	5
Projected Students						
	full time	5	6	8	10	12
break down	out of state	2	2	2	3	4
	in state	3	4	6	7	8
	part time	0	5	8	12	15
Additional Expenses						
1 GTA	\$33,300	\$33,300	\$33,300	\$33,300	\$33,300	\$33,300
Faculty			\$80,000	\$80,000	\$80,000	\$80,000
Fringe	\$0	\$0	\$25,320	\$25,320	\$25,320	\$25,320
Start up package			\$15,000	\$15,000		
E&E		\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
						fees
Income	full time	\$74,833	\$86,330	\$109,323	\$140,991	\$172,660
	part time	\$0	\$37,823	\$60,516	\$90,774	\$113,468
Total income		\$74,833	\$124,152	\$169,839	\$231,765	\$286,127
Total expenses		\$33,300	\$43,300	\$163,620	\$163,620	\$148,620
Net Worth to University		\$41,533	\$80,852	\$6,219	\$68,145	\$137,507
<b>Cumulative worth</b>		<b>\$41,533</b>	<b>\$122,386</b>	<b>\$128,605</b>	<b>\$196,750</b>	<b>\$334,257</b>

Notes: 08/09 rates

grad rate in engineering/supplemental fee 479.02 per hr

out of state/distance in eng/sup fee 840.50 per hr

grad hours per year full time 24 hrs

grad hours per year part time 9 hrs

Full time students broken down by in state and out of state. It is anticipated that a third will be out of state.

Part time students are expected to be out of state.

All numbers calculated in 08/09 dollars

GTA at \$33,300 for 9 month appointment

Faculty at \$80,000

Fringe at 31.65%

Will split GTA's probably into 4 x 25% to cover 4 heavy demand courses.

## APPENDIX C

### Graduate Course Transfers as Part of a Memorandum of Understanding with National Defense University



## **Proposal to accept up to 12 transfer hours from other Graduate Programs**

From Bruce McMillin, Department of Computer Science and Director of Center for Academic Excellence in Information Assurance Education and Research.

S&T is accredited by the National Security Agency as a Center for Academic Excellence (CAE) in Information Assurance Education and as a CAE in Research and has a recently-formed center by the same name. As part of this accreditation, S&T has the opportunity to partner with the National Defense University (NDU) (see attachment). In this program, students may take graduate credit at NDU and then finish their M.S. at S&T. Their program requests transferring more than the standard allotted amount of 9 credit hours. Current partners include such schools as U. Illinois, Texas A&M, Drexel, and the U. of Washington.

This is an opportunity for S&T to tap into a new group of distance students, primarily working for the government and industry from the D.C., Virginia, and Maryland areas who want to obtain their graduate degrees. S&T's graduate program in Computer Science presents a distinct advantage over our competitor schools as our M.S. program may be obtained entirely through distance.

This proposal requests that for organizations in which a memorandum of understanding is executed (see attachment), that up to 12 hours of graduate credit may be accepted (if the courses meet the standards of the S&T graduate program, as assessed and documented on Graduate Form I). At this time, the only specific relationship to be requested is for the NDU.

A potential set of transfer courses is shown in the table below:

Course (Catalog Nbr)	Course Title	Description	S&T Equivalent
AII (6203)	Information Assurance and Critical Infrastructure Protection	This course provides a comprehensive overview of information assurance and critical information infrastructure protection. Information assurance of information assets and protection of the information component of critical national infrastructures essential to national security are explored. The focus is at the public policy and strategic management level, providing a foundation for analyzing the information security component of information systems and critical infrastructures. Laws, national strategies and public policies, and strengths and weaknesses of various approaches are examined for assuring the confidentiality, integrity, and availability of critical information assets.	Portion of CS 317
GEN (6205)	Global Enterprise Networking and Telecommunications	This course focuses on the effective management of network and telecommunications technologies in a government-sector global enterprise. The course examines current and emerging network and telecommunications technologies, including their costs, benefits, and security implications, placing emphasis on enabling military and civilian network-centric operations. Topics include network-centric concepts, spectrum management, data networks and associated Internet technologies, telephony, the role of public policy, and the significance of industry as a service provider and as an engine of innovation.	Portion of CS 385
SEC (6201)	Cyber Security for Information Leaders	This course explores concepts and practices of defending the modern net-centric computer and communications environment. The course covers the 10 domains of the Certified Information System Security Professional (CISSP®) Common Body of Knowledge (CBK®). In addition, the course covers a wide range of technical issues and current topics including basics of network security; threats,	Portion of CpE 349

		<p>vulnerabilities, and risks; network vulnerability assessment; firewalls and intrusion detection; transmission security and TEMPEST; operating system security; web security; encryption and key management; physical and personnel security; incident handling and forensics; authentication, access control, and biometrics; wireless security; virtual/3D Worlds; and emerging network security technologies such as radio frequency identification (RFID) and supervisory control and data acquisition (SCADA) security. The course also defines the role of all personnel in promoting security awareness.</p>	
<p>ESS (6206)</p>	<p>Enterprise Information Security and Risk Management</p>	<p>This course examines the practical challenges of assessing and managing information security risks when developing an enterprise information security program. Based upon OMB, NIST, and DOD risk management guidance, the course addresses the key components of an organization's information security program including the identification, assessment, mitigation, and acceptance of risk. The course builds upon fundamental information assurance concepts and information security technology, integrating them into scalable, practical working solutions for defending the enterprise. Security program components, including configuration, incident, system lifecycle, and acquisition are examined from a risk management perspective. Other topics include program and system security planning, risk assessment, policy, control/countermeasure selection, and continuous performance measurement and monitoring.</p>	<p>CS 319</p>

# MEMORANDUM OF UNDERSTANDING (MOU)

Between

Your College/University

Your Department

Your City, State

and

National Defense University

Information Resources Management College

Washington, D.C.

**This Memorandum of Understanding (MOU) is made this \_\_\_\_ day of \_\_\_\_\_ (month/year) by and between YOUR ORGANIZATION and the National Defense University Information Resources Management College (NDU/IRMC).**

1. **PURPOSE:** Both parties wish to enter into this understanding to provide extended academic opportunities to their respective students and faculty. It is understood that the purpose of the MOU between YOUR ORGANIZATION and NDU/IRMC include: strengthening the quality and breadth of academic programs at both institutions; promoting an educational environment where faculty and graduate students from both institutions can learn from one another through sharing of information and knowledge; leveraging the strengths and resources of programs at both institutions.
2. **BACKGROUND:** NDU/IRMC has been entering into MOUs with academic institutions for approximately 10 years, with the goal of transferring academic credits for NDU/IRMC graduates into selected programs at graduate schools across the U.S. When the U.S. Department of Defense (DoD) began the Information Assurance Scholarship Program (IASP) in 2001, the need for academic partnerships supporting Masters and Doctoral programs related to IA became necessary. NDU/IRMC continues to form academic partnerships, related to credit transfer, to support the DoD in the area of IA education.

This is a (new) (renewal of an existing) MOU. Signing this MOU will allow students who graduate from NDU/IRMC to transfer graduate-level course credits into selected graduate programs within YOUR ORGANIZATION. NDU/IRMC will provide the manpower to help draft and review this MOU, including renewal when applicable.

3. **OBJECTIVE AND SCOPE:** This MOU applies to NDU/IRMC and to the above-stated department within YOUR ORGANIZATION. The expectations from this MOU include attracting more qualified students into Information Resources Management, or a related information-management field.
4. **REFERENCES AND DEFINITIONS:** Chapter 112, Title 10, United States Code, authorizes the DoD Information Assurance Scholarship Program (IASP). This

scholarship program is only applicable to the MOU for schools that are recognized as National Centers of Academic Excellence (CAEs) in Information Assurance Education. Only CAE schools may partner for credit transfer for NDU/IRMC's IA Certificate Program. Non-CAE schools may partner in other certificate areas. Since YOUR ORGANIZATION (is) (is not) a CAE, they (may) (may not) partner in the area of IA.

5. **SPECIFIC RESPONSIBILITIES/AUTHORITY:** IRMC and YOUR ORGANIZATION designate the person(s) set forth in Section 6 as their respective representatives to coordinate and manage the activities under this MOU. The representatives shall meet as needed to discuss the programs, changes to programs, and any other topics of interest to either party.

Each party in this MOU retains full authority over and reserves the right to make changes in their respective courses, programs, and credential requirements. Each party shall publicize this MOU and programs mentioned herein in academic materials as appropriate and shall brief students as appropriate. Neither party shall use the name or logo of the other party without the prior approval of the other party.

Within YOUR ORGANIZATION, the Your Department is interested in accepting DoD students into its graduate programs. YOUR ORGANIZATION is willing to award: (choose one or more)

- **9 graduate credit hours for students who complete the Information Assurance (IA) 4011 Certificate; or**
- **12 graduate credit hours for students who complete both the IA 4011 and 4012 Certificates; or**
- **12 graduate credit hours for students who complete the Enterprise Architecture (EA) Certificate; or**
- **12 graduate credit hours for students who complete the Information Technology Project Management (ITPM) Certificate; or**
- **15 graduate credit hours credit for students who complete the Chief Information Officer (CIO) Certificate; or**
- **15 graduate credit hours for students who complete the Chief Information Security Officer (CISO) Certificate; or**
- **15 graduate credit hours for students who complete the Organization Transformation (OT) Certificate.**

After NDU/IRMC graduates have completed the above-named certificate program at NDU/IRMC, and the remaining requirements at YOUR ORGANIZATION, the following degree(s) may be awarded from YOUR ORGANIZATION: **Name of Degree(s).**

Each institution agrees that the NDU/IRMC student(s) enrolled at YOUR ORGANIZATION under this MOU will be subject to all YOUR ORGANIZATION rules and policies governing the degree award, including maintenance of satisfactory

performance, and completion of the remaining credit hours inherent to the student's specific degree program.

6. **COORDINATION CONTACTS:** The following persons will serve as points of contact at YOUR ORGANIZATION and NDU/IRMC, and will communicate mainly by email and phone:

Point of Contact Name and Title  
Your College/University Name  
Your College/University Address  
Point of Contact Phone Number and Fax Number  
Point of Contact email address

Ms. Patricia Coopersmith, Project Manager  
National Defense University, Information Resources Management College  
Fort Lesley J. McNair, Marshall Hall, Room 150  
Washington, DC 20319-5066  
Phone (202) 685-2117; Fax (202) 685-3974  
[coopersmithp@ndu.edu](mailto:coopersmithp@ndu.edu)

7. **RESOURCES:**
- a. **Funding:** No funding will change hands as part of this MOU.
  - b. **Manpower:** NDU/IRMC will assign one individual, the POC listed above, to coordinate this MOU. YOUR ORGANIZATION may assign as many persons as needed.
  - c. **Workload:** NDU/IRMC projects approximately 4-8 hours/year to staff this MOU.
  - d. **Other Support:** An occasional event at NDU/IRMC may require the use of NDU conference rooms and projection equipment. Other support includes the NDU computer and regular office supplies used by the NDU/IRMC POC.
8. **EFFECTIVE DATE AND TERMINATION:** This MOU will be effective from the date of signing and will have a duration of **three years**. Upon expiration of the three years, the MOU will be subject to renewal. Additions and changes to this MOU may be made at any time with the written agreement of both YOUR ORGANIZATION and NDU/IRMC. Either party may withdraw from this understanding upon 60 days written notice to the other institution made to the institutional contact address, via U.S. Certified mail. Termination must be in writing and signed by the approving officials or their designated personnel.

9. **APPROVAL:** All parties identified below agree to the provisions and terms of this MOU.

**APPROVED:**

**National Defense University**

**(YOUR ORGANIZATION)**

**Name:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**Title:** \_\_\_\_\_

**Title:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Date:** \_\_\_\_\_

## **Appendix A - Course Information for IRM College Graduates**

Graduates of the IRM College XXX Certificate will receive credit for the following  
YOUR ORGANIZATION courses:

Course xxx – complete course names and number of semester credits

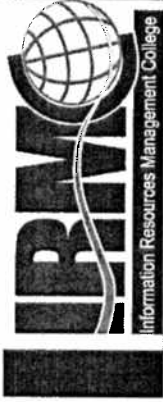
Course yyy

Course zzz

Course aaa

Course bbb





**Information Resources Management College**  
**National Defense University**



## **Academic Partnership Opportunities**



*“A global learning community for government’s most promising information leaders.”*



# Mutual Challenges

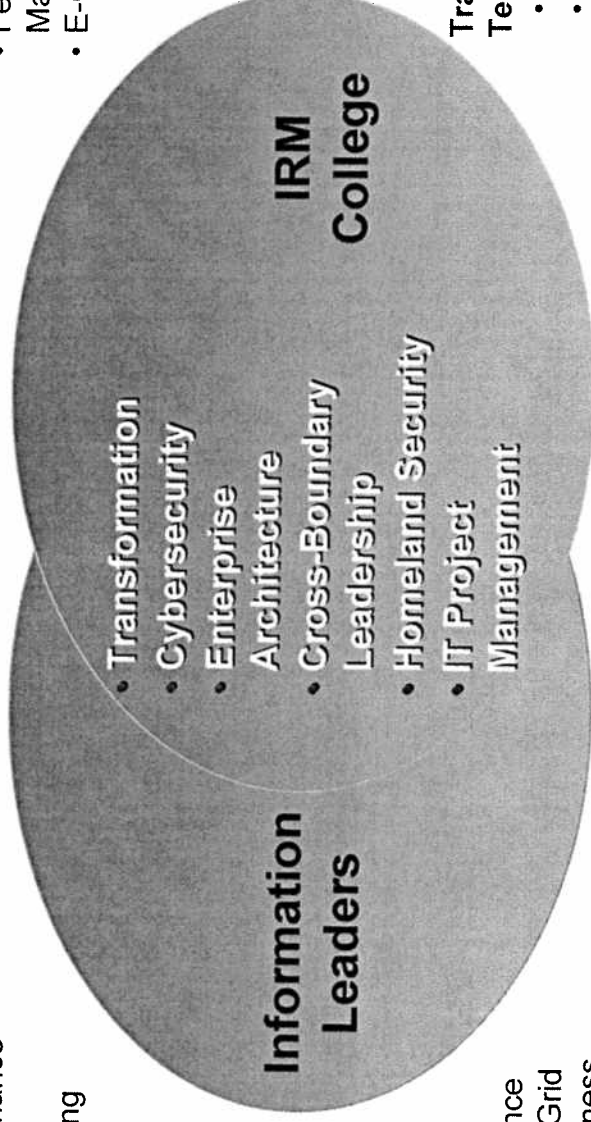
*IRM College understands the current priorities of government executives.*

## President's Management Agenda

- Strategic Human Capital Management
- Improved Financial Performance
- Expanded Electronic Government
- Budget and Performance Integration
- Competitive Sourcing

## Congressional Reform Agenda

- Chief Financial Officers Act
- Government Performance and Results Act (GPRA)
- Clinger-Cohen Act
- Federal Information Security Management Act (FISMA)
- E-Government Act



## Global War on Terror

- Information Assurance
- Global Information Grid
- Domestic Preparedness
- Intelligence and Information Sharing
- The "Information War"

## Transformation and Enabling Technologies

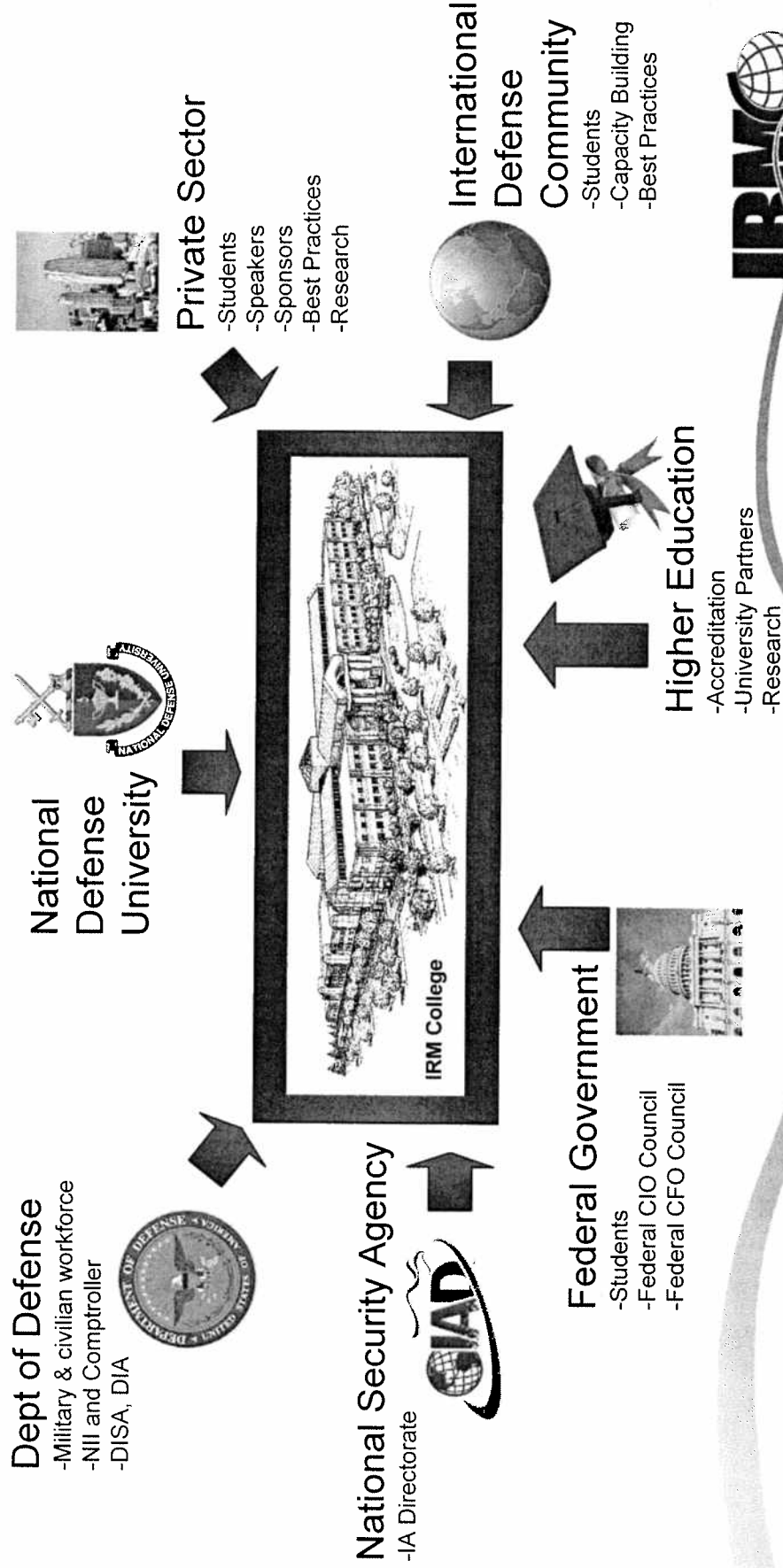
- Business Modernization
- Knowledge Management
- Networking and Integration
- Net-centricity
- Data Mining
- Business Intelligence



# IRM College Landscape

**MISSION** - Prepare military and civilian leaders to direct the information component of national power by leveraging information and information technology for strategic advantage.

**VISION** – Acknowledged world leader in information resources management education.



Updated 7/21/08

# IRM College Role

*The College educates current and future government thought leaders and change agents and strives to meet your workforce education needs.*

## **MISSION:**

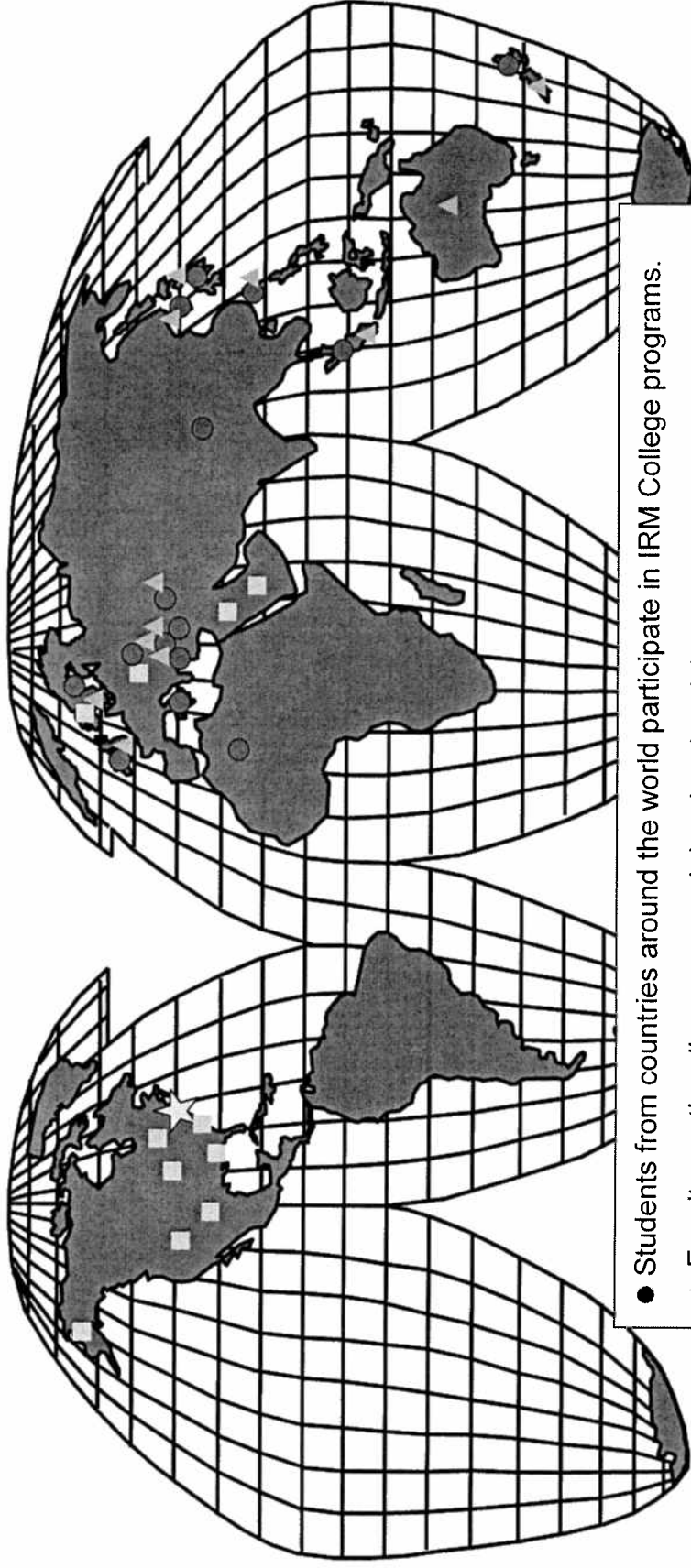
**IRM College prepares military and civilian leaders to direct the information component of national power by leveraging information and information technology for strategic advantage.**

## **KEY MESSAGES:**

- ✓ **Global learning community**
- ✓ **Just for you**
- ✓ **Wherever you are**
- ✓ **Learning that is current, timely, and future-focused**
- ✓ **Strategic leader development**

# Global Learning Community

*IRM College promotes global connectedness through a diverse student body and opportunities to communicate with information leaders from around the world.*

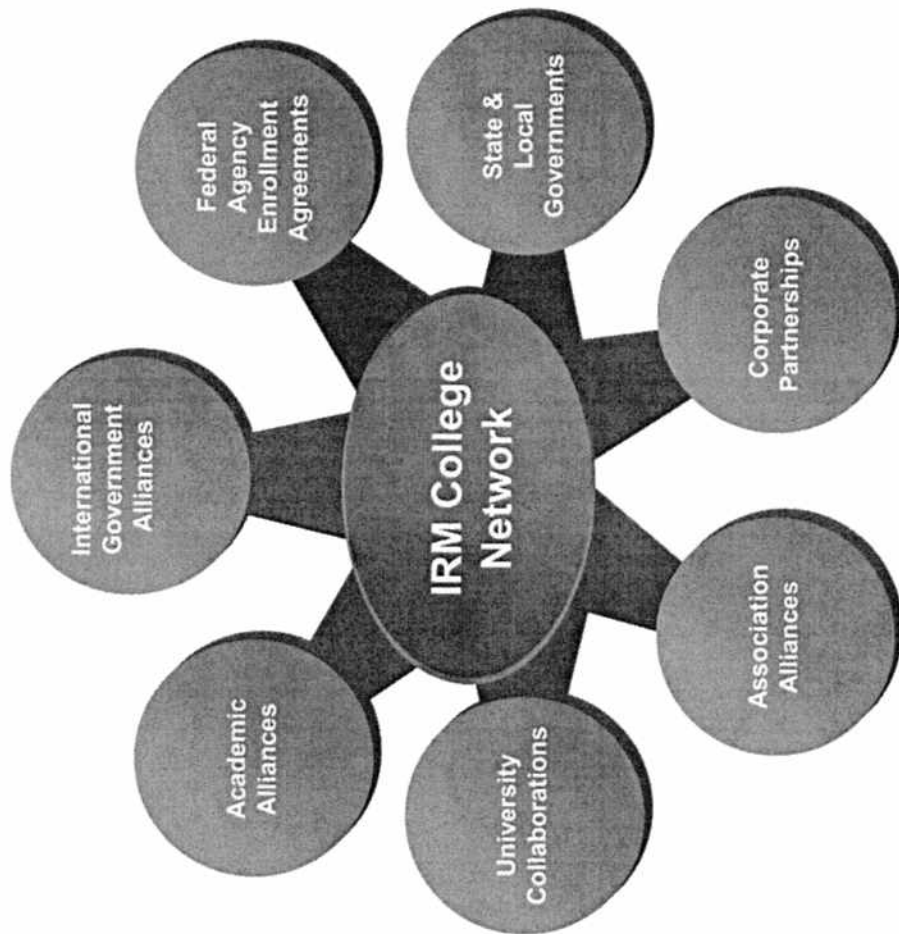


- Students from countries around the world participate in IRM College programs.
- ▲ Faculty continually access and develop the global network.
- U.S. students participate in IRM College courses from wherever they are located.



# IRM College Network

*IRM College fosters collaboration, an essential element of success for today's leaders and organizations.*



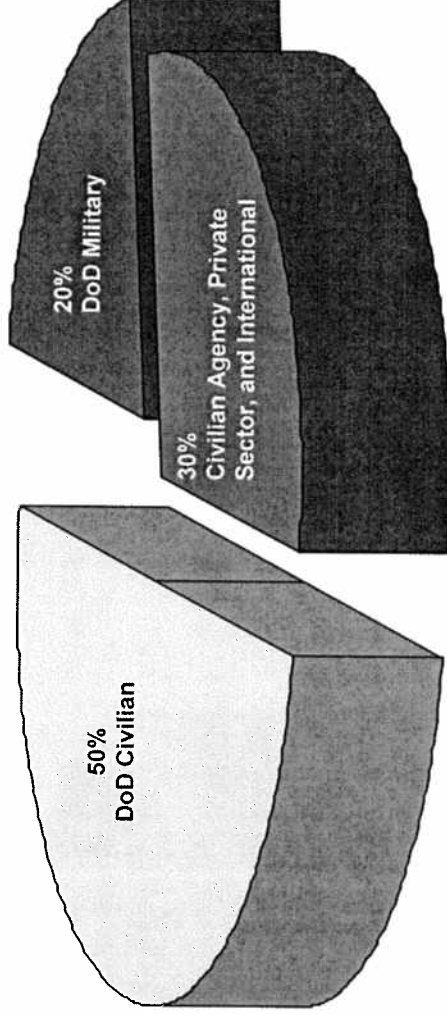
***IRM College engages current and future government leaders in interdisciplinary learning communities that explore ideas, questions, and solutions to mutual challenges.***

## **Students**

- Mid-career professionals (GS12+ and O4+)
- Includes DoD, federal agency, private sector, and international students
- Hold bachelor's degree or higher from regionally accredited institutions of higher education
- Earn graduate credits toward certificates, master's and doctoral degrees, or participate in classes for professional development

## **Faculty**

- 50 full-time faculty, 75% civilian, 75% with doctorates
- With a broad range of experiences and perspectives from academic, defense, federal, private sector, and international organizations
- Maintain interdisciplinary currency, relevance, and depth



# Wherever You Are

*Flexible learning programs accommodate the educational needs of students and their organizations.*

## Resident Program (Advanced Management Program)

- 14 weeks at Fort McNair
- Offered fall and spring
- Government/private sector field studies

## eResident Courses

- 1 week of online preparation
- 1 week in residence at Fort McNair
- 3 weeks to complete academic assignments for credit

## Distributed Learning Courses

- 1 week of online preparation
- 12 weeks of online coursework
- 3 weeks to complete academic assignments for credit
- Global, 24/7 access

Through the NDU Electives Program, courses are available in elective or DL format for ICAF and NWC students to complete towards IRM College certificates.





# Distributed Learning

Faculty-led  
cohorts of students

Seminar model with active  
learning and group work

Identical learning outcomes and  
assessments as resident courses

80% of DL students reside out of town  
(approx 30% of total college enrollment)

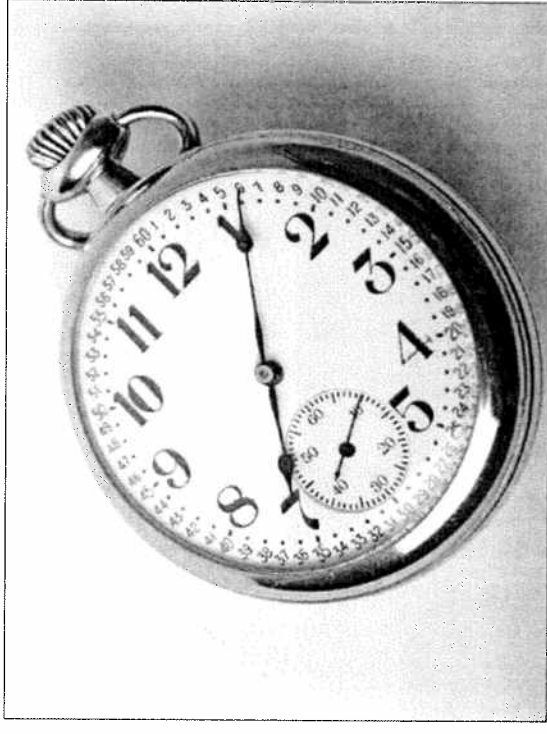
eLearning Solutions Group  
(graphic and instructional designers – 1:12 ratio)  
Faculty mentoring

Blackboard course management system hosted off-site 24/7  
4th generation/initial experimentation began in 1998

# Learning that is Current, Timely, and Future-Focused

*IRM College concentrates on the relevant questions, challenges, and opportunities facing today's and tomorrow's government leaders.*

- Students demonstrate learning through assignments relevant to their organizations' issues.
- Guest speakers from government and the private sector contribute unique perspectives.
- Innovative curricula prepare students to anticipate and create the future.
- Graduates may join the Association of the IRM College (alumni): <http://www.irmcollege.org>.



# Strategic Leader Development

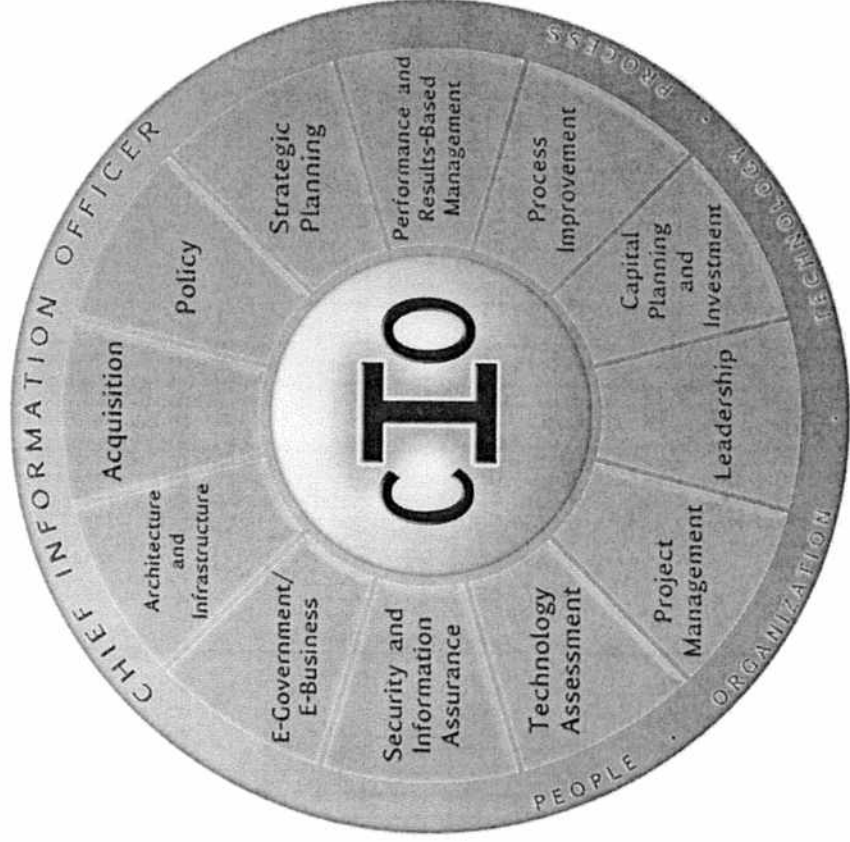
*IRM College prepares government and private sector leaders to direct the information component of national power.*

**Graduate-level courses, certificate programs, and educational services in:**

- Chief Information Officer competencies
- Information assurance
- Organizational transformation
- Domestic preparedness
- eGovernment
- Enterprise architecture
- Information technology project management
- Information operations
- Information technology acquisition
- Government Strategic Leader
- Chief Financial Officer competencies



*Provides government leaders with the necessary expertise to leverage information and information technology for strategic advantage.*



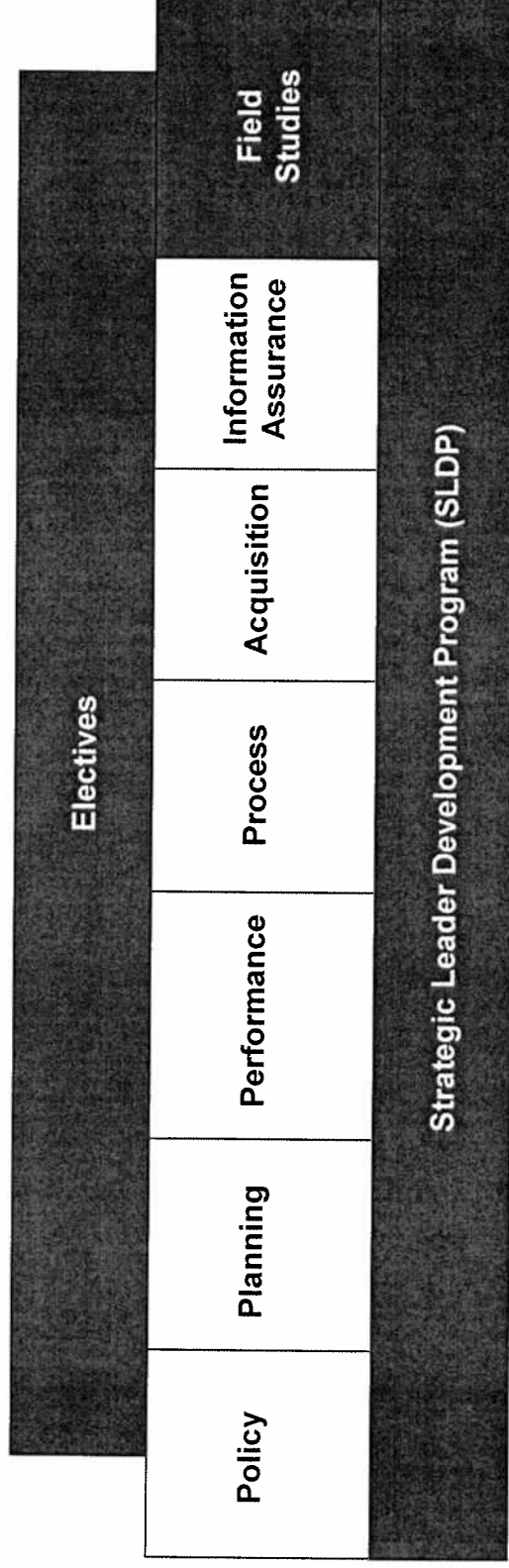
- Focuses on cross-governmental federal CIO competencies
- Aligns with the Clinger-Cohen Act (1996)
- Offered in three formats: eResident, Distributed Learning, and Advanced Management Program
- 8 courses to complete certificate



# Advanced Management Program

*Emphasizes strategic leader development, explores information resource management, and aligns with the CIO Certificate competencies.*

- Curriculum focuses on the leadership competencies of communication, critical thinking, collaboration, and leading change.
- Graduates can make significant progress towards the NSTISSI 4011 IA Certificate and the Enterprise Architecture and Organizational Transformation Certificates.



14 weeks in residence; offered Fall and Spring

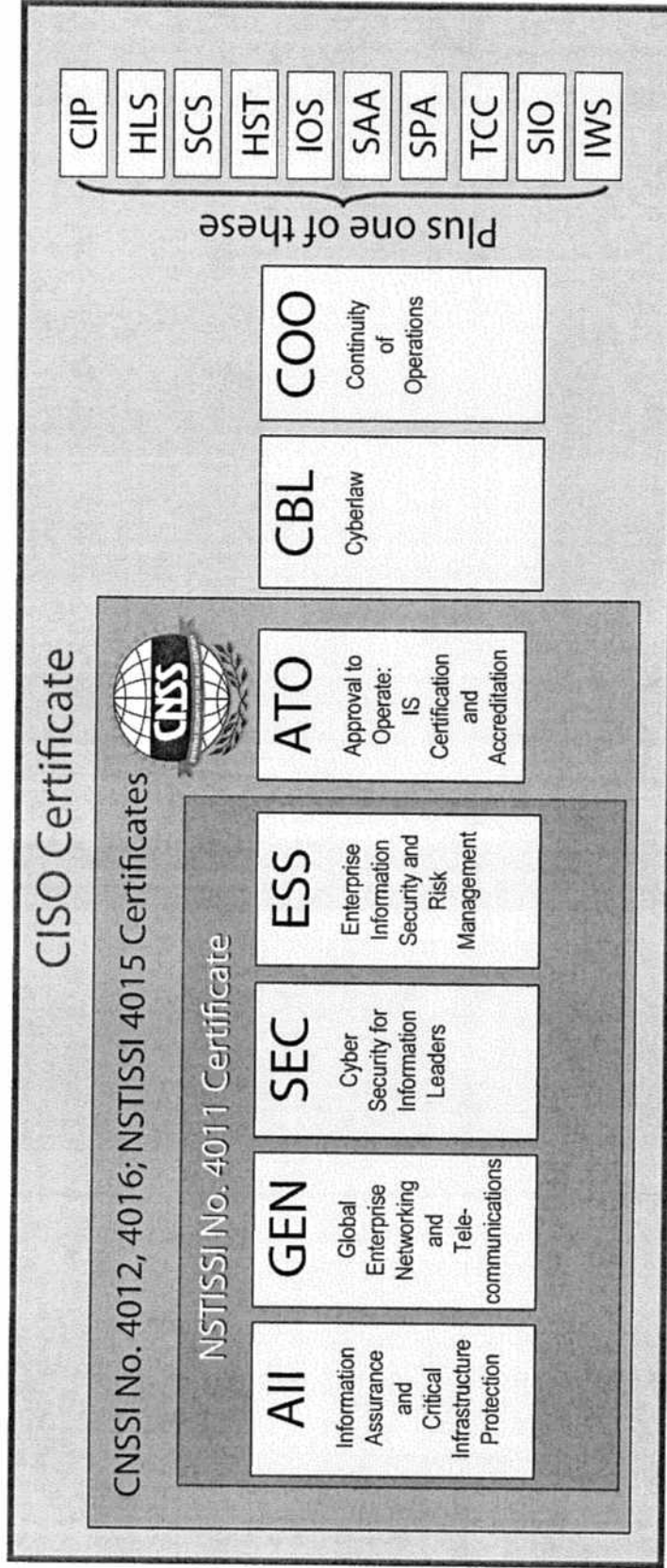


Updated 7/21/08



# Information Assurance Programs

*Develops leaders who can protect information, information systems, and critical infrastructures.*



- \*Protection of Critical Infrastructure and Key Assets (CIP)
- \*Homeland Security Information Management (HLS)
- \*Managing Security of Control Systems (SCS)
- \*Homeland Security Tools and Techniques (HST)
- \*Information Operations and National Security in the Information Age (IOS)
- \*Strategic Management of Software Assurance (SAA)

- \*Privacy Rights and Challenges in the Information Age (SPA)
- \*Terrorism and Crime in Cyberspace (TCC)
- \*Information, Warfare, and Military Strategy (IWS)
- \*Strategic Infrastructure Operations (SIO)





# Information Assurance Education



The National Security Agency and Department of Homeland Security reaffirmed the IRM College as a “National Center of Academic Excellence (CAE) in Information Assurance Education” (2006-2009). <http://www.nsa.gov/ia/academia/caeiae.cfm?MenuID=10.1.1.2>



The IRM College’s “Center for Information Assurance Education” advances understanding, fosters applied research, and serves as a clearinghouse for information operations and assurance education. <http://www.ndu.edu/irmc/ia/index.html>



The IRM College participates in the Information Assurance Scholarship Program (IASP). DoD civilian employees, military officers and enlisted members may apply for IT and IA Scholarships through their component or agency channels. <http://www.defenselink.mil/nii/iasp>





# Innovations and Simulation Laboratory

*The IRM College laboratories support experiential learning and advanced knowledge in information assurance and security*

## Crisis Management Center

- Teach crisis management through experiential activities
- Crisis simulations using real-life & simulated data
- Powerful hands-on learning using satellite feeds (both local and international), live data streams, with a deployable mobile crisis center for stand-alone or simultaneous exercises

## Emerging Technologies Demonstration Center

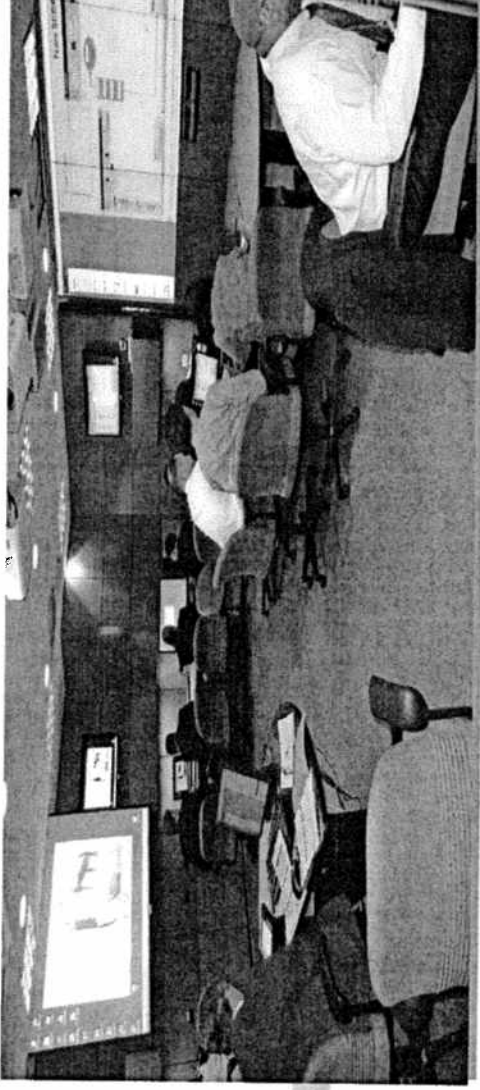
- Hands-on demonstration of innovative technologies
- Telecommunications
- PDAs and ultra-light computers
- IT wearable

## Simulation and Gaming Hub

- Using simulation and gaming to support and augment curriculum
- Deployed in multiple courses:
  - enterprise architecture, process management, global networking, homeland security, network-centric warfare, experimentation gaming and simulation, and others

## Virtual World Hub

- Interactive 3D Internet
- Investigating and teaching with multiple VW platforms
- Created and lead Federal Consortium for Virtual Worlds



Updated 7/21/08





# Information Technology Project Management Certificate

*Prepares graduates to lead complex IT and software projects successfully  
by applying advanced program management concepts.*

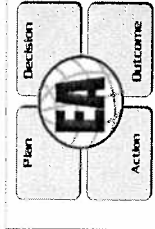
IT-PM combines the tools and techniques of project management with knowledge about leading IT projects, including linking technical and strategic outcomes, best practices, and decision making.

Core Courses		
Strategic IT Acquisition (ITA)	Critical Information Systems Technologies (CST)	Information Technology Project Management (ITP)
Building an IT Business Case (BBC)		

Specialty Courses	
Information Technology Program Leadership (IPL)	Software Acquisition Leadership (SAL)





# Enterprise Architecture Certificate

*Empowers information leaders to leverage enterprise architecture and transform organizations, ensuring the right capabilities, services, and resources are rapidly delivered through effective streamlined processes.*

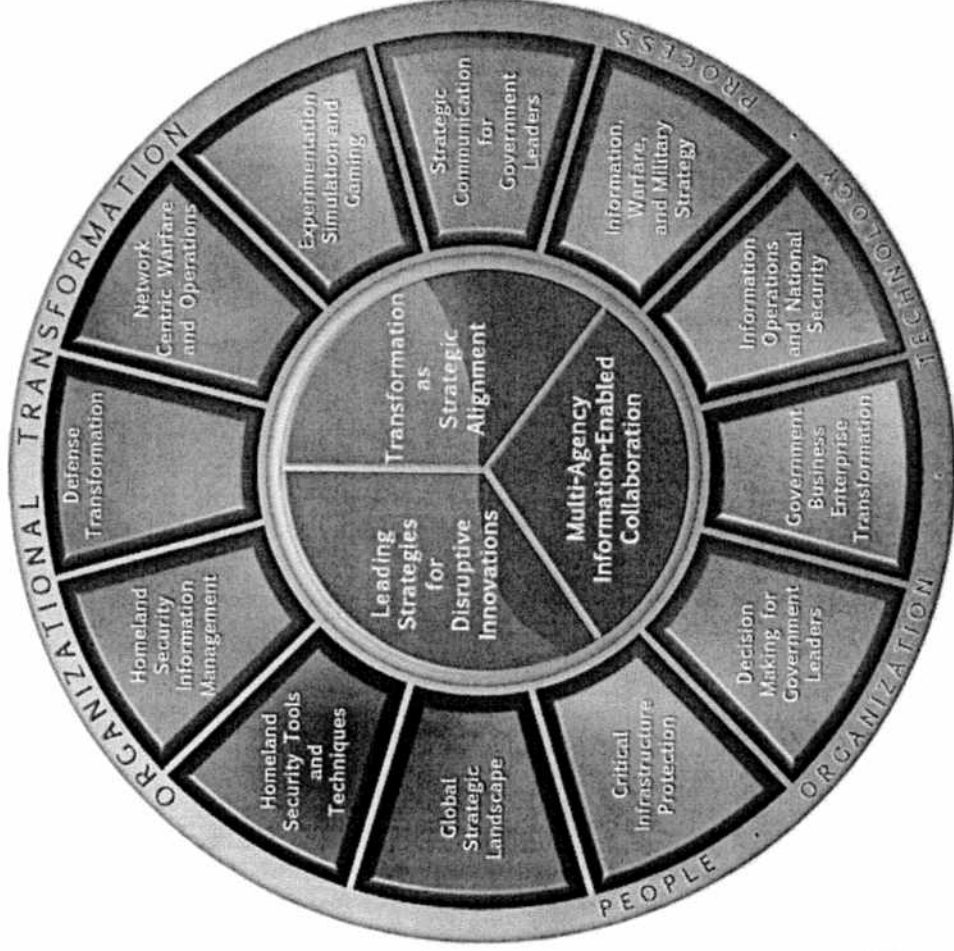
Core Courses			
Information Management Planning (IMP)	Strategies for Process Improvement (PRI)	Enterprise Architecture for Leaders (ARC)	Data Management Strategies and Technologies (DMS)
Specialty Courses			
Global Information Grid (GIG)	OR	Federal Enterprise Architecture (FAC)	Planning and Managing Enterprise Architecture Programs (PMA)
Practicum Course			
Enterprise Architecture Practicum (EAP)			





# Organizational Transformation Certificate

*Educates current and next-generation government leaders to anticipate and implement transformational change.*



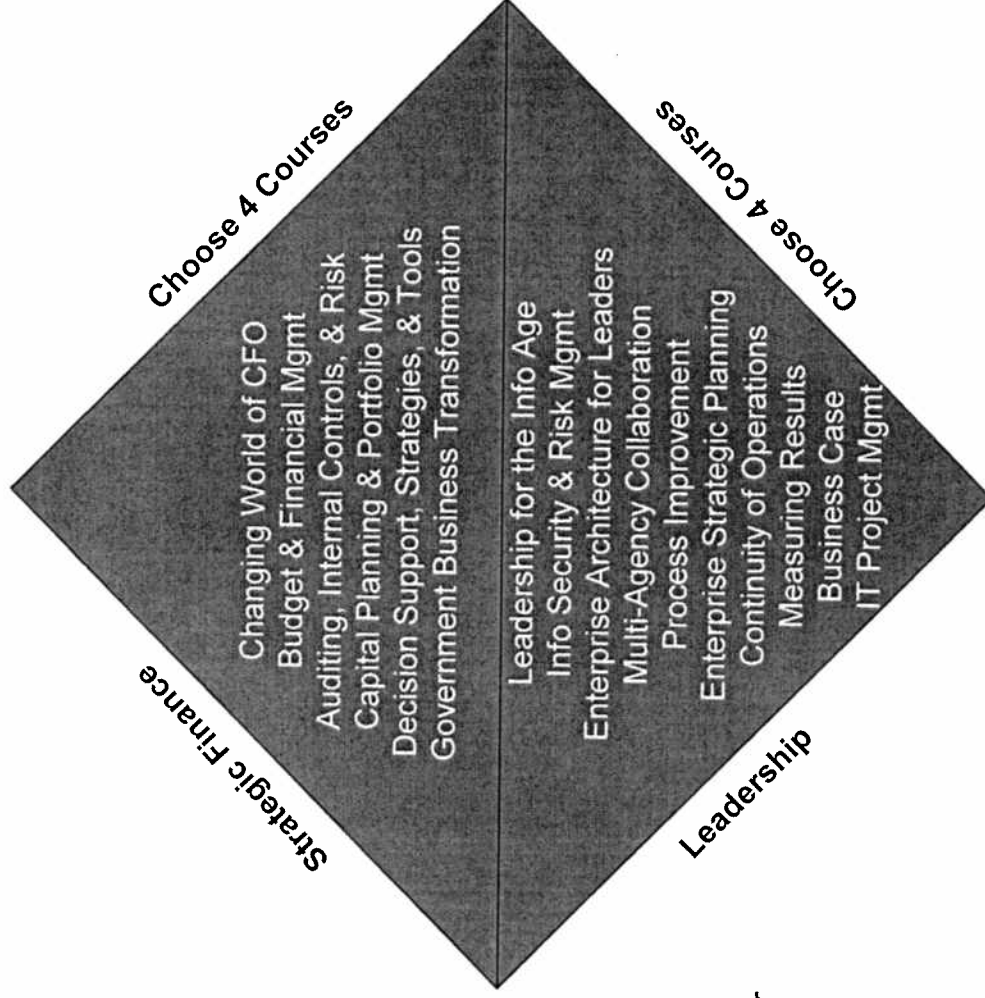
- Focuses on people, processes, technology, and organizations
- Expands creative and critical thinking about strategies, governance, networks, and transformative tools
- Offered as an 8-course program (3 foundation, 5 specialty courses)





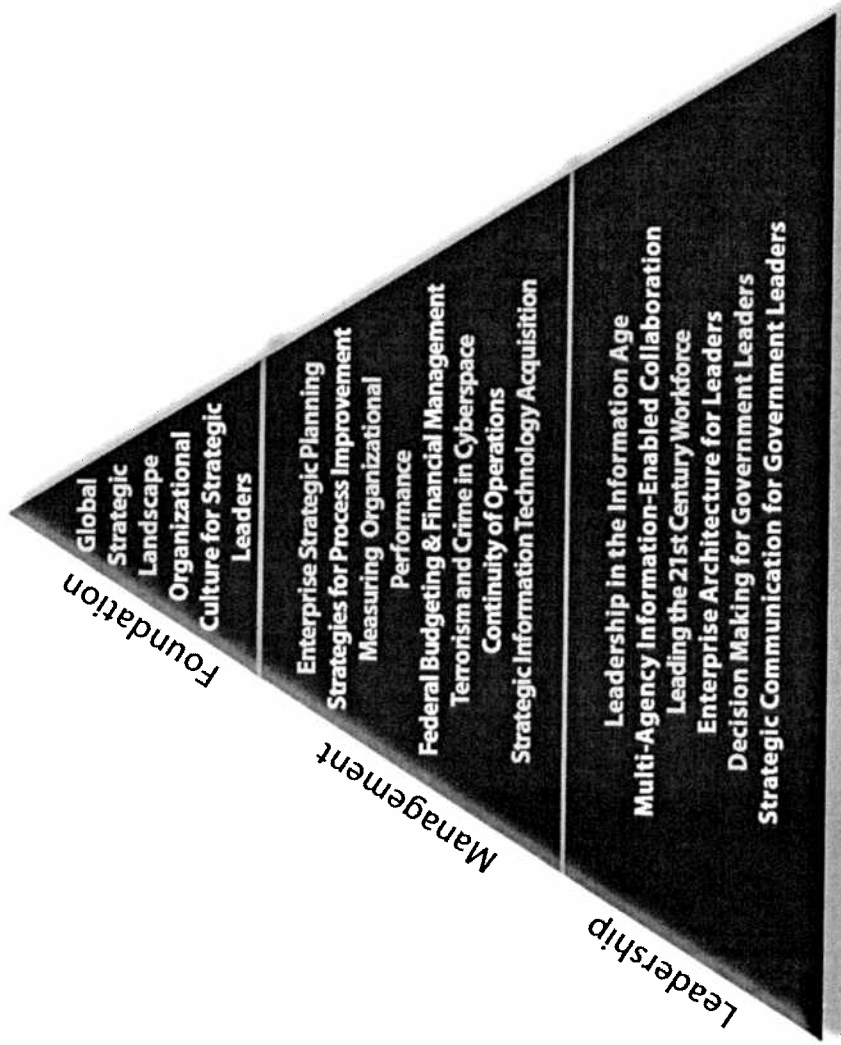
# CFO Leadership Certificate – New, Fall 2008!

- Supported by Under Secretary of Defense (Comptroller) in collaboration with the CFO Council.
- Strategic leader program for GS 14s and 15s.
- Sponsored by new CFO Academy.
- Focuses on unique challenges and opportunities facing government CFOs and their staff in present and into the future.
- Leverages IRM College's information leader courses.





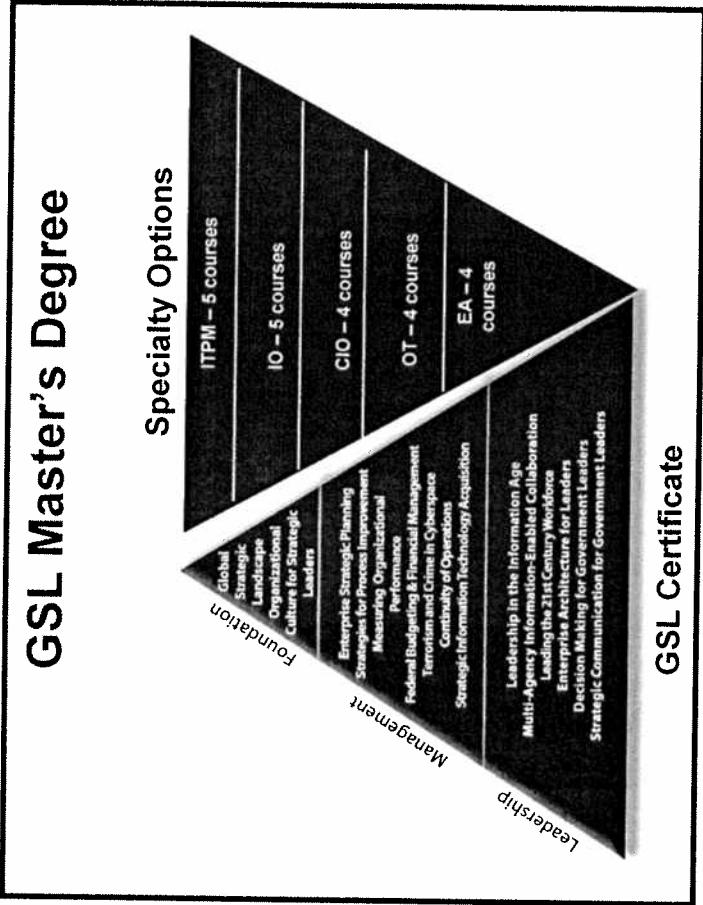
# Government Strategic Leader Certificate – New!



- Focuses on essential tools and strategies government managers and leaders need:
  - Collaboration and communication
  - Managing resources
  - Innovative thinking
- 8 graduate-level courses (2 foundation, 2 management, 2 leadership)
- Each course offered as one-week in residence or 10-12 weeks on line, followed by assessments (paper/presentation)
- Curriculum forms the core of the GSL Master of Science Degree



# Government Strategic Leader Master of Science Degree (pending approval)\*



\*The GSL Master of Science Degree is pending approval from the U.S. Department of Education and the U.S. Congress. Once approved (anticipated 2009-2010 academic year), students will receive graduate credit for the appropriate courses taken from the point of their matriculation.

- Combination of management and leadership courses
- Collaborative and interactive
- Participants from across Defense, Federal, state, and local government agencies
- 12-13 courses (36-39 credits) required:
  - GSL Certificate (8 courses) forms the core
  - Specialty options (4-5 courses)
- Specialities:
  - Chief Information Officer
  - Organizational Transformation
  - Enterprise Architecture
  - IT Project Management
  - Information Operations
- Reflective leadership portfolio requirement
- GS-12/O-4 or above and Bachelor's Degree required; up to seven years to complete



# Academic Partners

*IRM College graduates can apply 9-15 graduate credits toward selected master's and doctoral degree programs at these regionally accredited institutions.*

- |                                     |  |
|-------------------------------------|--|
| ➤ Air Force Institute of Technology | ➤ Rochester Institute of Technology          |
| ➤ Auburn University                 | ➤ San Diego State University                 |
| ➤ Capitol College                   | ➤ Syracuse University                        |
| ➤ Central Michigan University       | ➤ Texas A&M University                       |
| ➤ Clemson University                | ➤ Towson University                          |
| ➤ Drexel University                 | ➤ University of Dallas                       |
| ➤ Eastern Michigan University       | ➤ University of Detroit Mercy                |
| ➤ East Carolina University          | ➤ University of Illinois at Urbana-Champaign |
| ➤ Florida Tech                      | ➤ University of Maryland Baltimore County    |
| ➤ George Mason University           | ➤ University of Maryland University College  |
| ➤ James Madison University          | ➤ University of Nebraska at Omaha            |
| ➤ Johns Hopkins University          | ➤ University of North Carolina at Charlotte  |
| ➤ Mississippi State University      | ➤ University of Pittsburgh                   |
| ➤ New Mexico Tech                   | ➤ University of Texas at San Antonio         |
| ➤ Northeastern University           | ➤ University of Tulsa                        |
| ➤ Norwich University                | ➤ University of Washington                   |
| ➤ Pace University                   | ➤ Virginia Tech                              |
| ➤ Polytechnic University            | ➤ Walsh College                              |
| ➤ Regis University                  |  |



# Achievements and Recognition

*IRM College has been recognized for outstanding achievements.*

- Finalist, SC Magazine Awards, Best Professional Certificate Programs (2008)
- AFCEA Golden Link Award for partnering with industry (May 2003)
- “Best Practice Award” in Corporate/College Partnerships from Corporate University Xchange (February 2007)
- eGovernment Trailblazer Award (June 2002)
- Federal 100 Award (2002 and 2001)
- National Center of Academic Excellence (CAE) in Information Assurance Education (2006-2009)
- “Best Practice Award” for Government Learning Organization from Corporate University Xchange (November 2000)
- Tele-work in the Federal Government Leadership Award (October 2004)
- “Excellence in Corporate Education” Award from London Financial Times (May 2000)



# IRM College Contacts

- Academic Partnerships – Patricia Coopersmith, 202-685-2117, [coopersmithp@ndu.edu](mailto:coopersmithp@ndu.edu)
- Dr. Robert D. Childs, Director; 202-685-3886; [childs@ndu.edu](mailto:childs@ndu.edu)
- Dr. Elizabeth McDaniel, Dean of Faculty and Academic Programs; 202-685-3884; [mcdaniele@ndu.edu](mailto:mcdaniele@ndu.edu)
- Mr. Russell Quirici, Dean of Students and Administration; 202-685-3885; [quiricire@ndu.edu](mailto:quiricire@ndu.edu)
- Registrar's Office; 202-685-6300; [IRMCRegistrar@ndu.edu](mailto:IRMCRegistrar@ndu.edu)
- IRM College Website: <http://www.ndu.edu/irmc>
- Association of the IRM College: <http://www.irmcollege.org>
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