Civil & Environmental Engineering

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Memo

To: Provost Henrichs, Dean Goering, Associate VP Villa

Copy: Clint Adler, Dave Barnes, Billy Connor, Ross Newcomb, Dave Waldo, Dan White

Status Report: CEM Workforce Development Programs

For many years CEM has been working on developing the engineering workforce – preparing engineers for more responsible jobs – through our traditional MS programs and special courses such as arctic engineering. In recent years, several trends have become apparent:

- There is a growing shortage of middle management engineers and other technical professionals in Alaskan industry and the government agencies that administer development projects.
- Newly graduated Alaskan engineers are offered good starting salaries and have little financial incentive to postpone employment and pursue graduate courses – the knowledge gap appears somewhat later in their careers.
- The engineering profession nationwide recognizes these trends and proposes more education, a minimum of 30 credits after the BS, but implementation is developing very slowly. Current proposals suggest a mixture of technical and managerial subjects is needed.

With the support of AK DOT&PF, AUTC, and UA Workforce Programs, we have developed a program, a graduate certificate in construction management, which suits the needs of the construction branch of AK DOT&PF and had found good support with the construction branches of other agencies and industry. It has also become clear that other, similar, programs are needed and would be supported. However, while the management of construction is a narrow field, the management of other project entities, perhaps lumped as "pre-construction," would need a broader scope.

In order to assess what CEM has accomplished to date and give us facts to help plan for the future, we asked professor of engineering management emeritus, Larry Bennett, to examine the status of changes in engineering education, look over our current workforce endeavors, meet with key managers in industry and government, and hold a roundtable meeting with key mangers and leaders to examine their needs and the status of current and developing programs to meet those needs. His report is attached and divided into four tabs:

1. The current "BS+30" trends in the engineering education requirements for entering the profession,
2. The outcome of stakeholder needs meetings in Anchorage, Juneau, and Fairbanks,
3. The evaluation of the graduate certificate in construction management, including a survey of almost 100 students who have taken courses,
4. The report about the June roundtable in Anchorage, with appended comments and supplemental material from the participants.

The report has many details, but here is my impression of the data with respect to future workforce endeavors of CEM.

- The engineering profession, nationwide, believes that education beyond the BS, both managerial and technical, is needed for minimum competency. At some point ABET engineering schools will need to provide this, but that point is several years away. The profession has recommended changes to the basic ABET criteria that are mostly management and profession related.
- Alaskan industry and government agencies agree more education is needed and are willing to support this education. They believe the concept should be extended to technical professionals other than engineers, for example environmental scientists, right of way specialists, and geologists.
- Alaskan industry and government agencies who administer development projects need more engineers and technical professionals with managerial skills.
- There is often a need for technical skill development as well. For these technical topics, our standard CEM courses often cover the area, but the courses are not packaged to suit engineers who are working in the profession. Other training is so specialized that nationwide training is more likely than CEM training, although the employers would prefer training in Alaska by CEM.
- Students and employers who are engaged with the construction management program are happy with it. They have no problems with video conferencing delivery, and underserved groups in Southeast are very happy with it. Employers who are aware of the construction management program would like it extended to pre-construction as well.
- It is very difficult to get key managers and employers to lead with details about the course content they desire. On the other hand, they will offer very general ideas. Thus, we should regard most first offerings of courses as the first step of an iterative process.
- Communications and similar topics are almost always at the top of the employers' lists of needed education. Tab 2 and pages 8-12 of Tab 4 provide a good summary of the needs.

Dr. Bennett's report provides important information for future program. Currently I'm pursuing broadening some of the construction management offerings to encompass pre-construction topics. If they work out, we could consider a second certificate program in pre-construction or change the name to reflect both branches.

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Closure Report

Engineering Workforce Programs Development Project – May-July 2010

F. Lawrence Bennett, P.E.

July 27, 2010

Introduction

During May and June 2010, the writer was engaged as a consultant to the University of Alaska Fairbanks Department of Civil and Environmental Engineering to perform several tasks related to the development and training of the Alaskan engineering workforce. The work was authorized by University of Alaska Fairbanks Purchase Order FP03504 dated May 17, 2010. Notice to proceed was given by e-mail from Robert A. Perkins on May 5, 2010.

The project comprised five tasks, of which this report is the fifth.

The tasks were defined as follows:

Task One: The BS+30 – Background and Current Status

- Examining the details and current status of the proposal to increase the educational requirements for eligibility to take the professional engineer examination by requiring an additional 30 credit hours beyond the bachelors degree, based on written materials prepared prior to and after the approval of the BS+30 resolution by NCEES.
- Preparing a summary of findings and a Power Point presentation
- Making a presentation to a group in the Fairbanks area

Task Two: Stakeholder Needs

- Ascertaining local training needs of working engineers, including the need to meet the proposed BS+30 requirement, and how those needs might be met, as a preparatory step prior to the Task Four roundtable.

Task Three: Summary and Evaluation of Construction Management Graduate Certificate Program Efforts to Date

- Compiling a brief history of the program's development and approval
- Developing a database of all student participants to date, their contact information, and the courses they took
- Evaluating the course offerings with regard to
    - Course content
    - Course format, timing, and the like
    - Teaching methods
    - Other

Task Four: Roundtable on Graduate Engineering Education Needs in the BS+30 Era

- Holding a statewide gathering, whose primary purposes were a) to report on Tasks One, Two and Three (and thus provide feedback on efforts since the previous roundtable and workshop) and b) to solicit further information on graduate engineering education needs in the BS+30 era and how Alaskan institutions can meet those needs

Task Five: Final Report

- Preparing this report

The body of this report is organized into descriptions of, outcomes from, and supplementary materials related to each of Tasks One through Four.

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The BS+30 – Background and Current Status

The primary source of information for this part of the study was the American Society of Civil Engineers, the group that has taken the lead in advocating for the proposed change. Dr. Tom Lenox, ASCE's Executive Vice President for Professional & Educational Strategic Initiatives, was especially helpful, as was Dr. Jeff Russell of the University of Wisconsin Madison.

A number of documents gathered during the study are included following this section of the report, as is the Power Point presentation summarizing the investigation. Some key findings are the following:

1. The National Council of Examiners for Engineers and Surveying (NCEES) approved a resolution at its 2006 annual meeting in Anchorage, subsequently modified in 2009, that called for a change to the model law related to educational requirements for sitting for the Professional Engineer ("Principles and Practices") examination. Note that eligibility for taking the Fundamentals of Engineering examination (the first of the two required examinations) was not changed. NCEES is an umbrella organization of registration boards (such as Alaska's Board of Registration for Architects, Engineers and Land Surveyors) for all US states and other jurisdictions that register engineers and land surveyors. As such, it has no enforcement powers but can only develop proposals and encourage their approval and implementation in the various jurisdictions, in addition to its many other roles.

Extracts from salient portions of the current version of the proposed model law and its associated model rules are the following:

1. As a Professional Engineer – The following shall be considered as minimum evidence satisfactory to the board that the applicant is qualified for licensure as a professional engineer.

c. Licensure by Examination (Effective January 1, 2020) – The following individuals shall be admitted to an 8-hour written examination in the principles and practice of engineering and, upon passing such examination and providing proof of graduation, shall be licensed as a professional engineer, if otherwise qualified:

(1) An engineer intern who satisfies one of the following education and experience requirements:

(a) Following the bachelor's degree, an acceptable amount of coursework resulting in a master's degree in engineering from an institution that offers EAC/ABET accredited programs, or the equivalent, and with a specific record of 3 years or more of progressive experience on engineering projects of a grade and a character which indicate to the board that the applicant may be competent to practice engineering

(b) Following a master's degree in engineering from an EAC/M-ABET-accredited program, a specific record of 3 years or more of progressive experience on engineering projects of a grade and a character which indicate to the board that the applicant may be competent to practice engineering

(c) Following the bachelor's degree, an acceptable amount of coursework ... from approved course providers and a specific record of 4 years or more of progressive experience on engineering projects of a grade and a character which indicate to the board that the applicant may be competent to practice engineering

The portion of interest here is subsection c) above, for which "an acceptable amount of coursework" is described as

A minimum of an additional 30 credits of coursework, none of which were used to fulfill the bachelor's degree requirement.

All 30 additional credits shall be equivalent in intellectual rigor and learning assessments to upper-level undergraduate and/or graduate courses offered at institutions that have a program accredited by EAC/ABET.

Of the minimum required 30 additional credits, a minimum of 15 credits must be in technical topic areas, acceptable coursework shall be upper-level undergraduate and/or graduate-level courses in engineering.

Other topic areas of acceptable coursework shall be upper-level undergraduate and/or graduate-level courses relevant to the practice of engineering and may include engineering-related science, mathematics, and/or professional practice topics such as business, communications, contract law, management, ethics, public policy, and quality control.

2. Although originally proposed for implementation by 2010 and later changed to 2015, the current version suggests a "no-earlier-than-2020" target.

3. The proposal has not been without considerable controversy. The original 2006 resolution was approved by a vote of 35 to 26, with 9 not voting. Notwithstanding strong arguments in favor, there is significant and strident

opposition. The attached Power Point presentation lists oft-cited arguments on both sides.

4. ASCE has based its position on the BS-plus-30 in large measure on the concept of the profession's need for a Body of Knowledge, that totality of education and experience that qualifies one for professional practice. Thus, the educational requirements for sitting for the Professional Engineer examination are one part (albeit a large part) of that totality. The current version of ASCE's Body of Knowledge (BOK2) runs to 191 pages (a bit too long to be included here in hard copy!). A copy of the executive summary is part of the attachments that follow.

5. Despite opposition by some individuals and professional organizations to requiring more education as a prerequisite to licensing, every professional engineering society that has spoken on the matter of present-day educational requirements recognizes that more education, including continuing education and professional development, is needed in order to keep pace with an increasing complex society and its technological needs. Several examples of such position papers are attached

6. It is clear that the proposal to increase educational requirements for professional licensing will, if implemented, have a major impact on engineering educational institutions. Visionary, forward-thinking colleges and schools of engineering will examine the entire spectra of their bachelors-masters programs, seeking to find the optimum positions in the five-to-six-year timeframe for foundation, technical and professional courses. Such an exercise will be a challenge, but it will also be an opportunity to devise best practices for the needs of contemporary society. Note that the attached "Analysis of Potential Impact ..." addresses this matter as well as other impacts.

7. It should be noted that the BS-plus-30 movement is but one driver in the pressure to provide more relevant and better education, training and development opportunities for the engineering workforce. If there were no such movement, there would still be a need to examine such educational needs and provide responses appropriate to today's conditions.

8. Following this section will be found a large number of supporting materials, in roughly the order they are discussed above.

9. An excellent source of information on ASCE's work and opinion on this matter can be found at www.asce.org/raisethebar.

A Power Point presentation (hard copy attached) was made to the UAF School of Engineering and Mines executive group on May 18 2010. It is planned to make a similar presentation to the Engineering and Mines faculty after the beginning of the fall 2010 semester.

August 20, 2009
Extract of 2009 NCEES Model Law/Rules
(Resulting from 2009 NCEES Annual Meeting in Louisville)

Model Law

130.10 General Requirements for Licensure

Education, experience, and examinations (as described in *Model Rules*) are required for licensure as a professional engineer or professional surveyor.

A. As an Engineer Intern – The following shall be considered as minimum evidence that the applicant is qualified for certification as an engineer intern. A college senior or graduate of an engineering program of 4 years or more accredited by EAC/ABET, or the equivalent, or an engineering master's program accredited by EAC/ABET shall be admitted to an 8-hour written examination in the fundamentals of engineering. Upon passing such examination and providing proof of graduation, the applicant shall be certified or enrolled as an engineer intern, if otherwise qualified.

B. As a Surveyor Intern – The following shall be considered as minimum evidence that the applicant is qualified for certification as a surveyor intern.

1. .....

2. .....

3. .....

C. Professional Engineer or Professional Surveyor – To be eligible for admission to the examination for professional engineers or professional surveyors, an applicant must be of good character and reputation and shall submit five references acceptable to the board with his or her application for licensure, three of which references shall be professional engineers or professional surveyors having personal knowledge of the applicant's engineering or surveying experience.

1. As a Professional Engineer – The following shall be considered as minimum evidence satisfactory to the board that the applicant is qualified for licensure as a professional engineer.

c. Licensure by Examination (Effective January 1, 2020) – The following individuals shall be admitted to an 8-hour written examination in the principles and practice of engineering and, upon passing such examination and providing proof of graduation, shall be licensed as a professional engineer, if otherwise qualified:

(1) An engineer intern who satisfies one of the following education and experience requirements:

(a) Following the bachelor's degree, an acceptable amount of coursework resulting in a master's degree in engineering from an institution that offers EAC/ABETaccredited programs, or the equivalent, and with a specific record of 3 years or more of progressive experience on engineering projects of a grade and a character which indicate to the board that the applicant may be competent to practice engineering

(b) Following a master's degree in engineering from an EAC/M-ABET-accredited program, a specific record of 3 years or more of progressive experience on engineering projects of a grade and a character which indicate to the board that the applicant may be competent to practice engineering

(c) Following the bachelor's degree, an acceptable amount of coursework as defined in Section 230.10 D from approved course providers and a specific record of 4 years or more of progressive experience on engineering projects of a grade and a character which indicate to the board that the applicant may be competent to practice engineering

(2) An engineer intern with a doctorate in engineering acceptable to the board and with a specific record of 2 years or more of progressive experience on engineering projects of a grade and a character which indicate to the board that the applicant may be competent to practice engineering.

(3) An individual with a doctorate in engineering acceptable to the board and with a specific record of 4 years or more of progressive experience on engineering projects of a grade and a character which indicate to the board that the applicant may be competent to practice engineering.

August 20, 2009
Extract of 2009 NCEES Model Law/Rules
(Resulting from 2009 NCEES Annual Meeting in Louisville)

Model Rules

230.10 Programs Education Requirements Approved by the Board

A. Undergraduate Engineering Program

The term "an engineering program of 4 years or more" used in Section 130.10 A in of the NCEES Model Law is interpreted by this board to mean:

1. A bachelor's degree in an engineering program accredited by EAC/ABET at the time of the awarding of the degree. (The board may accept the degree if accreditation is received within a prescribed period of time.)

2. A bachelor's in engineering not accredited by EAC/ABET, such as those programs recently developed or programs offered by foreign schools evaluated by the board as being substantially equivalent to those programs which have been accredited by EAC/ABET.

B. Post-Graduate Engineering Course Providers

The term "approved course provider" used in Section 130.10 C.1.c of the Model Law is interpreted to mean the following:

1. An institution that has an EAC/ABET-accredited program;

2. An institution or organization accredited by an NCEES-approved accrediting body; or

3. An institution or organization that offers specifically approved courses that are individually approved by an NCEES-approved accrediting body.

C. Post-Graduate Acceptable Coursework

The term "acceptable upper-level undergraduate and/or graduate-level coursework" used in Section 130.10 C.1.c of the Model Law is interpreted to mean the following:

1. In technical topic areas, acceptable coursework shall be upper-level undergraduate and/or graduate-level courses in engineering.

2. Other topic areas of acceptable coursework shall be upper-level undergraduate and/or graduate-level courses relevant to the practice of engineering and may include engineering-related science, mathematics, and/or professional practice topics such as

business, communications, contract law, management, ethics, public policy, and quality control.

D. Post-Graduate Minimum Required Education

The term "acceptable amount of coursework" used in Section 130.10 C.1.c of the Model Law is interpreted to mean the following:

1. A minimum of an additional 30 credits of coursework, none of which were used to fulfill the bachelor's degree requirement.

2. All 30 additional credits shall be equivalent in intellectual rigor and learning assessments to upper-level undergraduate and/or graduate courses offered at institutions that have a program accredited by EAC/ABET.

3. Of the minimum required 30 additional credits, a minimum of 15 credits must comply with Section 230.10 C.1.

4. The term "credit" is defined as a semester hour, or its equivalent, from an approved course provider as defined in Section 230.10 B.

NCEES
advancing licensure for engineers and surveyors

Background on the NCEES Additional Education Initiative

Prepared by the NCEES Engineering Education Task Force
May 2009

In 2000, NCEES President Richard Cottingham, P.E., P.S., assembled the Engineering Licensure Qualifications Task Force (ELQTF). The task force was made up of 12 NCEES members (later reaching 15 in 2002), including representation from all four NCEES zones and four past presidents. In addition, several engineering organizations (Member Organizations) agreed to participate directly on the task force by sending delegates. Each had voting rights on the task force and participated in the development of the report. The Member Organizations were as follows:

- American Academy of Environmental Engineers
- ABET
- American Council of Engineering Companies
- American Society for Engineering Education
- ASEE Engineering Deans Council
- American Society of Civil Engineers
- American Society of Heating, Refrigerating and Air-Conditioning Engineers
- American Society of Mechanical Engineers
- Canadian Engineering Qualifications Board
- Institute of Electrical and Electronics Engineers–USA
- National Society of Professional Engineers

Approximately 10 other engineering organizations agreed to be Consulting Organizations. These organizations were provided information from the ELQTF deliberations and were requested to comment as appropriate.

ELQTF's charge was to perform a baseline review of the engineering licensure system, consider the various stakeholder perspectives in licensure, identify issues and concerns, develop alternatives to the current system, and make recommendations for improvement. The task force focused on the three qualifications for licensure—education, experience, and examination—and considered other related issues such as the industrial exemption and continuing education. The full task force met for the first time in April 2001. NCEES President Ted Fairfield, P.E., reconstituted ELQTF for Council-year 2001–02 to complete its work. During the two-year period, the task force held six face-to-face meetings.

Relative to the educational qualification for licensure, ELQTF noted several concerns. These included the following:

- Engineering has fallen behind other learned professions in preparing students for practice;
- Credit requirements for undergraduate engineering degrees have steadily declined;
- The depth of education in core subjects has declined;
- The knowledge base required for competent practice is expanding;
- Greater specialized technical competence is needed than required in previous generations; and
- ABET criteria reflect an increase in the requirements for nontechnical training. This, coupled with the decline in the total credit hour requirements, resulted in a reduction of the available hours for technical training.

Based on these concerns, ELQTF concluded that "additional education beyond the current 128 +/– credit hour programs is necessary in the future to prepare students for engineering practice" and recommended that the *Model Law* be revised to require a bachelor's degree plus additional coursework. The task force did not prescribe the amount of additional education that should be required.

The ELQTF report was issued in March 2003 and presented to NCEES at each zone meeting in the spring of 2003 and at the Annual Meeting in August 2003. At the 2003 NCEES Annual Meeting in Baltimore, the report was presented and accepted, and the Council approved the following motion:

> *Move that the President consider charging LQOG [the Licensure Qualifications Oversight Group] with researching the conclusions and recommendations contained in the ELQTF report and preparing appropriate recommendations for NCEES consideration.*

NCEES President Robert Krebs, P.E., L.S., formed the Licensure Qualifications Oversight Group (LQOG) in late 2002. LQOG was made up exclusively of NCEES members. It included representatives from all zones and the full range of NCEES membership—including engineering members, public members, emeritus members, and administrators. Its charge was to review the ELQTF recommendations from the regulatory perspective and to bring specific recommendations forward for consideration by NCEES. The group had been formed before ELQTF completed its report so that LQOG members could observe ELQTF at its last meeting in January 2003. NCEES President Donald Hiatte, P.E., reconstituted LQOG during Council-year 2003–04 following the approval of the ELQTF motion.

LQOG reported its progress to the Council at the 2004 NCEES Annual Meeting in Cleveland. After considerable discussion, the group agreed with the ELQTF recommendations on engineering education and unanimously passed a supporting motion as follows:

> *Move that the President consider initiating a process to determine specific recommendations regarding additional engineering education for the purpose of licensure and prepare an implementation plan.*

The motion passed. NCEES President Jon Nelson, P.E., reconstituted LQOG for Council-year 2004–05, providing a second year of deliberation.

At the 2005 NCEES Annual Meeting in Memphis, LQOG made a motion to add specific language to the *Model Law* relative to additional education. The motion was based on several arguments similar to those of ELQTF:

- Other professions have increased their educational requirements, while engineering has effectively decreased its requirements through the reduction in credit hour requirements;
- The curriculum emphasis has shifted, resulting in an increase in general studies and decrease in core engineering subjects and subjects relating to technical breadth and depth;
- At the same time, "the practice of engineering is becoming more complicated" and "the body of knowledge required for the practice of engineering in the future and for the continued adequate protection of the public health, safety, and welfare is beyond the scope" of the "traditional four-year engineering curricula in the U.S."

The motion resulted in significant discussion, and it was amended on the floor as shown below (double strikethrough and double underlines show amendments to the motion made at the Annual Meeting):

> *Move that the Uniform Procedures and Legislative Guidelines Committee be charged with incorporating the following language requiring additional engineering education into the* Model Law *and* Model Rules ~~*no sooner than 2010*~~ *unless recommended otherwise by UPLG in 2006.*
>
> *Graduation with a bachelor of science degree from an engineering program of four years or more accredited by EAC/ABET, or equivalent, plus 30 additional credits from an approved course provider(s) in upper-level undergraduate or graduate-level coursework in professional practice and/or technical topic areas. The additional education requirements would be implemented no sooner than 2010.*

The motion passed by a narrow margin (35 in favor, 26 against, 9 not voting). Some of the arguments against included the following:

- There is no evidence that there is a problem, e.g., the level of disciplinary actions for incompetence is not on the rise;
- The recommendation in the motion is not well defined and could result in variable requirements from state to state, leading to comity problems; and
- The problem should be addressed by ABET through accreditation.

Following the meeting, NCEES President Martin Pederson, L.S., charged the 2005–06 Committee on Uniform Procedures and Legislative Guidelines (UPLG) to modify the *Model Law* to require additional education as a base requirement for licensure and to consider the language recommended by LQOG.

At the 2006 NCEES Annual Meeting in Anchorage, UPLG brought forth two motions. They addressed the proposed language of the LQOG motion in the *Model Law* (Motion 3) and added another requirement to the *Model Rules* that was not specifically raised by LQOG (Motion 4). They also revised the phrase "no sooner than 2010" in the LQOG motion by adding a phrase in both the *Model Law* and *Model Rules* stating that the requirements would be effective January 1, 2015.

UPLG Motion 3 addressed the *Model Law* and LQOG language requiring the "additional 30 credits of acceptable upper-level or graduate-level coursework from approved course providers." The UPLG language dropped the reference to coursework being "in professional practice and/or technical topic areas." After lengthy debate, the motion passed (39 in favor, 27 against, 4 not voting) and the *Model Law* was thus amended.

Arguments for the motion included the following:

- The same and similar arguments raised at past meetings;
- The proposed change emanated from a high level of study and deliberation not only in UPLG but also LQOG and ELQTF, and ELQTF was a task force that included representation from a significant cross-section of the profession;
- NCEES represents engineering licensure in the United States and should be the leader on this issue; and
- Adding the proposed language to the *Model Law* should help to engage in the debate other engineering societies that represent the profession.

Arguments against the motion included the following:

- The same and similar arguments raised at past meetings;
- Additional data is needed to support the concept before the *Model Law* is changed;
- Because the issue is not favored by a significant number of licensure jurisdictions, adoption into the *Model Law* could result in serious comity problems;

- Several terms in the proposed *Model Law* language need additional definition, and the changes should not be adopted until they are completed; and
- While the additional credit hour approach may be appropriate for civil engineering, it will not necessarily be appropriate for other disciplines.

UPLG offered another motion to change the *Model Rules* to allow individuals who complete five-year engineering programs to request that some of their credits, earned as part of their undergraduate work, be applied to the 30 additional credit-hour requirement. This motion was amended on the floor to allow individuals who complete engineering degrees "requiring more than 120 credits" to request credit for hours "in excess of 120 credits" be applied to the 30 additional credit requirement. This motion passed with little discussion, but it created some concern later when it was interpreted by some as establishing a minimum standard of 120 hours for bachelor's degrees. Establishing such a standard was not the intent of the clause. The intent was to recognize that not all engineering programs carry the same credit-hour requirements and to provide a means to accommodate the differences.

At the 2006 Annual Meeting, UPLG also recommended in its report that approved credits and approved course providers needed to be defined. NCEES President Louis Raimondi, P.E., P.S., charged UPLG to address this recommendation during Council-year 2006–07, and UPLG brought back recommendations. However, upon review of the recommendations and based on the discussion of the recommendations at the 2007 interim zone meetings, the NCEES Board of Directors requested that these recommendations not be presented in the form of motions at the 2007 Annual Meeting. Instead, the Board suggested that UPLG report its progress and recommendations and pass them on to a separate task force for specific deliberation during Council-year 2007–08. UPLG agreed to the board's request, and no motions relative to the additional education requirements were offered at the 2007 NCEES Annual Meeting in Philadelphia.

While there were no committee-generated motions on the initiative in Philadelphia, the Nevada Board presented a motion from the floor to rescind UPLG Motion 3 (the addition of the bachelor's plus 30 requirement to the *Model Law*) passed by NCEES at the 2006 Annual Meeting.

Nevada raised several points in presenting the rationale for its motion, including the following:
- The board acknowledged and commended ASCE's effort to "raise the bar" in engineering education, but pointed out that NCEES is made up of state-appointed licensing boards and is not the proper body to bring about such change;
- It noted that the additional 30 credit hours only address the education of those pursuing licensure (approximately 20 percent of all graduates) and thereby leave out the larger issues facing engineering education;
- It suggested that implementation will be very difficult; and
- It noted the divisive nature of the debate within the Council.

Proponents of the initiative cited the following:
- The change is proposed for the future, and adequate time can be provided to work out the difficulties in implementation;
- The additional educational requirements are necessary toward fulfilling the Council's mission to protect the health, safety, and welfare of the public; and
- More time is needed to develop the definitions of acceptable coursework and approved course providers before the Council makes a final decision.

After lengthy discussion, NCEES voted down the motion to rescind (19 in favor, 40 opposed, 11 not voting), thus upholding the 2006 decision.

In a related matter at the 2007 Annual Meeting, the Western Zone presented a resolution resolving:

> *That NCEES strongly urges ABET to institute a set of minimum number of credits that shall be required to graduate with a bachelor's degree in engineering; that a set percentage of the total required credits shall be courses defined by ABET as "engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study"; and that the professional societies that oversee the ABET accreditation of each engineering program shall determine these parameters.*

This resolution passed (41 in favor, 24 opposed, 3 not voting).

Following the 2007 NCEES Annual Meeting, NCEES President Gene Corley, Ph.D., P.E., S.E., sent a letter to ABET outlining the Western Zone resolution. The resolution was discussed at a leadership meeting between both organizations in the fall of 2007 and was part of a presentation of the additional education initiative that was made by NCEES to the ABET Board of Directors in March 2008. As of the spring of 2009, ABET had not formally responded to the resolution, but indications from ABET are that the organization is not in a position to implement such requirements.

In 2007, President Corley also constituted a new task force, the Bachelor's Plus 30 Task Force, and charged it with addressing the UPLG recommendations as well as devising a strategy to assist Member Boards with implementing the additional education requirements. The task force was also charged with addressing potential barriers to mobility that could result from implementing the requirement and with developing definitions for approved coursework and approved course providers.

At the 2008 NCEES Annual Meeting in Minneapolis, NCEES passed several UPLG and Bachelor's Plus 30 Task Force motions relating to the additional education initiative. One UPLG motion amended the previously approved *Model Law* and *Model Rules* language that added the additional 30 credits as a requirement for licensure. It moved the earliest effective date of implementation for the new requirements from 2015, as originally passed, to the year 2020 and footnoted the effective date for clarification as follows:

> *The implementation of these provisions in all jurisdictions is anticipated to take a number of years, so the actual effective date will vary by jurisdiction. A minimum 8-year transition period subsequent to adoption by a jurisdiction is recommended to allow jurisdictions and prospective licensees to prepare for the new requirements. The 2020 date was selected as the earliest reasonable date for adoption by a jurisdiction based on a 4-year implementation period plus an 8-year transition period for first-time licensure candidates.*

Thus, the Council clarified that the effective date contained in the *Model Law* is intended to serve as an example, not set a requirement or even a target at this point. This motion passed with no discussion.

Another UPLG motion proposed modified *Model Rules* language relative to the motion passed (as amended on the floor) at the 2006 Annual Meeting allowing credits taken in excess of 120 hours to potentially count toward the additional 30 credits requirement. The wording of the clause was revised
to state:

> *Effective January 1, 2020, a graduate of an EAC/ABET-accredited baccalaureate program may request that credits earned in excess of the institution's requirements for the acceptable degree be applied to*

satisfy the requirements for an additional 30 credits of acceptable upper-level undergraduate and/or graduate-level coursework.

The new language removed the specific reference to 120 credits to eliminate the implication that 120 credit-hour programs represent a minimum standard for bachelor's degrees in engineering. This motion also passed with no discussion.

The Bachelor's Plus 30 Task Force offered three motions. One motion called for a committee to be charged with exploring the idea of creating a clearinghouse to carry out activities needed to implement the additional education requirements for licensure. This motion passed with no discussion on the floor.

A second motion recommended charging UPLG with incorporating the M-ABET (a degree from an ABET-accredited master's program) concept into the *Model Law* and *Model Rules*. This motion also passed with no floor discussion.

The third motion presented conceptual language defining the acceptable coursework and approved course providers acceptable in fulfilling the requirement. This motion created some debate. The Rhode Island Board pointed out that it would be difficult to convince state legislatures to pass such language since, in its opinion, the language is rather vague and would require significant judgment in its assessment. The board also noted the possibility of eliminating the 30 additional credits in favor of simply requiring a master's degree as the educational requirement for licensure. Following floor debate, this motion passed.

At the 2008 Annual Meeting, the Council adopted an important resolution initiated by the Western Zone, which was subsequently modified by the Southern Zone and amended on the floor. The idea behind this resolution was to reopen the debate on the merits of requiring additional education prior to licensure and to identify possible alternative solutions to this concept. Proponents of the resolution felt that Member Boards should have an opportunity to revisit the issues related to the future requirements for additional education five years after its first introduction by NCEES.

In essence, the Southern Zone resolution called for a written analysis of the following:

- Various Whereas statements, as appropriate;
- The potential educational, professional, regulatory, and economic impact of the additional education requirement; and
- Any "alternative solutions to the concept of additional education that might have been or might be identified."

After passage of this resolution, NCEES President Henn Rebane, P.E., constituted the Engineering Education Task Force (formerly called the Bachelor's Plus 30 Task Force) for Council-year 2008–09 and charged it to address the resolution as well as to continue the work of defining the additional educational requirements. Another charge required the task force to prepare a white paper addressing the history and issues involved in the initiative. This paper is the task force's response to that charge.

Executive Summary

Destiny is not a matter of chance,
it is a matter of choice.
William Jennings Bryan, American statesman

The civil engineering profession is proactively preparing for the future.

The manner in which civil engineering is practiced must change. That change is necessitated by such forces as globalization, sustainability requirements, emerging technology, and increased complexity with the corresponding need to identify, define, and solve problems at the boundaries of traditional disciplines. As always within the civil engineering profession, change must be accomplished mindful of the profession's primary concern for protecting public safety, health, and welfare.

The profession recognizes the need for change. For example, in June 2006, the American Society of Civil Engineers (ASCE) convened the Summit on the Future of Civil Engineering – 2025. This gathering of civil engineering and other leaders, including international participants, articulated a global vision for the future of civil engineering. The vision[1] sees civil engineers as being entrusted by society as leaders in creating a sustainable world and enhancing the global quality of life.

Body of Knowledge

ASCE's Policy Statement 465 calls for attainment of a body of knowledge for entry into the practice of civil engineering at the professional level.

Even before the 2006 summit, the profession recognized the need for change. Beginning in 1998, ASCE's Board of Direction adopted, refined, and confirmed ASCE Policy Statement (PS) 465—"Academic Prerequisites for Licensure and Professional Practice"[2]—which "...supports the attainment of a body of knowledge (BOK) for entry into the practice of civil engineering at the professional level." The policy explains that this "...would be accomplished through the adoption of appropriate engineering education and experience requirements as a prerequisite for licensure." PS 465 recognizes that the profession's principal means of changing the way civil engineering is practiced lies in reforming the

manner in which tomorrow's civil engineers are prepared—through education and early experience—to enter professional practice.

The permanent board-level Committee on Academic Prerequisites for Professional Practice (CAP^3) is charged with implementing PS 465. CAP^3 developed an implementation master plan, of which the BOK is the foundation. As one of its actions, CAP^3 created a BOK committee, which published the first BOK (BOK1) in January 2004. In response to the expanding use of BOK1 by various stakeholders, and the questions asked and suggestions offered as a result of that use, CAP^3 formed the second BOK Committee in October 2005. This committee was asked to produce a second edition of the BOK report in response to stakeholder input and recent developments in engineering education and practice. The result is the refined BOK (BOK2) presented in this report.

The BOK2 committee began its work by reviewing the 15 outcomes making up the core of BOK1.[3] Also examined were recent National Academy of Engineering reports,[4,5] which aligned with BOK1, and other documents. Outcomes are the heart of the BOK because they define the knowledge, skills, and attitudes necessary to enter the practice of civil engineering at the professional level in the 21st century.

The original BOK was refined in response to stakeholder input and recent developments in engineering education and practice.

Following careful deliberation, the original set of 15 outcomes was expanded to 24 outcomes organized into three categories: foundational, technical, and professional. The evolution from 15 to 24 outcomes further describes the BOK. Rather than add content, the larger number of outcomes add specificity and clarity. (See Appendix H for more detail.)

The committee adopted Bloom's Taxonomy, which is widely known and understood within the education community, as the means of describing the minimum cognitive levels of achievement for each outcome. Figure ES-1 presents the 24 outcomes and, for each one, the level of achievement that an individual should demonstrate to enter the practice of civil engineering at the professional level.

Fulfilling the Body of Knowledge

The BOK will be fulfilled by a combination of education and experience.

According to PS 465, the BOK will be fulfilled by means of formal education and experience—that is, a bachelor's degree plus a master's degree, or approximately 30 semester

Outcome Number and Title	Level of Achievement					
	1	2	3	4	5	6
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Foundational						
1. Mathematics	B	B	B			
2. Natural sciences	B	B	B			
3. Humanities	B	B	B			
4. Social sciences	B	B	B			
Technical						
5. Materials science	B	B	B			
6. Mechanics	B	B	B	B		
7. Experiments	B	B	B	B	M/30	
8. Problem recognition and solving	B	B	B	M/30		
9. Design	B	B	B	B	B	E
10. Sustainability	B	B	B	E		
11. Contemp. issues & hist. perspectives	B	B	B	E		
12. Risk and uncertainty	B	B	B	E		
13. Project management	B	B	B	E		
14. Breadth in civil engineering areas	B	B	B	B		
15. Technical specialization	B	M/30	M/30	M/30	M/30	E
Professional						
16. Communication	B	B	B	B	E	
17. Public policy	B	B	E			
18. Business and public administration	B	B	E			
19. Globalization	B	B	B	E		
20. Leadership	B	B	B	E		
21. Teamwork	B	B	B	E		
22. Attitudes	B	B	E			
23. Lifelong learning	B	B	B	E	E	
24. Professional and ethical responsibility	B	B	B	B	E	E

Key:

B	Portion of the BOK fulfilled through the bachelor's degree
M/30	Portion of the BOK fulfilled through the master's degree or equivalent (approximately 30 semester credits of acceptable graduate-level or upper-level undergraduate courses in a specialized technical area and/or professional practice area related to civil engineering)
E	Portion of the BOK fulfilled through the prelicensure experience

Figure ES-1. Entry into the practice of civil engineering at the professional level requires fulfilling 24 outcomes to the appropriate levels of achievement.

credits, and experience. Two common fulfillment paths were developed—one involving an accredited bachelor's degree in civil engineering followed by a master's degree, or approximately 30 semester credits of acceptable graduate-level or upper-level undergraduate courses, and the other using an appropriate bachelor's degree followed by an accredited master's degree.

The roles of the bachelor's degree, the master's degree or approximately 30 credits, and experience in fulfilling the BOK are shown in Figure ES-1. A detailed version of the figure, known as an outcome rubric, appears as Appendix I and non-prescriptive explanations for outcomes are presented in Appendix J. These two appendices are the heart of this report. The report presents two models for validating the fulfillment of the BOK, one for each of the two previously mentioned common fulfillment paths.

The refined BOK is the foundation of the Policy Statement 465 Master Plan.

This report stresses the foundational role of the BOK in implementing the PS 465 Master Plan, noting how the CAP[3] committee and its subcommittees build on BOK2. Also presented are ways the BOK could be used by prospective civil engineering students, high school counselors, parents, employers, and others.

Roles of Faculty, Students, Engineer Interns, and Practitioners

This report offers guidance to BOK stakeholders.

PS 465 and the foundational BOK will reform the education and prelicensure experience of tomorrow's civil engineers. The resulting changes may raise concerns for some faculty members, students, engineer interns, and those practitioners who recruit, employ, supervise, coach, or mentor engineer interns. Accordingly, the BOK2 Committee invited various accomplished professionals, drawn from academia and practice and from the private and public sectors, to offer guidance ideas. Their input was used by the committee to create separate guidance for faculty, students, interns, and practitioners. That guidance is offered in this report in the hope that it provides useful insights and advice.

The Next Steps

The BOK2 Committee believes that this report will significantly assist with further implementation of ASCE PS 465. Accordingly, the report concludes with implementation recommendations for many stakeholders, including the CAP[3] accreditation, licensure, educational fulfillment, and experience fulfillment committees; university departments of civil and environmental engineering; employers of civil engineers; civil engineering students and interns; and other engineering disciplines and organizations.

The report concludes with recommendation for using the BOK to continue implementation of ASCE Policy Statement 465.

ASCE Policy Statement 465 on Academic Prerequisites for Licensure and Professional Practice

Approved by the Committee on Academic Prerequisites for Professional Practice on February 15, 2007
Approved by the Policy Review Committee on March 9, 2007
Adopted by the Board of Direction on April 24, 2007

Policy

The American Society of Civil Engineers (ASCE) supports the attainment of a Body of Knowledge (BOK) for entry into the practice of civil engineering at the professional level. This would be accomplished through the adoption of appropriate engineering education and experience requirements as a prerequisite for licensure.

ASCE encourages institutions of higher education, governmental units, employers, civil engineers, and other appropriate organizations to endorse, support, promote, and implement the attainment of the Body of Knowledge for individual civil engineers. The Body of Knowledge includes (1) the fundamentals of math, science, and engineering science, (2) technical breadth, (3) breadth in the humanities and social sciences, (4) professional practice breadth, and (5) technical depth or specialization. Fulfillment of the Body of Knowledge requires additional education beyond the bachelor's degree for the practice of civil engineering at the professional level. The implementation of this effort should occur through establishing appropriate curricula in the formal education process, appropriate experience guidelines for the workplace, and related education and experience standards **by the 55 engineering licensure jurisdictions**.

Admission to the practice of civil engineering at the professional level means professional engineering licensure requiring attainment of a Body of Knowledge through appropriate engineering education, experience and examinations. Fulfillment of this Body of Knowledge will typically include a combination of:

- a baccalaureate degree in civil engineering,
- a master's degree, or approximately 30 coordinated graduate or upper level undergraduate technical and/or professional practice credits or the equivalent agency/organization/professional society courses providing equal academic quality and rigor, and
- appropriate experience based upon broad technical and professional practice guidelines which provide sufficient flexibility for a wide range of roles in engineering practice.

Issue
The practice of civil engineering at the professional level means practice as a licensed professional engineer.

The Body of Knowledge prescribes the necessary depth and breadth of knowledge, skills, and attitudes required of an individual entering the practice of civil engineering at the professional level in the 21st Century. This Body of Knowledge exceeds today's typical civil engineering baccalaureate degree, even when coupled with the practical experience gained prior to licensure.

The civil engineering profession is undergoing significant, rapid, and revolutionary changes that have increased the Body of Knowledge required of the profession. These changes include the following:

- Globalization has transcended the historically recognized worldwide geographic boundaries primarily as a result of enhanced communication systems.
- Information technology continues to make more information available; however, the analysis and application of this information is becoming more challenging.

- Complex systems are requiring integration of our knowledge and skills outside of traditional sub-discipline focus.
- The diversity of society is challenging our traditional views and increasing our need for improved interpersonal and communications skills.
- any clients are searching for leadership in new management approaches that equitably manage risk as well as improve cost, quality and safety performance.
- New technologies in engineering and construction are emerging at an accelerating rate
- Enhanced public awareness of technical issues is creating more informed inquiry by the public of the technical, environmental, societal, political, legal, aesthetic, and financial implications of engineering projects.
- Civil infrastructure support within the United States is rapidly changing from a focus on development and operation, to the innovative renewal, maintenance, and improvement of existing systems, and the visionary development of new systems.

These changes have created a need for civil engineers to have simultaneously greater breadth of capability and specialized technical competence than that required of previous generations. For example, many civil engineers must increasingly assume a different primary role from that of designer to that of program, project or team leader. The knowledge required to support this new need is found in the combination of an appropriate baccalaureate education, additional education, and experience.

Rationale

Requiring education beyond the baccalaureate degree for the practice of civil engineering at the professional level is consistent with other learned professions. The Body of Knowledge gained in the formal civil engineering education process is not significantly less than the comparable knowledge and skills required in other professions. It is unreasonable to believe in such complex and rapidly changing times that we can impart the specialized Body of Knowledge required of professional engineers in just four years of formal schooling while other learned professions necessitate seven or eight years. Four years of formal schooling were considered the standard for medical, law and engineering professionals 100 years ago. While the education requirements for physicians and attorneys have been increased with the growing demands of their respective professions, the requirements for the practice of engineering have remained virtually unchanged. Today, many other professions beyond medicine and law require education beyond the baccalaureate degree including pharmacy, architecture, occupational therapy and accounting. Most likely, the retention of a four-year undergraduate engineering education has contributed to the lowered esteem of engineering in the eyes of society, and prospective students and the commensurate decline in the perceived value brought forth by engineers relative to other professions.

Current baccalaureate programs, while constantly undergoing reform, still retain a nominal four-year education process. This length of time limits the ability of these programs to provide a formal education consistent with the increasing demands of the practice of civil engineering at the professional level. There are diametrically opposed forces trying to squeeze more content into the baccalaureate curriculum while at the same time reducing the credit hours necessary for the baccalaureate degree. The result is a baccalaureate civil engineering degree satisfactory for an entry-level position, but becoming inadequate for the professional practice of civil engineering. The four-year internship period (engineer-intern) after receipt of the baccalaureate degree cannot make up for the formal educational material i.e. the expanded Body of Knowledge that would be gained from additional education.

The implementation of this concept will not happen overnight. While ASCE cannot mandate that it be done in a specified time period or manner, ASCE will be an active partner with other groups and organizations to accomplish this policy. The ultimate full implementation may not occur for 5 to 15 or more years. Appropriate grandfathering for existing registered and degreed engineers will be part of the implementation process. This concept is a legacy for future generations of civil engineers. However, perhaps the most important aspect of the implementation of this policy is already in place. Within the U.S. system of higher education, high quality, innovative and diverse master's degree programs currently exist in colleges and universities to support this concept. A growing number of government agencies, public

and private organizations, and professional societies now offer high quality on-site and distance learning educational opportunities that can support attainment of the Body of Knowledge outside of college campuses and as adjuncts to employee development. The active support of this policy by all of the stakeholders such as the educational institutions, the registration boards, and the various employers of civil engineers will be required for the implementation of this concept.

ASCE Policy Statement 465

Executive Summary

This report is the result of an initiative of the National Academy of Engineering that attempts to prepare for the future of engineering by asking the question, "What will or should engineering education be like today, or in the near future, to prepare the next generation of students for effective engagement in the engineering profession in 2020?" It accepts as a given that, first and foremost, engineering education must produce technically excellent and innovative graduates, but it does not attempt to define a "core" curriculum, recognizing that individual institutions need to design their own. It asks, rather, how to enrich and broaden engineering education so that those technically grounded graduates will be better prepared to work in a constantly changing global economy. It notes the importance of improving the recruitment and retention of students, and making the learning experience more meaningful to them. It discusses the value of considering changes in engineering education in the broader context of enhancing the status of the engineering profession and improving the public understanding of engineering.

Although the report comments on education beyond the baccalaureate, its primary focus is undergraduate education, not the academic engineering research enterprise. The success of academic engineering research is undeniable. It helped shape this nation's industrial capabilities and it continues to do so in an increasing degree as more complex products and systems based on advanced technologies are emerging in

the marketplace and in the social and economic infrastructure. Many of the most hi-tech companies have been spun off from university research. The end of the Cold War and the shift from defense work has put pressure on university research to accept funding from industry for shorter term product- or process-oriented research. Meanwhile, industry has decreased its own in-house fundamental engineering research, making it even more important that universities conduct advanced basic research. Thus, this is a part of the engineering education infrastructure that must be preserved, but, at the same time, it must not lead to the neglect of the undergraduate engineering education experience. Indeed, if domestic engineering students are energized by their undergraduate education experience, it will enhance the possibility that they will be retained and graduate as engineers *and* aspire to advanced degrees through the academic engineering research enterprise.

In response to the issues facing undergraduate engineering education, the committee presents a suite of recommendations in this report, including the following:

- The B.S. degree should be considered as a preengineering or "engineer in training" degree.
- Engineering programs should be accredited at both the B.S. and M.S. levels, so that the M.S. degree can be recognized as the engineering "professional" degree.
- Institutions should take advantage of the flexibility inherent in the EC2000 accreditation criteria of ABET, Incorporated (previously known as the Accreditation Board for Engineering and Technology) in developing curricula, and students should be introduced to the "essence" of engineering early in their undergraduate careers.
- Colleges and universities should endorse research in engineering education as a valued and rewarded activity for engineering faculty and should develop new standards for faculty qualifications.
- In addition to producing engineers who have been taught the advances in core knowledge and are capable of defining and solving problems in the short term, institutions must teach students how to be lifelong learners.
- Engineering educators should introduce interdisciplinary learn-

ing in the undergraduate curriculum and explore the use of case studies of engineering successes and failures as a learning tool.

- Four-year schools should accept the responsibility of working with local community colleges to achieve workable articulation[1] with their two-year engineering programs.
- Institutions should encourage domestic students to obtain M.S. and/or Ph.D. degrees.
- The engineering education establishment should participate in efforts to improve public understanding of engineering and the technology literacy of the public and efforts to improve math, science, and engineering education at the K-12 level.
- The National Science Foundation should collect or assist collection of data on program approach and student outcomes for engineering departments/schools so that prospective freshman can better understand the "marketplace" of available engineering baccalaureate programs.

The report is grounded by the observations, questions, and conclusions presented by the Phase I report, *The Engineer of 2020: Visions of Engineering in the New Century.* That report begins with a review of the likely technological changes and challenges that will impact the world and the engineering profession. It notes that a dramatic expansion of knowledge is expected that offers exciting opportunities for engineering to develop new technologies to address the problems faced by society. It addresses the societal, geopolitical, and professional context within which engineering and its new technologies will exist. It notes that the coming era will be characterized by rapid population growth, which will contain internal dynamics that may affect world stability as well as the types of problems engineers will face. Growth will be concentrated in less developed countries where a "youth bulge" will occur, whereas in advanced countries the population will age. Issues related to improving quality of life through advanced technologies in some countries will be

[1]Articulation agreements establish rules that govern transfer credits that students earn at one institution (typically the community college) and are recognized and accepted by the partner institution (typically a four-year institution) for particular major courses of study.

contrasted with more basic problems such as access to water and housing in others. Within countries, the demographics will change, including in the United States, where the numbers of minorities will grow rapidly whereas those of the traditional majority will decline in a relative sense. This has major implications for the future of engineering, a profession where minorities and women remain underrepresented.

Although certain basics of engineering will not change, the explosion of knowledge, the global economy, and the way engineers will work will reflect an ongoing evolution that began to gain momentum a decade ago. The economy in which we will work will be strongly influenced by the global marketplace for engineering services, evidenced by the outsourcing of engineering jobs, a growing need for interdisciplinary and system-based approaches, demands for new paradigms of customization, and an increasingly international talent pool. The steady integration of technology in our public infrastructures and lives will call for more involvement by engineers in the setting of public policy and in participation in the civic arena. The external forces in society, the economy, and the professional environment will all challenge the stability of the engineering workforce and affect our ability to attract the most talented individuals to an engineering career. However, amid all these challenges, exciting opportunities also will exist if the engineering community takes the initiative to prepare for the future.

If the United States is to maintain its economic leadership and be able to sustain its share of high-technology jobs, it must prepare for this wave of change. Although there is no consensus at this stage, it is agreed that innovation is the key and engineering is essential to this task; but engineering will only contribute to success if it is able to continue to adapt to new trends and provide education to the next generation of students so as to arm them with the tools needed for the world as it will be, not as it is today. It is within this context that this Phase II report considers recommendations for changes in engineering education.

Reinventing engineering education requires the interaction of engineers in industry and academe. The entire engineering enterprise must be considered so that the changes made result in an effective system. Because most engineers work in industry and do not interact one-on-one with people who directly benefit from their services, as do physicians, lawyers, and teachers, the public is unclear about what most engineers do, and secondary students (and their parents and advisors) have poorly formed ideas about what an engineering education offers and

how they can serve society through engineering practice. Engineering needs to develop iconic images that the public immediately recognize and respond to in a positive way. Those "icons" should include simple images of the options for engineering education, their implications for future career paths, and the image of a person who never stops learning.

This report is intended to begin a dialog about reinventing engineering education, but it makes recommendations that are broader than the curricular challenges indicated in the Phase I report. In the spirit of considering engineering education as a system and as part of a system of systems, consideration is given herein to important factors such as improving the public's understanding of engineering, its technological literacy, and K-12 education, which can have an important but indirect effect on engineering in terms of encouraging secondary school students to consider an engineering education and preparing them intellectually so that an engineering education is accessible to them.

NSPE Adopts Position Statement on Engineering Education Outcomes

At its April 2010 Board of Directors meeting, NSPE adopted a new position statement advocating that certain engineering education outcomes be attained by engineers of all disciplines who become licensed professional engineers. These outcomes, listed below, are not currently required by existing accreditation criteria, and thus are not commonly included in engineering curricula.

1. Apply principles of leadership;
2. Account for risk and uncertainty in the solution of engineering problems;
3. Apply principles of project management;
4. Explain where and how public policy is developed and how it influences engineering practice;
5. Explain business concepts applicable to engineering practice; and
6. Apply principles of sustainability to the design and evaluation of engineering systems.

This position statement was developed by reviewing the "Body of Knowledge" reports that have been prepared for two engineering disciplines, comparing the education outcomes recommended in those reports and identifying the delta between current accreditation criteria and the recommended outcomes, and determining which of those new outcomes apply to all engineering disciplines.

As it was developed, this position statement was reviewed by a number of NSPE committees, representing practitioners and academicians, as well as engineers of various disciplines. It is interesting to note that the "what" of the list of six outcomes above was not significantly controversial among these different groups. As long as what is meant by each outcome is described adequately, there was general concurrence that a background in each of these topic areas is needed for the professional practice of engineering. It is the "how" that is controversial.

NSPE's position statement doesn't specify whether these outcomes should be required in baccalaureate education or in graduate programs; it simply advocates that these outcomes be attained by the time of licensure. The "how" has been left to ABET and the National Council of Examiners for Engineering and Surveying to determine the combination of accreditation criteria and licensure requirements of the future.

This is a visionary step on the part of NSPE to advocate raising the bar for engineering licensure requirements of the future. Rather than discussing degrees and credit requirements, this position statement addresses the issue at a higher level in defining professional practice topic areas that typically are not currently incorporated in the education of most engineers but are necessary in

the education of professional engineers in the interest of enhancing the protection of the public health, safety and welfare.

Published Wednesday, May 05, 2010 2:19 PM by Craig Musselman, P.E., F.NSPE

IEEE★USA
Building Careers & Shaping Public Policy

IEEE

POSITION STATEMENT

EDUCATIONAL REQUIREMENTS FOR ENGINEERING LICENSURE

Adopted by the IEEE-USA
Board of Directors, 20 Nov. 2009

IEEE-USA endorses the need for engineering education to evolve to meet the increasing technical and professional requirements for the practice of electrical engineering and supports the efforts of the National Academy of Engineering to anticipate the future educational needs of electrical engineers.(1) IEEE-USA is confident that the Accrediting Board for Engineering and Technology (ABET) will adapt its educational program accreditation criteria to meet the evolving needs for an electrical engineering career path.

IEEE-USA neither supports nor opposes the National Council of Examiners for Engineering and Surveying (NCEES) decision to recommend that engineers who have successfully completed accredited baccalaureate-degree educational programs be required to take 30 additional hours of engineering education to become licensed, beginning in 2020. IEEE-USA recommends that NCEES work with ABET and concerned professional societies to ensure that the proposed additional education requirement is better defined, and to develop a clearly articulated process by which state licensing boards can ensure that individual applicants for licensure have met the requirement. Such actions will better serve the career needs of electrical engineers and the public need for an adequate supply of licensed professional engineers.

IEEE-USA will work with the IEEE's Educational Activities Board (EAB) to ensure that engineering education is consistent with the licensure-related needs of the IEEE's U.S. members.

This statement was developed by the IEEE-USA Licensure and Registration Committee and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public policy interests of the 210,000 engineers, scientists and allied professionals who are U.S. members of the IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of IEEE or its other organizational units.

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(1) See, e.g., Educating the Engineer of 2020: Adapting Engineering Education to the New Century (National Academy of Engineering, 2005). Source: http://www.nap.edu/catalog/11338.html

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ACEC

Last Word

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ACEC Opposes Bachelor's Plus 30 Initiative; Little Support Found Among Members

ACEC Chairman John Hennessy

The "Bachelor's Plus 30" initiative proposed by the National Council of Examiners for Engineering and Surveying (NCEES) has found little support among ACEC state Member Organizations, Executive Committee and Board of Directors.

The proposal, which was considered in depth by ACEC over the past year, would require a bachelor's degree plus 30 additional credits or master's degree as a prerequisite for licensure. NCEES proposed the initiative in 2006 and is seeking implementation by all states by 2016.

In a letter to NCEES President Gene Corley, ACEC Chairman John Hennessy outlined the Council's concerns: "We believe that the "Plus 30" would be better incorporated within the basic Bachelor's degree; that if the proposal were enacted in some states and not in others, there would be a serious comity problem; that the proposal would likely exacerbate the engineer shortage; and that it would not enhance the image of the profession."

An ACEC Executive Committee resolution stated that the initiative is "not the most effective approach to promoting engineering professionalism."

The Council remains a strong supporter of NCEES and will continue to work with the organization in a wide range of areas to benefit the engineering community.

Take ACEC Liability Insurance Survey Now; Deadline Extended To May 23

The 2008 ACEC Professional Liability Insurance Survey of Member Firms for fiscal year 2007 is being extended online through Friday, May 23.

This annual survey collects information on Member Firms' professional liability insurance experience, including claims and the threat of litigation.

Member Firms that respond to the survey will receive a free copy of the complete results upon request. The survey results will also be available for sale through the ACEC Bookstore.

To access the survey, please click on the URL below or copy and paste it into your Web browser: http://www.surveymonkey.com/s.aspx?sm=KcZsqU5Nn_2bIGY1mJ3F3Gcw_3d_3d.

It is critical that ACEC receives only one response from each member firm. Therefore, only the key principal, risk manager, or another member of the firm designated by the key principal, should fill out this survey. In

Bachelor's Degree Should Remain the Educational Requirement for Engineering Licensure Says ASME

NEW YORK, Jan. 22, 2009 – ASME believes a four-year bachelor's degree from an accredited college or university should remain the mandatory educational requirement for licensure as a professional engineer in the United States.

Responding to a recent change the National Council of Examiners for Engineering and Surveying (NCEES) made to its Model Law to increase the mandatory educational requirements for professional licensure, ASME has released an official position statement making the case for the traditional four-year bachelor's degree plus career-long continuing education.

"ASME believes that the typical scope of an ABET-accredited bachelor's degree has been demonstrated to accommodate technical breadth and flexibility and the intellectual skills necessary for engineering graduates to attain licensure as a professional engineer," says the position statement.

The ASME statement, Mandatory Education Requirements for Engineering Licensure, is endorsed by organizations that include the American Institute of Chemical Engineers (AIChE), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the Illuminating Engineering Society (IES), the Institute of Industrial Engineers (IIE), the Instrumentation, Systems, and Automation Society (ISA), Society for Mining, Metallurgy and Exploration Inc. (SME), the Society of Naval Architects and Marine Engineers (SNAME), and The Minerals, Metals and Materials Society (TMS), representing more than 302,000 engineers.

The bachelor's degree, along with passing the Fundamentals of Engineering and Principles and Practices examinations and successfully completing a four-year internship, "assure that the knowledge, skills, and ethical standards expected from a professional engineer are attained," says the statement.

ASME believes continuing education is an essential component for maintenance of one's engineering license. The Society is a strong advocate of lifelong learning and sponsors continuing education and professional development programs, including short courses, in many technical areas.

The NCEES plan, known as "Master's or Equivalent," proposes 30 additional credits or a master's degree, on top of the bachelor's, for licensure. ASME states that the higher educational requirements are unnecessary.

"There is no evidence to suggest that adding 30 credit hours, representing a full academic year of upper-level undergraduate coursework or graduate-level coursework, will have a positive impact on the public's health and safety," according to the position statement.

The higher educational requirements also could produce an adverse affect on America's ability to place an adequate supply of engineers in the industrial workforce, enabling the nation to compete technologically and economically, according to ASME.

"Increasing the professional licensing requirements has the potential to reduce the supply of licensed engineers who are able to practice, therefore reducing the nation's technological competitiveness," says the statement.

A companion Web site called Licensing That Works has been created by the partnering organizations listed above to share information and collaborate on the need to maintain the current educational requirements.

Founded in 1880 as the American Society of Mechanical Engineers, ASME is a not-for-profit professional organization promoting the art, science and practice of mechanical and multidisciplinary engineering and allied sciences. ASME develops codes and standards that enhance public safety, and provides lifelong learning and technical exchange opportunities benefiting the global engineering and technology community.

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Analysis of the Potential Impact of Requiring Additional Education for Engineering Licensure

Prepared by the NCEES Engineering Education Task Force
March 2009

Introduction

At its 2008 Annual Meeting in Minneapolis, NCEES passed a resolution to investigate the potential impact of the requirement for additional education prior to engineering licensure. The Council adopted this requirement in the *Model Law* and *Model Rules* in 2006. The 2008 resolution describes a number of concerns held by some NCEES Member Boards and others in the engineering profession that related to implementation of the requirement. This resolution is known as the Southern Zone Resolution. As a result of this action, President Henn Rebane, P.E., charged the Engineering Education Task Force (formerly known as the Bachelor's Plus 30 Task Force) with providing a written analysis of the following:

- The potential educational, professional, regulatory, and economic impact of the B+30 requirement; and
- Any alternative solutions to the additional education concept that have been or might be identified (including items such as additional experience before licensure in lieu of additional education).

This charge to the task force was to be completed prior to the interim zone meetings in 2009.

The task force conducted a conference call in October 2008 and held two face-to-face meetings (one in December 2008 and the other in February 2009). This written analysis provides the results of the task force deliberations.

Terms and concepts in the analysis

It is important to note a few key terms and concepts used throughout the analysis. First, the term "master's or equivalent" is used to refer to the additional education requirement for engineering licensure. This is a departure from the terms "bachelor's plus 30" and "B+30" that were used by NCEES after passage of this requirement in 2006. Since then, members of NCEES have wrestled with the specifics of implementing it at the state level. A number of state boards indicated that it would be easier to pass legislation if the requirement were called a master's degree in engineering or equivalent. Therefore, after the 2008 Annual Meeting NCEES began referring to this requirement as simply "master's or equivalent," with one of the primary "equivalents" being B+30.

Second, the concept of a clearinghouse is mentioned throughout the analysis. The purpose of a national clearinghouse would be to perform additional education-related services for Member Boards, organizations and institutions, and individual applicants. The clearinghouse would be designed to make the master's or equivalent requirement easier for Member Boards to implement. In response to a separate charge—one that is outside the scope of this analysis—the Engineering Education Task Force has developed a conceptual model of such a clearinghouse, which will be included in the task force's 2009 Annual Meeting report.

Finally, in all discussion of master's or equivalent, it is important to recognize that a degree earned from a master's program accredited by EAC/ABET (known as an M-ABET degree) should satisfy the future requirement for additional education. ABET has recently lifted its prohibition of dual-level bachelor's and master's accreditation for the same engineering program at a college or university. This could, in the future, increase the number of M-ABET degree programs and add another pathway to satisfying the master's or equivalent.

Structure of the analysis

The impact analysis in this paper is presented in a question/answer style. The task force felt that this style was most appropriate considering the number of individuals who contributed to writing the content. The information presented is based on the experience and expertise of the individual task force members.

The Engineering Education Task Force membership is made up of the following:

- 11 voting members from NCEES, including the chair
- 3 consultants, including a past president of ABET and the chair of the NCEES Committee on Uniform Procedures and Legislative Guidelines
- 7 society resources, representing ACEC, AIChE, ASCE, ASHRAE, ASME, IEEE–USA, and NSPE
- 1 Board of Directors liaison and 1 NCEES staff liaison

During the course of the task force meetings, the group discussed conducting original research to address the various issues. It was quickly decided that there was not enough time or funding available to conduct any serious research. Therefore, this analysis is the best effort task force members could accomplish in the few months available with the information readily available to them.

The full text of the Southern Zone Resolution is in the Appendix. One of the directives of the resolution is to develop a written analysis of the 10 Whereas statements, as appropriate. After developing the analysis of the various impacts, the task force members felt that most of the Whereas statements were addressed within the context of the analysis of each impact. Therefore, a separate analysis of each individual Whereas is not presented.

The following sections analyze the potential impact of the additional education requirements in educational, professional, regulatory, and economic areas. The paper concludes with a listing of alternatives to the master's or equivalent requirement.

Educational Impact

The task force studied the potential educational impact by forming answers to the following questions.

- What are the pathways by which a candidate can obtain the required additional education?
- How long will it take for a candidate to obtain the needed education by these pathways?
- What other educational factors should be considered?

The task force considered six pathways by which a candidate could obtain the education needed for licensure in 2020, as shown in the table below.

Table 1: Pathways to meeting additional education requirements in 2020

Path	Bachelor's Education	Additional Education	Years for Education (B.S. = 4 years)	Additional Years of Experience	Total Years
1	EAC/ABET	• Engineering master's degree • Full-time student	B.S. + 1–2 years	3	8–9
2	EAC/ABET	• Engineering master's degree • Part-time student • Full-time employee	B.S. + 4–6 years	0*	8–10
3	EAC/ABET	• Engineering master's degree • Executive format or "weekend" format • Full-time employee	B.S. + 2 years	2*	8
4**	EAC/ABET	• Full-time student	B.S. + 1–2 years	4	9–10
5**	EAC/ABET	• Part-time student • Full-time employee	B.S. + 4–6 years	0*	8–10
6	Non-EAC/ABET	• EAC/ABET engineering master's degree (M-ABET)	B.S. + 1–3 years	3	8–10

*Accrues all or part of the experience requirement while completing the additional education requirement

**B+30 option

In the table, it is assumed that all full-time employment is acceptable for engineering experience and that experience credit for graduate education cannot be counted if it is concurrent with employment experience. The number of years of experience required prior to licensure varies depending on the type and length of education. Candidates with a master's degree are allowed to waive a year of the four years of progressive experience required for licensure. Candidates who earned the additional education as an alternative to a master's degree (the "or equivalent" part of the requirement) are not allowed to waive the year of experience.

In its discussions about the possible educational impact, the task force also addressed the following questions.

Will there be a problem if it takes a long time to earn a master's degree?

Some universities have a time limit on how old a course can be and still be counted toward a master's degree. Usually, older courses in engineering can be validated by some procedure because the underlying theory has not changed.

Will engineering classrooms have room for the additional students who will be taking courses because of the master's or equivalent requirement?

It is very likely that there will be room since the majority of engineering programs currently have available capacity at the graduate level.

Will requiring more education increase the number of courses engineering faculty will have to teach?

An increase in the faculty-teaching load is unlikely at the present time because most programs have excess capacity for students. Many factors influence the number of courses that are assigned to each faculty member to teach. It is the responsibility of the university administration, starting with the chair of the department, to make these assignments. Each institution will make these teaching assignments according to its own needs and requirements.

Would an engineering dean be concerned about another accreditation visit for a master's program?

Typically, a dean would be concerned about another accreditation visit because that visit would require additional work on the part of faculty and staff. The additional education requirements outlined in Table 1 would not require that any additional programs be accredited. An existing EAC/ABET-accredited bachelor's program is all that is needed. The dean may elect to have a master's program accredited, but M-ABET accreditation is not required to fulfill the additional education requirement for licensure.

What is the difference between an accredited program and an approved course?

To ABET, a program includes the ability to change courses and create new courses. The concept of a program includes the procedures to evaluate courses and their contribution to overall objectives. An approved course for the additional education requirement is a standalone item. Any changes in the course and all new courses would have to be approved by the same authority that approved the course originally. It is expected that non-university institutions will not set up the procedures needed to establish a program. Thus, there needs to be a way for companies, laboratories, and professional societies to get their courses approved on an individual basis. For these institutions, the expense of setting up a full program may not be justified.

Will bachelor's-degree recipients with low grade point averages (GPA) have a problem becoming licensed because their GPAs prevent them from being admitted to a master's program?

Applicants to an engineering master's program are generally evaluated on several criteria, including overall undergraduate GPA, GPA over the last 60 hours, Graduate Record Examination (GRE) scores, original essays, etc. Students are routinely admitted on probation if they meet most, but maybe not all, of the entrance requirements. Probation generally means that the student must have a B average after the first 12 hours of graduate work; if the student does not earn that B average, then he or she will no longer be in the program. There is sometimes an ability to waive an entrance requirement because the candidate has an alternative criterion that can be used (such as using a passing score on the FE or PE exam instead of the GRE). It is not necessary that a candidate be admitted into a graduate program in order to take graduate courses as a non-degree-seeking student; such candidates would not be earning a master's degree but would be able to earn credit for coursework that would qualify for the "or equivalent" portion of the master's or equivalent.

Will graduate-level engineering courses be available by distance education or in an executive or "weekend" format?

Such courses and engineering master's degree programs are already available by distance education and in executive format. Two examples of these courses and programs are North Carolina State University (engineeringonline.ncsu.edu) and Iowa State University (www.ede.iastate.edu/Grad-Pro/). It is expected that the number of engineering master's degrees available by distance education or in executive format will increase with the demand for flexible locations and times.

Will the increase in educational requirements for engineering licensure result in bachelor's education reform in engineering programs?

While it cannot be stated that undergraduate programs will change as a direct result of the additional educational requirements for licensure, the opportunity to reform undergraduate engineering programs will be available. Currently, many undergraduate engineering programs have eliminated "breadth" courses because of credit-hour limits and university core-curriculum requirements. If a master's degree increasingly becomes viewed as a degree required for practice, it is more likely that programs will shift senior elective courses in very specific subjects to the graduate level. If this were done, it could open up room in the undergraduate programs to put back the breadth courses that have been removed.

Professional Impact

In its discussions about the potential professional impact, the task force addressed the following questions.

Will the master's or equivalent requirement affect the number of individuals who will consider engineering as a career in the future? Will the requirement affect the number of licensed engineers who might be available in the future?

The answers to these questions differ for three different groups of individuals:

- **Pre-College Individuals:** For individuals who are considering an engineering career, the effects will probably be minimal. They will be able to understand the requirements well in advance of their decision and properly prepare for them. It is anticipated that their response will depend more on their impression of the profession, their level of interest in the profession, the efforts by the professional societies to promote the profession, and economic factors. For individuals with career plans that include licensed practice, the effect of the change would likely be similar to the effect for college students discussed under the next bullet.
- **College Students:** For individuals who have decided on an engineering career that requires a license and who will continue with their education to satisfy the additional education requirements, the proposal adds a significant amount of additional educational time (a minimum of 1 to 2 years beyond the bachelor's degree) and cost (addressed in this paper's section on Economic Impact). These factors could reduce the number of these individuals who pursue licensure.
- **Post-College Engineers:** Those who decide to pursue licensure after graduation with a bachelor's degree will also be affected by the time (an estimated 4 to 6 years) and cost to complete the additional education requirements. In addition, there may be significant non-economic costs while they fulfill the requirements, such as the impact on an individual's personal and family life. These factors could reduce the number of these individuals who pursue licensure. This is not a completely new situation in licensure. It is fairly common for state boards to address individuals who did not decide on a career in licensed engineering practice until after college. Depending on the individual circumstances, some of them have to make significant additions to their education and experience to qualify.

In the Economic Impact section, the task force considered it likely that the value of lifelong earnings would offset the cost for pursuing the proposed additional education requirements. Some task force members believe that individuals may not value such a long-term return in such a quantitative way. If that is the case, there could be a negative effect on those who choose a career as a licensed engineer. Other members said that the need for licensed engineers will not diminish and that as the demand for licensed engineers exceeds the supply, market forces will adjust and the shortage would be addressed.

What effect will the master's or equivalent requirement and the potential reduction of numbers of individuals that pursue licensure have on NCEES exam usage?

If the number of individuals pursuing licensure drops, it would result in a corresponding drop in the number of both Group I and Group II PE examinations administered. This would have a financial impact on NCEES that would have to be addressed. Perhaps of more concern would be the effect on the Group II exams. The Group II exams are supported by lower numbers than the Group I exams. Consequently, a drop in numbers for certain Group II exams could result in the exams being placed on probationary status.

If the additional education requirement results in fewer engineers becoming licensed, would this have a negative effect on the ability of licensed engineers to properly exert responsible charge?

The task force noted that a reduction in the number of licensed engineers could result in licensed engineers having to be in responsible charge of more projects. This may or may not have an effect on their ability to properly exert responsible charge.

Would the master's or equivalent requirement result in better P.E.'s?

The task force agreed that raising the educational standard should eventually result in a more knowledgeable, capable, and better-educated engineering workforce, which could be reflected in an improved quality of services by licensed engineers.

Will the new requirement increase the perceived stature of the engineering profession?

The task force decided that although this is not a primary driver of the initiative, the stature of the profession might improve as a result of the master's or equivalent requirement.

What have other learned professions recently done relative to educational requirements?

Many of the learned professions, including architecture and accounting, have increased their educational requirements. This fact does not necessarily mean that engineering should follow suit, but it is an indication that the concern currently being considered in our learned profession has also occurred in others. Since part of the definition of a learned profession includes "specialized knowledge gained through formal training or education," this fact should not be ignored. In addition, it may be of value to look at the lessons learned by the other professions.

Regulatory Impact

The task force interprets the regulatory impact of the master's or equivalent requirement to mean the effect it will have on Member Boards as they license professional engineers beginning in 2020 and thereafter.

One of the primary concerns of Member Boards is the perceived difficulty in implementing the *Model Law/Model Rules* additional education language and the associated clearinghouse in their jurisdictions. State legislators may have an easier time passing additional education legislation that looks like a master's degree, or equivalent, than legislation that looks like the B+30 requirement. Under the bachelor's-plus-a-master's-or-equivalent scenario, the B+30 pathway is one of the equivalents (see pathways 4 and 5 in Table 1 in the Educational Impact section); therefore a jurisdiction could bypass the B+30 requirements and enact just the master's requirement if it felt the former was too difficult to implement.

How will the additional education requirement affect comity?

Like everything else in the NCEES *Model Law* and *Model Rules*, the master's or equivalent concept becomes a national guideline once the effective date is reached. The *Model Law* and *Model Rules*, however, are simply that—a model. They exist for the use of individual jurisdictions to the extent a jurisdiction wishes to use them. It follows that the master's or equivalent requirement will have no regulatory impact if no jurisdictions choose to adopt the *Model Law* and *Model Rules* in their statutes.

The regulatory impact will occur after a jurisdiction adopts the additional education requirement in its statute. The most obvious impact is that individuals will not be able to obtain their first license in that jurisdiction without meeting the requirement. This could initially decrease the number of first-time licensed engineers in that jurisdiction if individuals choose not to fulfill the new education requirement. If individuals desire to practice in that jurisdiction, the impact will be less because they will choose to fulfill the requirement.

Additionally, comity will be affected for non-Model Law Engineers properly licensed in other jurisdictions but only if the jurisdiction with the master's or equivalent requirement will not "grandfather" the engineer for being licensed prior to the effective date.

The number of engineers who meet the Model Law Engineer 2020 designation could increase as a result of a desire to receive national comity through the Council Records program.

It should be noted that comity issues between jurisdictions currently exist. With regard to the additional education requirement, comity will be affected if an individual Member Board has different requirements for the credit split between technical and nontechnical courses or different interpretations relative to what is considered a technical course versus a nontechnical course or if individual Member Boards accept different equivalents. Jurisdictional differences in the definitions of acceptable coursework and providers as well as the percentage of engineering and non-engineering

coursework could also affect comity. In another case, comity could be affected if a Member Board accepts only the master's degree while not accepting the "or equivalent" portion of the master's or equivalent requirement.

Another potential impact of the master's or equivalent requirement could be comity affected by the equivalency of master's degrees. If, in the future, only a small percentage of master's programs are accredited by ABET, some NCEES Member Boards may not deem all master's degrees equivalent, thus affecting comity.

How will enforcement be affected by implementation of the additional education requirement?

Another regulatory impact could be an increase in unlicensed practice. This could occur if the master's or equivalent requirement results in fewer licensed engineers. There could be instances where more unlicensed engineers are performing the work, which could result in more plan stamping.

In the above case, the regulatory impact is assumed to be the result of fewer individuals becoming licensed because of increased education requirements for licensure. If the number of individuals who become licensed after the master's or equivalent goes into effect does not significantly decrease over time, then the impact will not be more significant than it currently is.

The number of complaints/disciplinary actions resulting from incompetence could decrease if the additional education requirement produces a population of more highly educated, competent professional engineers.

Will the master's or equivalent requirement increase the workload of Member Boards?

A potential Member Board impact is an increased workload. This could result if a particular Member Board chooses to review applications individually rather than relying on the clearinghouse. In addition, a Member Board administrator and his or her staff could spend more time answering questions from individuals seeking clarification on clearinghouse issues. This impact is expected to occur mainly during the initial stages of a jurisdiction adopting the master's or equivalent requirement and is not expected to be a long-term impact.

How could the clearinghouse potentially diminish the regulatory impact?

In all the examples cited above, it is critical that a highly functioning clearinghouse be in place to facilitate greater national uniformity in the application of the new requirement. The clearinghouse will also need to create a level of trust so that Member Boards will not feel compelled to exhaustively review the record of every individual applying for licensure. With a clearinghouse in place, the regulatory impact could be minimized.

Economic Impact

The implementation of the *Model Law* provisions requiring a master's or equivalent will have an economic impact on applicants and their employers due to the cost of the additional education borne by those engineers who otherwise would not obtain a master's degree. Some engineers' salaries will likely increase. There will be an economic impact on the public in that the cost of engineering services may increase to cover the cost of additional education and increased salaries.

What percentage of current engineers would potentially meet the master's or equivalent requirement for licensure if it were in effect today?

The task force reviewed data from several sources in addressing this question.

- The task force looked at responses from an NCEES survey of 19,100 examinees who sat for the FE, PE, FS, and PS exams in ELSES states in October 2008. There were 8,231 respondents, of whom 3,395 took the PE exam. When asked to indicate the highest engineering degree they had completed, 70 percent said a bachelor's, 26 percent a master's, and 4 percent a Ph.D.
- Data from the American Society for Engineering Education for the United States in 2006–07, the latest year for which statistics were available, indicate that the number of master's degrees awarded in engineering was roughly half (50.4 percent) the number of engineering bachelor's degrees awarded. This percentage has increased in recent decades. Some of those who receive master's degrees are foreign born, and some of them return to their native countries. The percentage of graduates with M.S. degrees varies widely by discipline; it is 40 percent for civil and environmental engineers, most of whom are licensed, and 64 percent for electrical and computer engineers, most of whom are not licensed. The percentage is lower for chemical and mechanical engineers: 23 and 27 percent, respectively.
- Data from several exam administrations in Texas indicate that about 40 percent of PE examinees had an advanced degree at the time of examination. Some of these advanced degrees were in business.

Based on the available information, the estimated portion of current engineers who would have been required to attain additional education for initial licensure if the requirement were already in effect is about 60 percent or somewhat higher.

Will P.E. salaries be affected?

Salary survey information and an analysis of the survey data was provided by the National Society of Professional Engineers Licensure and Qualifications for Practice Committee. The salary survey data from a sample of about 12,000 professional engineers indicate that the median career-long salary differential between P.E.'s with a master's degree and P.E.'s with only a bachelor's degree is 5.5 percent over the course of a 30-year career. This translates to a 30-year increase in compensation of a present value of $75,000 if the spread between salaries does not increase over time with inflation and of $125,000 if the spread does increase with inflation.

Some engineers receive a compensation increase when they receive a P.E. license. In cases where the additional engineering education requirements delay the time of licensure for one or more years, this additional compensation might be received later. After completing the additional engineering education and becoming licensed, engineers may have improved prospects of advancing to positions of greater responsibility and higher compensation, and they may have increased long-term employment security due to increased skills. Future salary differentials may or may not be consistent with historic data.

What does it cost to earn a master's degree in engineering?

The cost of obtaining a master's degree in engineering varies widely based on the institution, delivery method, and program. Many conventional master's engineering programs that require a thesis may take an average of 18 months as full-time students in residence at a university. Project and course-only master's degrees, as well as accelerated "executive" M.S. degrees, are becoming more common; full-time students can typically complete them in one year. High-quality graduate engineering distance-learning options are now available in most engineering disciplines, allowing an engineer intern to take one course at a time and obtain a master's degree while working full time. Costs for tuition, fees, and books for 30 credits of graduate engineering education by distance learning are currently in the range of $18,000 and up. Costs for attendance at a university with living expenses included are in the range of $20,000–25,000+ per year.

Who will bear the cost of the additional education?

The cost of additional engineering education may be borne by engineers early in their careers, when earning power and available assets are limited. The cost may be partially offset by scholarship grants for some engineers or by contributions from some employers.

Engineers' employers will also experience an economic impact, either through higher salaries or through employers' partial contributions to employees' cost of education, or both. Many employers currently share in the cost of tuition for some employees. These contributions may continue at current levels or may be reduced as demand increases, perhaps placing more of the burden on the individual. Engineering employers will have to adopt appropriate policies to deal with the possibility of losing an engineer to a competitor or other employment following the employer's sharing in the investment in additional engineering education costs.

In some engineering disciplines, compensation for engineers with master's degrees is significantly higher in industry than is the case in the "built environment." Some perceive there to be an associated risk that engineers with master's degrees will move away from the built environment to industry.

Accurately estimating the national economic impact of this change in the engineering profession would require far more resources than are available to the Engineering Education Task Force. Taking a simplistic approach with the information and resources currently available, one might estimate based on historical data that salary levels for 60 percent of engineers might increase an average of 5.5 percent

over the course of their careers, resulting in a ballpark estimate of the overall impact on the cost of engineering services in a range of 3 to 4 percent. This is the cost to be weighed against the subjective benefit of a more qualified professional engineering workforce and improved protection of public health, safety, and welfare resulting from engineers' increased knowledge and skills.

Alternatives to the Master's or Equivalent Requirement

As mentioned in the introduction to this paper, this section addresses the Southern Zone resolution's request for alternatives to the current additional education requirement. Two things to note are that an EAC/ABET engineering bachelor's degree is assumed to be a prerequisite in all of the alternatives and that the amount of hours and years mentioned below are merely suggestions and would need to be analyzed if the Council decides to move in one of these directions.

During the discussions about what alternatives to present in this analysis, the task force deliberated on whether to include rescission of language about the additional education requirement that the Council voted to add in the *Model Law* and *Model Rules* in 2006. A motion was made to accept all of the alternatives listed below, including one about rescinding the current definition. A motion was then made to amend the original motion by removing "rescission" as an alternative. The amendment passed by a 6:5 vote of the task force members; the nonvoting society resources took a straw poll vote and were equally split. The task force then voted on the amended motion to present the following alternatives as shown below. The amended motion passed by a 7:2 vote.

What the task force presents here is a list and not an analysis of the viability or equivalency of the items in the list. Just as the master's or equivalent has been researched and developed over a number of years, these alternatives would need to be further studied and defined in the future.

A. Continuing education between the FE and PE exams

Similar to the continuing education required in the *Model Law* for a P.E. to maintain a license, individuals who are beginning their engineering career should also be expected to continue their education. During the period in between taking the FE and PE exams, the candidate would be required to take courses totaling 150 contact hours (approximately 10 college credit hours) in areas germane to the applicant's area of practice. As with the present additional education requirement, criteria should be developed that would allow either credit or noncredit courses to be accepted. In its discussions, the task force envisioned that the contact hours were to have more rigor and assessment than most jurisdictions' requirements for a professional development hour. The clearinghouse function in this alternative would be to ensure that the provider and the coursework were of the rigor and assessment appropriate in advancing the applicant's ability to practice as a professional. The hours taken by the applicant should supplement the professional experiences gained during 4 years of professional practice.

B. Continuing education between the FE and PE exams with mentoring

This alternative includes all of Alternative A described above, plus the implementation of a structured mentoring program that would assure the quality of the professional experience. This could be a program similar to Canadian, Australian, and architecture programs.

For example, the architects have developed an intern development program that requires an architectural intern to have two mentors who are registered architects; one is the intern's supervisor and the other is selected by the intern. Specific professional categories that apply to the work environment are identified. The intern is mentored for 700 hours over 3 years and must submit documentation along the way on what he or she has covered.

C. Continuing education between the FE and PE exams with 6 years' experience

This alternative includes all of Alternative A described above, except that the hours taken by the applicant should supplement the professional experiences gained during 6 years of professional practice.

D. Master professional engineer

This alternative is a market-driven approach where an individual's knowledge in a specific discipline would be enhanced by additional education. The idea of a master professional engineer is consistent with what is done in the United Kingdom with the chartered engineer designation. In the United States, the master professional engineer concept is similar to that of the structural engineer in discipline-specific title act states. Most individuals who pursue the discipline of structural engineering will major in civil engineering with an emphasis in structural engineering. They then go on to graduate school to specialize in structural and get a master's degree either in structural or civil engineering. The master professional engineer license would be available only to those choosing the additional education path, but it could be broadened to any engineering discipline offering a master's program.

In this alternative, the P.E. licensing requirements with regard to education would revert to those in effect prior to the 2006 change to the *Model Law*, i.e., an EAC/ABET bachelor's degree and 4 years of experience.

APPENDIX

Southern Zone Resolution Passed by NCEES at the 2008 Annual Meeting

Concerning the bachelor of engineering degree plus thirty credit hours (B+30) as a requirement for engineering licensure

WHEREAS, Some have expressed support of the concept of additional engineering education for all engineers (not just those who choose the path to professional licensure); and

WHEREAS, Some believe that the educational community will adapt to teaching students the fundamental body of knowledge needed to be entry-level engineers in the profession; and

WHEREAS, Some believe that technology allows for greater efficiency in analyzing and solving technical problems, using less classroom and study time than at previous times; and

WHEREAS, The B+30 concept, as currently constructed, only impacts the engineers who become licensed; and

WHEREAS, Some contend that the engineering licensure process should not be compared to other professions; and

WHEREAS, Some question the strength of the correlation between credit hours required for the bachelor's degree and the competency of entry-level engineers via items such as lower FE/PE pass rates, the production of less competent practicing engineers, or other measures; and

WHEREAS, Some are concerned that placing additional curriculum requirements would adversely affect meeting a perceived shortage of licensed professional engineers in this country; and

WHEREAS, The B+30 concept has been opposed by some professional engineering organizations; and

WHEREAS, The B+30 concept may not be easily adopted into individual state statutes and, where adopted, some are concerned that comity between states will be put into jeopardy; and

WHEREAS, The 2007 NCEES resolution regarding a greater effort to include ABET in the goal of additional education has led to discussions between these organizations' leadership; therefore, be it

RESOLVED, That the NCEES president charge a committee/task force (and it is recommended that this committee/task force be the current B+30 Task Force) with the development of a written analysis of 1) the above listed points as appropriate; 2) the potential educational, professional, regulatory, and economic impact of B+30; and 3) any alternative solutions to the concept of additional education that have been or might be identified (including items such as additional experience before licensure in lieu of additional education, etc.). The purpose of these reports would be to allow NCEES jurisdictions to make better-informed decisions regarding B+30. It would be expected that this analysis could be completed by the time of the 2009 Interim Zone Meetings.

Developing Alaska's Engineering Workforce

Needs of the Profession and Responses by the Academy

UAF College of Engineering and Mines Executive Group

May 18 2010

Larry Bennett, P.E.
UAF Engineering Emeritus

"In a time of drastic change, it is the learners who inherit the future. The learned usually find themselves equipped to live in a world that no longer exists." -- Eric Hoffer, self-taught social philosopher

A quick outline

- The Engineer of 2020
- Historical Context
- Proposals and Positions
- What does it mean for UAF Engineering?

Some alphabet soup ...

- NAE
  - National Academy of Engineering
- NCEES
  - National Council of Examiners for Engineering and Surveying
- ABET
  - ABET Inc. (formerly Accreditation Board for Engineering and Technology)
- NSPE
  - National Society of Professional Engineers
- ASCE
  - American Society of Civil Engineers
- IEEE
  - Institute of Electrical and Electronics Engineers
- ACEC
  - American Council of Engineering Companies

The Engineer of 2020 (Tietjen, ABET, 2007, borrowed from NAE)

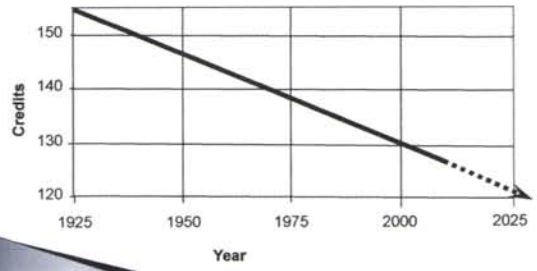
- Strong analytical skills
- Practical ingenuity
- Creativity
- Strong communication skills
- Understanding business and management principles

Engineer of 2020, con'd

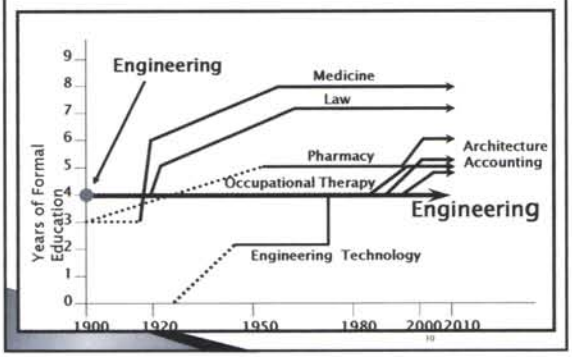
- Understanding the principles of leadership
- High ethical standards
- Strong sense of professionalism
- Dynamism, agility, resilience, flexibility
- Lifelong learner

- What should be the academy's roles in preparing these engineers and supporting them as they live their professional lives?

A Concern?



A Century of Professional Preparation



Trends and Pressures

- Expanding knowledge base
- An increasingly complex world resulting in the need for greater specialized technical competence
- Addition of non-technical courses to the curriculum (ABET, core curriculum, etc)
- Decrease in BS credit hours

NCEES Recent History

- 2001 Engineering Licensure Qualifications Task Force Established
- 2005 Begins process of changing *Model Law*
- 2006 Adds language to *Model Law*

[educational requirement to qualify to take PE exam] Graduation with a bachelor of science degree from an engineering program of four years or more accredited by EAC/ABET, or equivalent, **plus 30 additional credits from an approved course provider(s) in upper-level undergraduate or graduate-level coursework in professional practice and/or technical topic areas.** The additional education requirements would be implemented no sooner than 2010.

NCEES, con'd

- 2008 – Bachelors Plus 30 Task Force Established
- 2009 – Reaffirms basic position; changes some words
- 2010 – Begins exploring alternatives

Other history, quickly

- NAE (Educating the Engineer of 2020 (2005)) ***"It is evident that the exploding body of science and engineering knowledge cannot be accommodated within the context of the traditional four year baccalaureate degree."***
- ***"The B.S. degree should be considered as a preengineering or 'engineer in training' degree. Engineering programs should be accredited at both the B.S. and M.S. levels so that the M.S. degree can be recognized as the engineering 'professional' degree."***

NSPE

- NSPE (2002) ***"With the continuing rapid expansion of knowledge required to practice . . . , NSPE believes that additional engineering education, beyond the four year ABET/EAC degree, will be required in order to meet the formal academic preparation necessary for the practice of engineering at the professional level (licensure) in the 21st century. "***

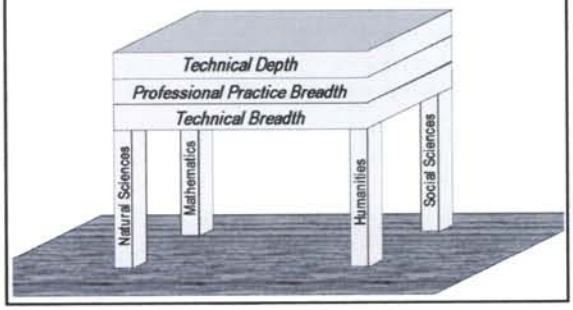
ASCE

- ASCE (1998, rev 2007) Policy Statement (PS) 465—Academic Prerequisites for Licensure and Professional Practice ... "...supports the attainment of a **body of knowledge** (BOK) for entry into the practice of civil engineering at the professional level... accomplished through the adoption of appropriate engineering education and experience requirements as a **prerequisite for licensure**."

ASCE, con'd

- ASCE (2004) – BOK1 defined 15 outcomes
- (2008) – BOK2 defined 24 outcomes
- (2005) +30 semester credits of acceptable upper-level undergraduate or graduate courses in **professional practice or technical topic areas**. The +30 program does not have to lead to a master's degree.

BOK FOR LEARNED PROFESSIONS



Body of Knowledge

- SWEBOK
- EnvE BOK
- CE BOK

***Knowledge, skills,* & *attitudes* necessary to ENTER into the practice of civil engineering at the professional level.**

BOK Outcome Titles

Technical

5. Materials science
6. Mechanics
7. Experiments
8. Problem recognition & solving
9. Design
10. Sustainability
11. Contemporary/ Historical issues
12. Risk & uncertainty
13. Project management
14. Breadth in CE areas
15. TECHNICAL DEPTH

Professional

16. Communication
17. Public policy
18. Business & public administration
19. Globalization
20. Leadership
21. Teamwork
22. Attitudes
23. Lifelong learning
24. Professional & ethical responsibility

Foundational

1. Mathematics
2. Natural sciences
3. Humanities
4. Social sciences

Finally, the gist of all this …

What do the Model Law/Rules say as of now?

First, they are effective no earlier than January 1, 2020 in any licensure jurisdiction.

They still require a combination of education, experience and examination.

National Council of Examiners for Engineering and Surveying

To Be an Engineer Intern (EI) --

B^{ABET} + FE Exam

or

B + M^{ABET} + FE Exam

Model Law Section 130.10 (2020)

21

National Council of Examiners for Engineering and Surveying

To Take Professional Engineer (PE) Exam, you must be Engineer Intern (EI) and

M^{ENRG} + Experience

or

M^{ABET} + Experience

or

"+30" + Experience

24

National Council of Examiners for Engineering and Surveying

And what is the +30 ?

- 30 credits of courses equivalent in rigor to upper-level undergraduate or graduate courses.
- At least 15 credits in engineering (ALL 30 credits can be in engineering!).
- Remainder of credits can include science, math, and/or professional practice topics (such as business, communications, contract law, management, ethics, public policy, & quality control)
- From "approved course providers."

25

National Council of Examiners for Engineering and Surveying

Who are "approved course providers?"

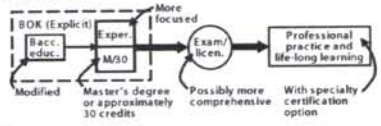
- Institution with EAC/ABET programs.
- Institution/organization accredited by an NCEES-approved accrediting body.
- Institution/organization that offers specifically approved courses approved by an NCEES-approved accrediting body.

26

Now and later ...

Today

Tomorrow



Arguments Against This Change

High school students are better prepared.
BS curriculum is already too rigorous.
Modern teaching resources promote efficiency.
Shortage of engineers will be exacerbated.
Costs will increase (for individual and/or employer).
Experience is key . . . not more education.
ABET can/will/should take care of this.
Life long learning is the answer.
Advances in the cognitive science will solve problem
Only licensed engineers are affected by solution.

28

Arguments For This Change

Increased complexity of professional practice has increased BOK to enter profession.
Globalization requires additional knowledge, skills & attitudes to compete in the global market place.
Expanding BOK requires additional education to protect public's health, safety, & welfare.
Other proposed solutions (to date) are not viable (e.g., ABET, experience, etc.).

29

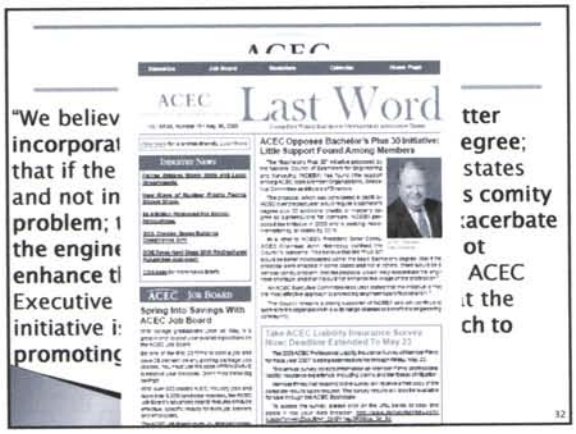
Top Ten Misconceptions

~~10. Implementation will occur instantly.~~
~~9. Current P.E.'s must obtain a "M or 30."~~
~~8. The goal is to eliminate the 4-year degree.~~
~~7. Education is more important than~~ Experience.
~~6. All undergraduates must pursue licensure.~~
~~5. "M/30" should follow directly after "B."~~
~~4. Degrees (not knowledge) are the key.~~
~~3. "M" means traditional MS degree with thesis.~~
~~2. The current BS will not be changed.~~
~~1. We are working for faculty job security.~~

30

Other voices …

- **IEEE-USA** (2009- *"IEEE-USA endorses the need for engineering education to evolve to meet the increasing technical and professional requirements …"*
- *"…neither supports nor opposes the National Council of Examiners for Engineering and Surveying (NCEES) decision to recommend that engineers who have successfully completed accredited baccalaureate-degree educational programs be required to take 30 additional hours of engineering education to become licensed, beginning in 2020."*



This just in …

- April 2010 -- NSPE Board of Directors adopted a new position statement advocating that certain **engineering education outcomes** be attained by engineers of all disciplines who become **licensed professional engineers.**

1. Apply principles of leadership;
2. Account for risk and uncertainty in the solution of engineering problems;
3. Apply principles of project management;
4. Explain where and how public policy is developed and how it influences engineering practice;
5. Explain business concepts applicable to engineering practice; and
6. Apply principles of sustainability to the design and evaluation of engineering systems.

doesn't specify whether these outcomes should be required in baccalaureate education or in graduate programs; it simply advocates that these outcomes be attained by the time of licensure. The "how" has been left to ABET and NCEES …

So what?

- Sure, change in licensure is coming, but …
- Even without the "BS+30" movement, university programs still need to respond to changing needs and conditions.
- What do employers think they need?
- What should UAF Engineering be doing now?

2

Stakeholder Needs

This task consisted of a series of three luncheon meetings held in Anchorage, Juneau and Fairbanks on June 1, 2 and 3, 2010. To the meetings were invited key engineering managers, some of whom would be participating in the up-coming June 22 roundtable. The purpose was to hold pre-roundtable discussions about training needs for working engineers, in part as input for the roundtable. The dates, venues, and participants, in addition to the writer, were as follows:

Anchorage, June 1, Southside Bistro

Dick Cattanach
Randy Kinney
Dale Nelson
Steve Shrader
Lance Wilber

Juneau, June 2, Canton House

Brian Goettler
Colleen Ivaniszek
Kate Mickelson
Rich Pratt
Ricardo Rodriguez
Vic Winters

Fairbanks, June 3, Zach's at Sophie Station

Janet Brown
Pat Crisenbery
Ron Gebhart
Lon Krol
Jim Loftus
Jeff Putnam
Frank Richards
Paul Schneider
Steve Titus

To provide structure to the discussions, a brief questionnaire was given to each participant. Discussion then followed, based on responses to the questionnaire. A copy of one such questionnaire is attached.

Although responses to the questionnaire were varied as well as difficult to summarize because of the open-ended nature of the questions, some patterns emerged. Attached are 1) two lists of those needs identified by at least two participants for younger and older engineers, and 2) two graphs with similar data but limited to high priority needs.

For younger engineers, the results were similar to responses from previous surveys, with communication identified as the highest priority need, followed by environmental laws, regulations and permitting, various technical specialties, and project management. Attached is a list of needed training in technical areas.

The results for older engineers suggested that mentoring of younger engineers by more senior persons was the area in which training is most needed. Though different from results of earlier studies, this need was confirmed in discussions at the later roundtable, and it thus becomes a need that must be addressed. Other high priority training needs for older engineers were leadership and supervision, project management, environmental law, regulations and processes, scheduling and schedule management, and communication.

These results were presented at the opening session of the June 22 roundtable, as will be seen in the report from that meeting.

Anchorage Luncheon June 1, 2010

Training Needs of Working Engineers

It is likely that your employees have some unmet needs concerning what they should know to do their jobs well. There are probably many reasons –

- An expanding body of knowledge, advancing technology
- A more complicated world, more complex projects, more demands on engineering services
- Fewer credits taken as undergraduates
- Changing job responsibilities
- An involved public
- Changing regulatory environment
- Likelihood of the adoption of the BS+30 requirement, stipulating 30 credits beyond the bachelors degree as a prerequisite for professional licensing
- Educational requirements for continued professional licensing
- The need for additional depth knowledge (in the technical specialty) and breadth knowledge (in both technical and non-technical areas)

Please list the four or five most important unmet training needs of your younger, as-yet-unregistered engineers. Try to be specific: If "communication," what kind and for what purpose? Highlight the top one or two needs.

Please list the four or five most important unmet training needs of your more senior, probably registered engineers. Highlight the top one or two needs.

Training needs of younger engineers
from June 1 - 3, 2010 luncheon meetings

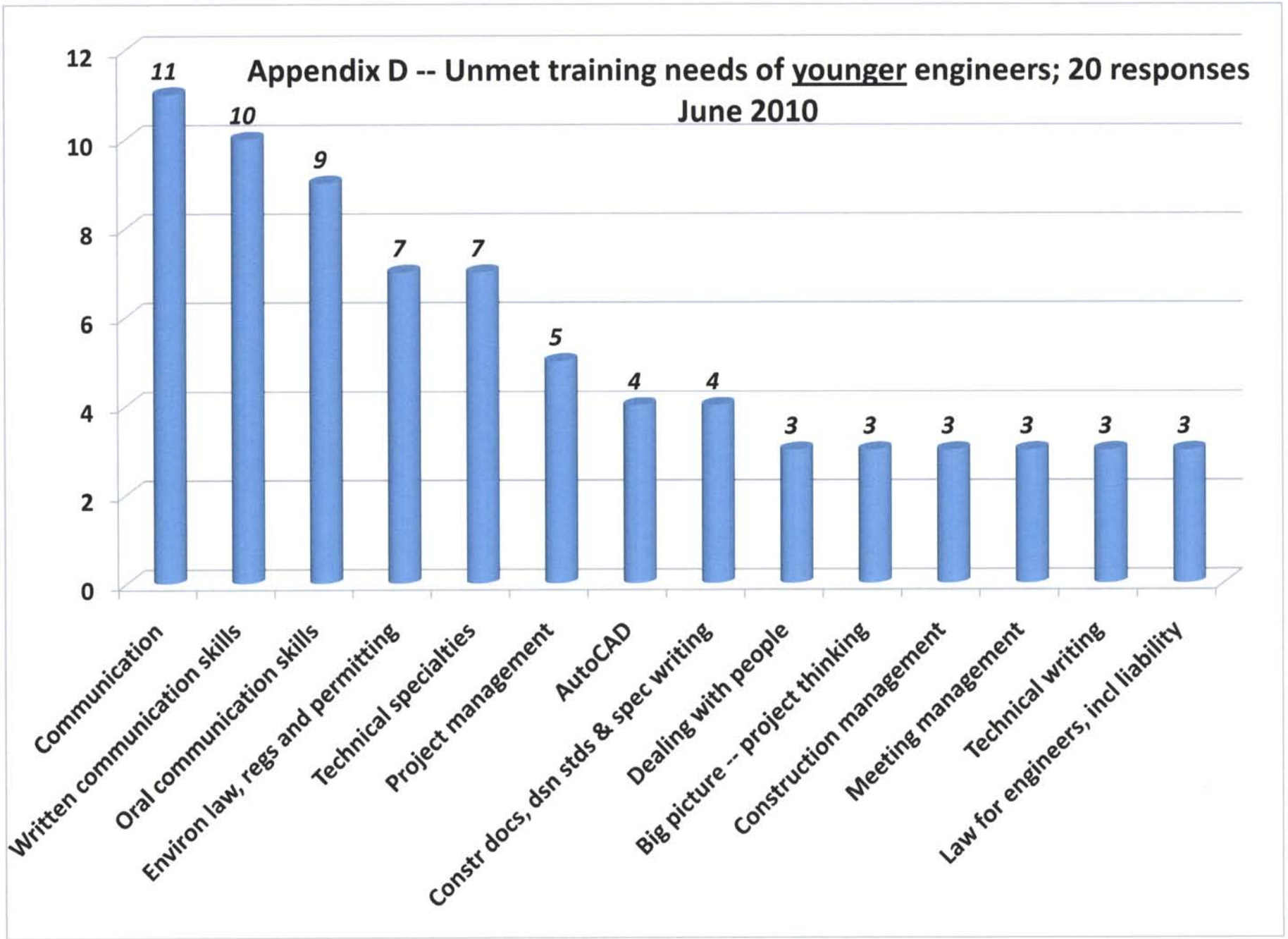
Communication	11
Written communication skills	10
Oral communication skills	9
Environ law, regs and permitting	7
Technical specialties	7
Project management	5
AutoCAD	4
Constr docs, dsn stds & spec writing	4
Dealing with people	3
Big picture -- project thinking	3
Construction management	3
Meeting management	3
Technical writing	3
Law for engineers, incl liability	3
Engineering economics; life cycle costing	2
QA/QC	2
LEED; green build	2
Safety	2
Regulations; regulatory framework	2
Multi-tasking	2

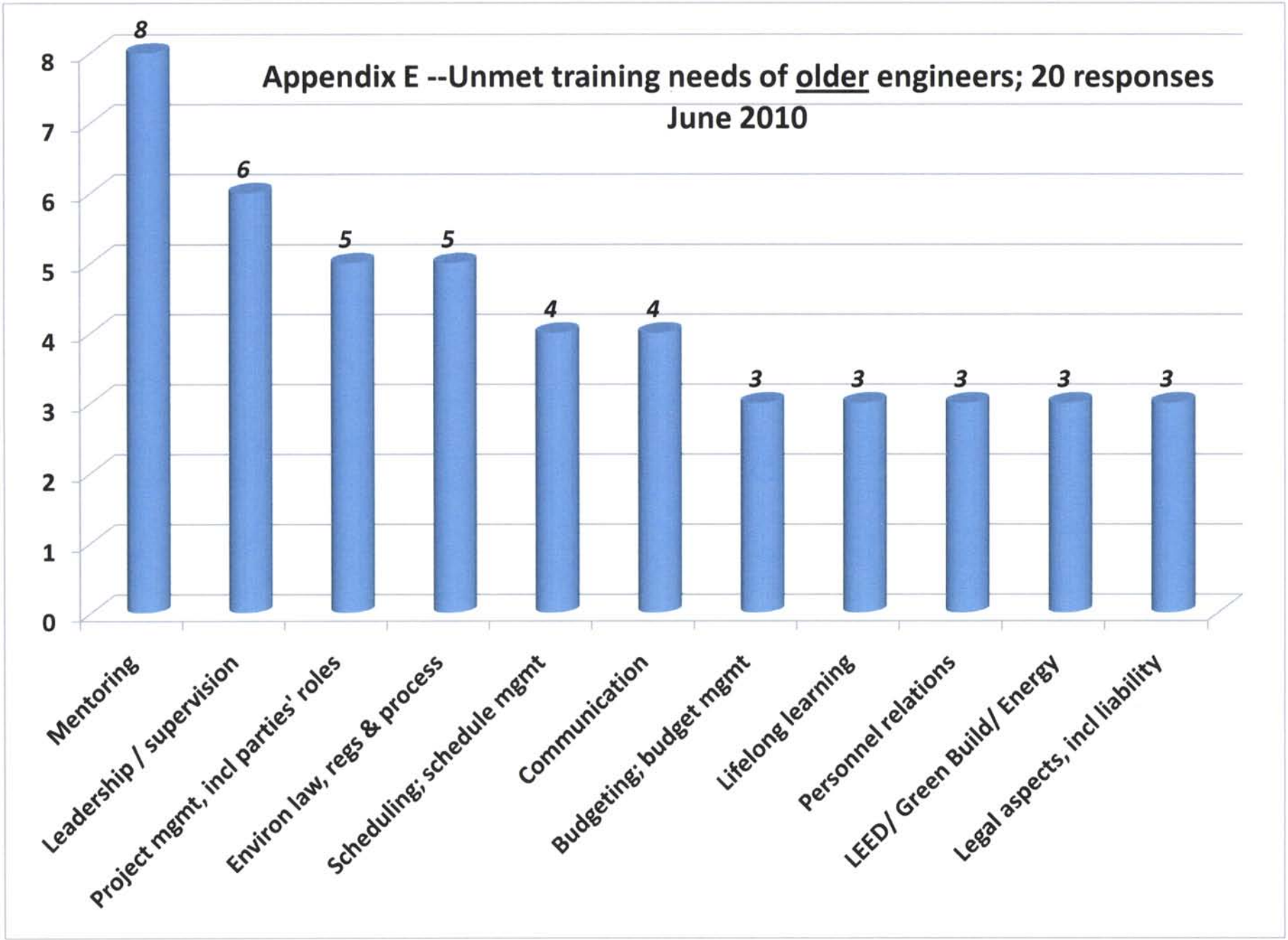
Technical training topics identified at luncheon meetings

- Grading
- Drainage
- Bridge design details
- HVAC
- EE
- Water
- Timber
- Tidal
- Surveying

Training needs of older engineers
from June 1 - 3, 2010 luncheon meetings

Mentoring	8
Leadership / supervision	6
Project mgmt, incl parties' roles	5
Environ law, regs & process	5
Scheduling; schedule mgmt	4
Communication	4
Budgeting; budget mgmt	3
Lifelong learning	3
Personnel relations	3
LEED/ Green Build/ Energy	3
Legal aspects, incl liability	3
Risk management	2
Decision making	2
Legal aspects	2
Ethics	2
Liability	2
Contract management	2
Time management	2
Working in regulatory environment	2
Public speaking	2
Business writing	2


Appendix D -- Unmet training needs of younger engineers; 20 responses
June 2010
12
10
8
6
4
2
0
11
10
9
7
7
5
4
4
3
3
3
3
3
3
Communication
Written communication skills
Oral communication skills
Environ law, regs and permitting
Technical specialties
Project management
AutoCAD
Constr docs, dsn stds & spec writing
Dealing with people
Big picture -- project thinking
Construction management
Meeting management
Technical writing
Law for engineers, incl liability


Appendix E --Unmet training needs of older engineers; 20 responses
June 2010
8
6
5
5
4
4
3
3
3
3
3
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1
2
3
4
5
6
7
8
Mentoring
Leadership / supervision
Project mgmt, incl parties' roles
Environ law, regs & process
Scheduling; schedule mgmt
Communication
Budgeting; budget mgmt
Lifelong learning
Personnel relations
LEED/ Green Build/ Energy
Legal aspects, incl liability

Summary of Survey of Construction Management
Graduate Certificate Course Takers
Spring 2008 through Spring 2010

A questionnaire was designed, using the survey instrument Survey Monkey™, to assess reactions of students who have taken at least one of the eleven courses given to date in the Construction Management Graduate Certificate Program, to determine the extent of their satisfaction, and to solicit suggestions for future courses and for otherwise improving the program. On July 22, 2010, a request was sent by e-mail to the 95 students whose e-mail addresses were available; those 95 were nearly all of the students who have registered for at least one class. Three requests were returned as unknown; thus, we conclude that 92 requests were received. Two reminder e-mails were sent subsequently – on July 29 and August 16. As of the close of the day on August 18, 2010, 57 surveys had been returned, for a return rate of 62% of the 92 requests.

Attached are a large stack of graphs and lists that summarize the Survey Monkey study. They are arranged as follows:

- Four graphs and one spreadsheet that summarize the quantitative questions about individual courses
- A set of graphs and lists for each of the 11 course. Note that these documents are presented with all information for one course, followed by all information for the next course, and so forth. By rearranging the papers, one could see the results for the first question for each of the 11 courses, followed by the results for the second question for each of the 11 courses, and so forth
- A set of graphs and lists summarizing general questions about the management of the courses and program

A quick summary of the quantitative results for the eleven courses is the following:

- 96% (107 of 111) said course content was very relevant or relevant to their job.
- 97% (106 of 109) said course content was very relevant or relevant to their personal professional growth.
- 88% (90 of 102) said the workload was appropriate for a one credit graduate course.

- 96% (103 of 107) were very satisfied or satisfied with the instructor and instructional methods.

The last set of responses indicates widespread satisfaction with the course presentations so far. 98% of respondents are very happy or happy with the twice-a-week schedule and the one-credit modular packaging. 98% find the time-of-year scheduling very convenient or convenient. 89% are very happy or happy with the 3:00 to 5:15 PM class schedule. 100% found the locations convenient and the facilities adequate. 83% did not think the video-style presentations were disruptive. 93% are very likely or likely to take at least one course within the next year, if the subject matter is appealing and the time and place are convenient.

Finally, perhaps the most satisfying result was the overall summary question: "Overall and all things considered, how positive was your experience with the construction management certificate program course(s) you have taken so far, on a scale of 1 to 5?" 93.5% of respondents rated their experience in the top two categories, with 50% checking the top category, very positive.

Survey and summary by
F. Lawrence Bennett, P.E.
BENNETT ENGINEERING
August 18, 2010

Summary and Evaluation of Construction Management Graduate Certificate Program Efforts to Date

This task was part of the on-going effort to provide up-to-date information about the construction management certificate program, its participants, and its courses, as one means of improving the content and presentation of old and new courses. The present effort involved compiling a list of students who have taken at least one course in the program and then surveying them to evaluate attitudes about relevancy of the course content, instructor effectiveness, and such housekeeping matters as facilities, scheduling, and interactive video transmission.

To date, eleven one-credit courses have been given since inception in spring 2008. Several courses have been given in multiple sections. The investigation revealed the names of 98 individuals who registered for at least one of the courses. Of those, 95 e-mail addresses were available. A listing of those e-mail addresses is included after this text.

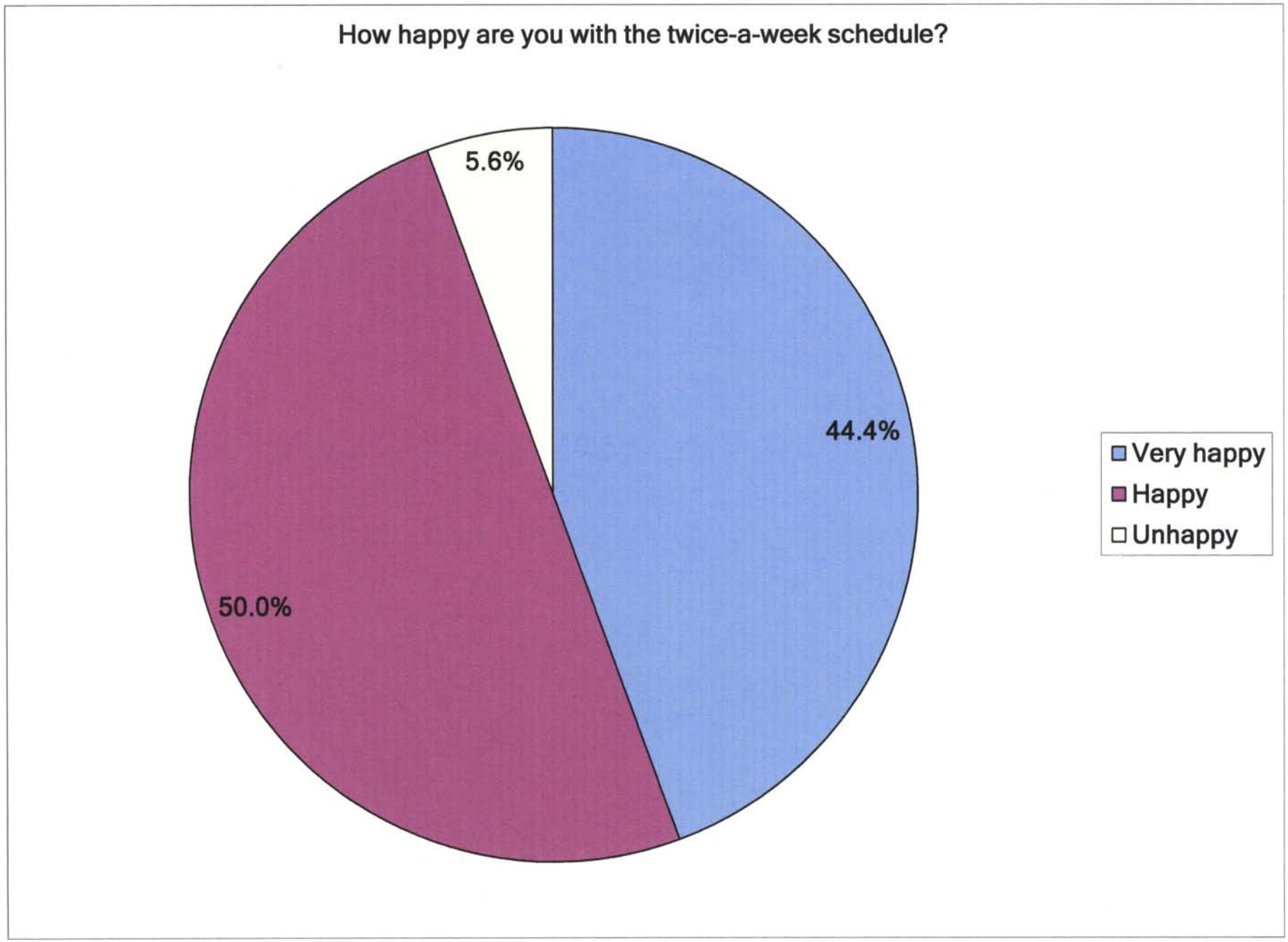
The evaluation was conducted using an Internet-based survey instrument called Survey Monkey.™ A hard copy of the questionnaire, which is available on-line, is included here. Each student was notified by an e-mail message that included a link to the questionnaire and was asked to complete the survey.

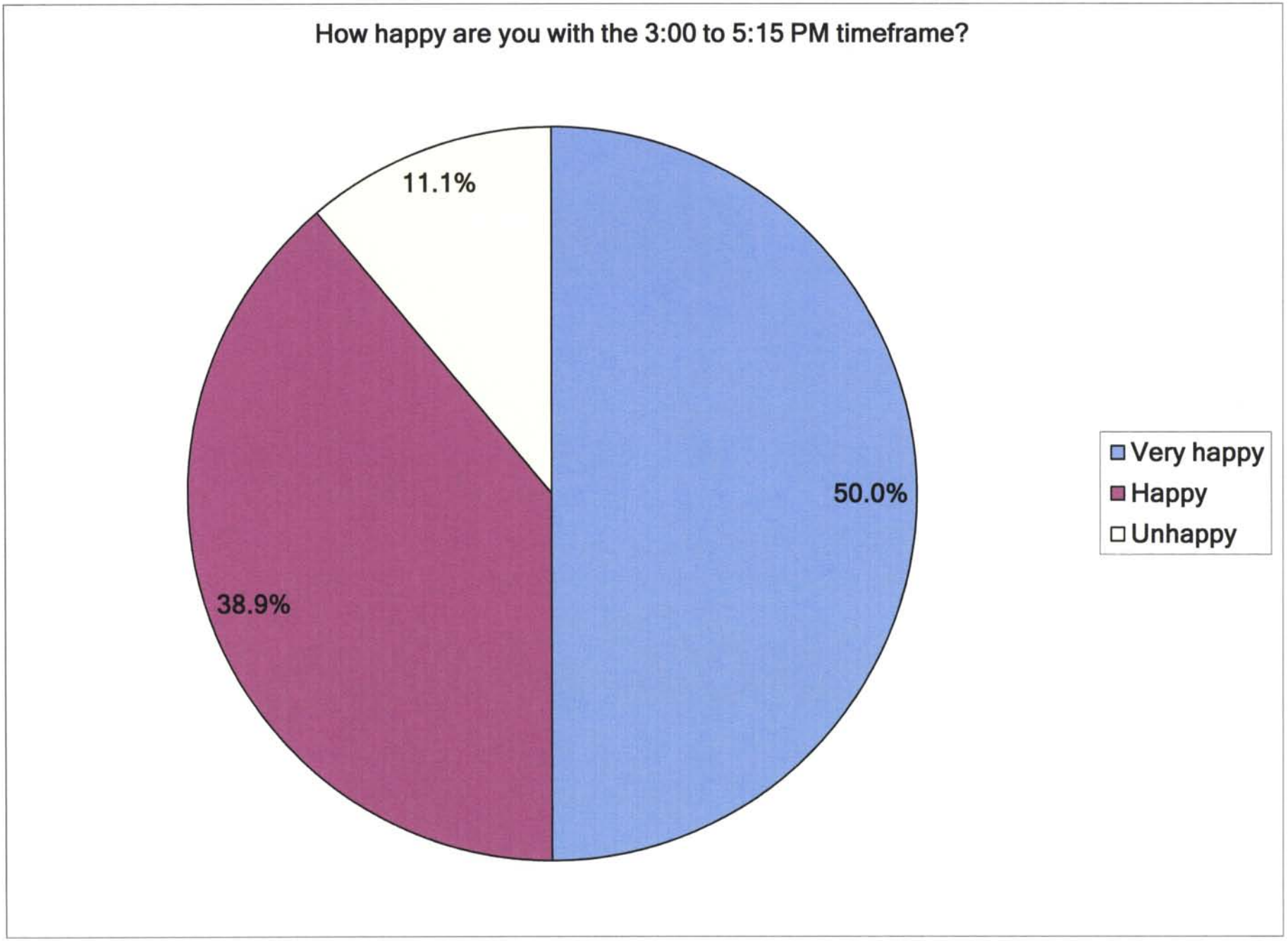
The 95 e-mail messages were sent on July 22, 2010. Ultimately three were returned as undeliverable. Thus, a total of 92 students should have received the request to participate in the survey. As of July 27, data from 23 responses have been received, for a 25% response rate early in the response period. Responses will be accepted for one month, until August 22, 2010, after which Survey Monkey will accept no further responses, if any are forthcoming.

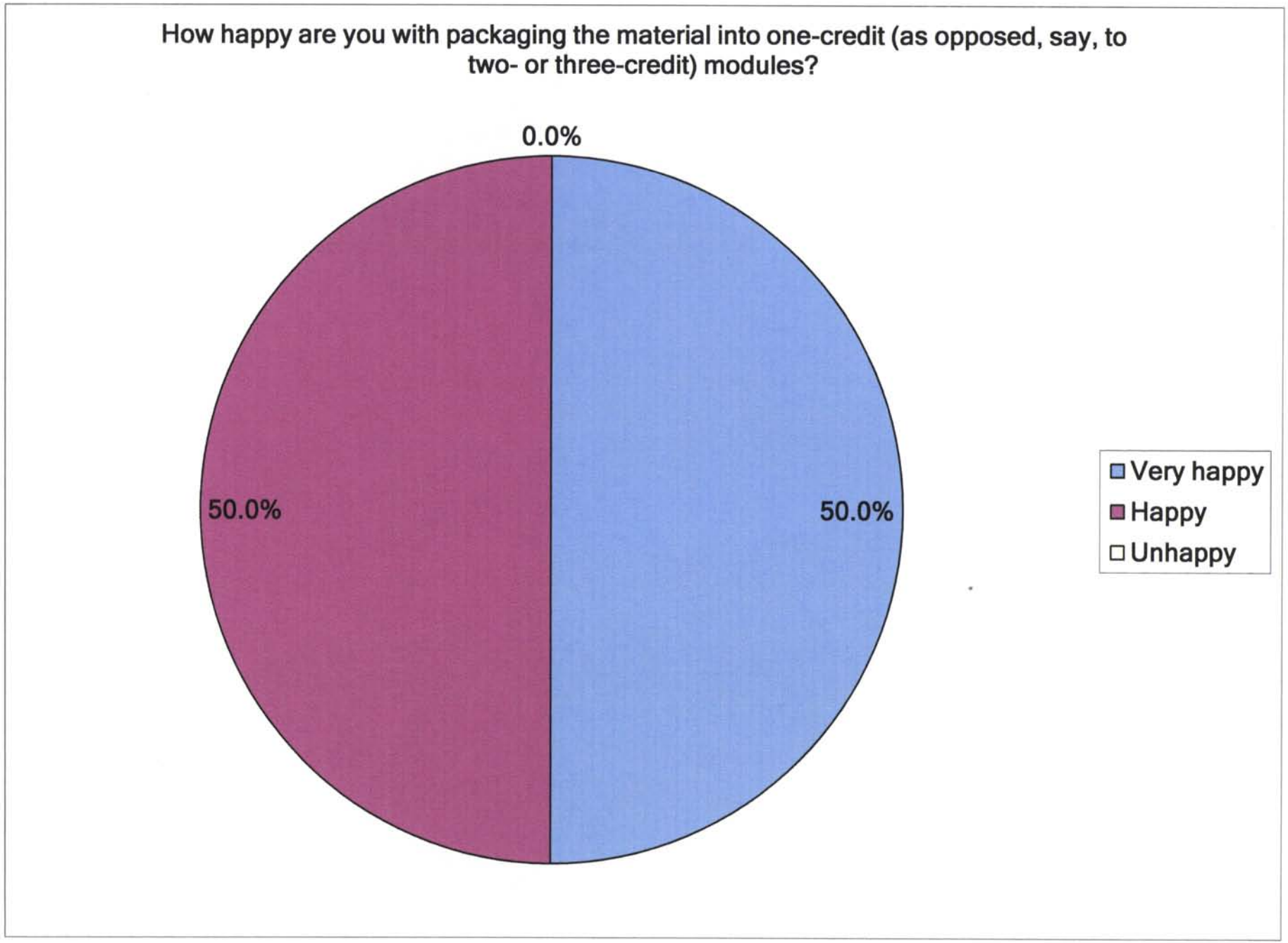
As can be seen on the questionnaire, questions were asked about each of the eleven courses and about the schedule, packaging (one-credit courses), location and facility, and time-of-year. An opportunity was also presented to give an overall evaluation, to offer comments, to suggest other courses, and to indicate the likelihood that the student would take another course.

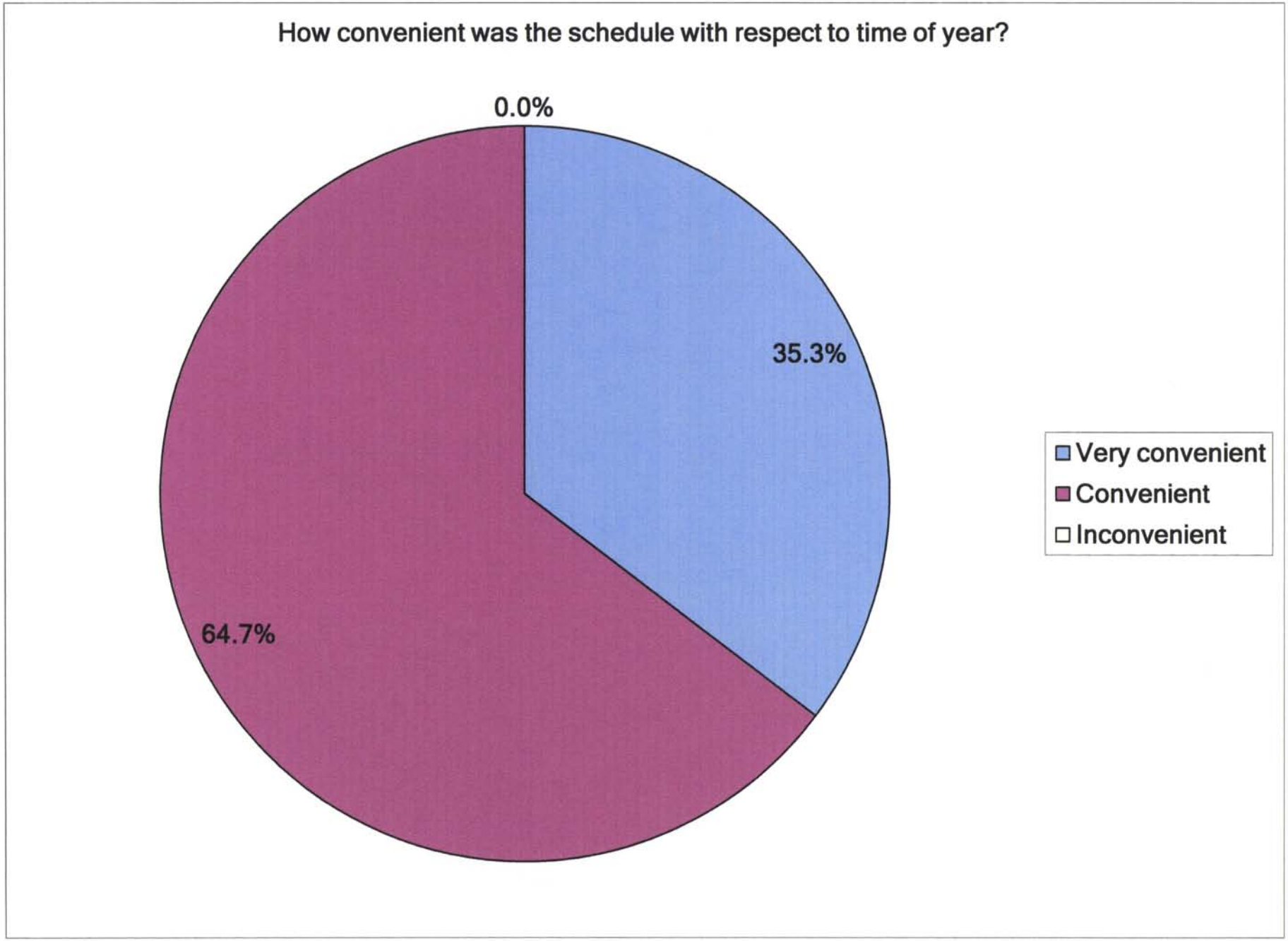
Pending additional returns, this report summarizes responses to date only for the latter part of the questionnaire, leaving until later a summary of data about satisfaction with the eleven courses. The general responses are overwhelmingly positive and indicate satisfaction with the program to date. There are also helpful suggestions for making the program even better.

On the pages following the questionnaire, charts summarizing those responses will be found. Also, lists of responses to the open-ended questions are given.


How happy are you with the twice-a-week schedule?
5.6%
44.4%
50.0%
Very happy
Happy
Unhappy


How happy are you with the 3:00 to 5:15 PM timeframe?
11.1%
50.0%
38.9%
Very happy
Happy
Unhappy


How happy are you with packaging the material into one-credit (as opposed, say, to two- or three-credit) modules?
0.0%
50.0%
50.0%
Very happy
Happy
Unhappy


How convenient was the schedule with respect to time of year?
0.0%
35.3%
64.7%
Very convenient
Convenient
Inconvenient

CM Program Course Survey

What time of year is best for you?

	Response Count
	17
answered question	17
skipped question	6

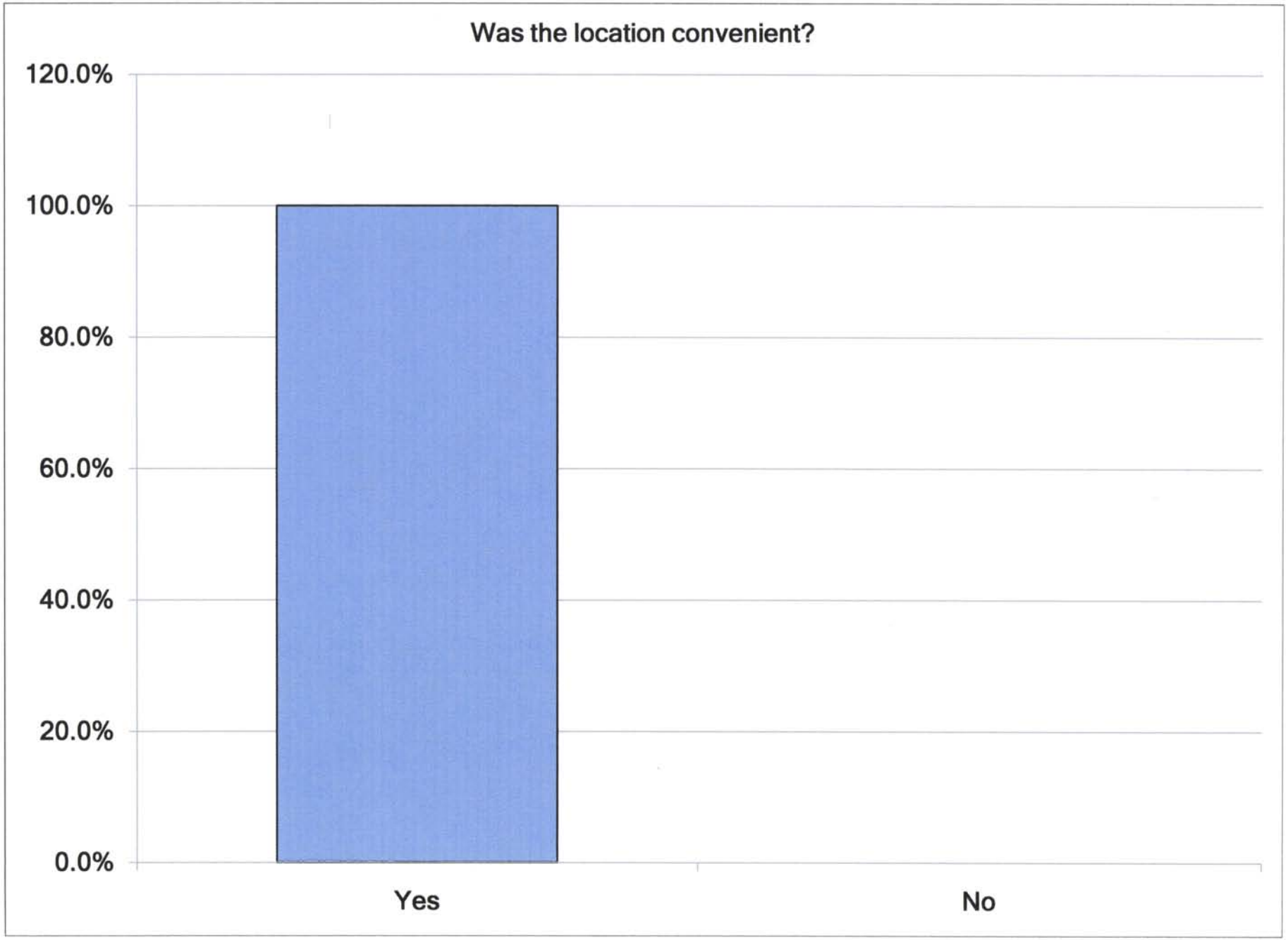
	Response Text	
1	Late fall. Early spring.	Jul 23, 2010 5:00 AM
2	Winter Nov thru March	Jul 23, 2010 2:37 PM
3	fall or spring	Jul 23, 2010 5:00 PM
4	Fall through Spring	Jul 23, 2010 5:22 PM
5	Winter	Jul 23, 2010 5:56 PM
6	Spring	Jul 23, 2010 5:59 PM
7	Feb - Mar and Oct to Nov will be good for me.	Jul 23, 2010 6:09 PM
8	spring and fall	Jul 23, 2010 6:54 PM
9	Winter	Jul 23, 2010 7:00 PM
10	Early Jan. thru mid-March or October/November.	Jul 23, 2010 8:01 PM
11	early winter	Jul 23, 2010 8:08 PM
12	November thru March, going into April get to be too late in the year.	Jul 24, 2010 5:32 PM
13	Winter	Jul 25, 2010 6:37 PM
14	Winter	Jul 26, 2010 2:52 PM
15	October, March, April	Jul 27, 2010 5:25 AM
16	Late fall through early spring	Jul 27, 2010 5:38 PM
17	We are very busy during the summer months with project and inspection related work. Thus, fall, winter, and early spring are best for courses.	Jul 27, 2010 6:00 PM

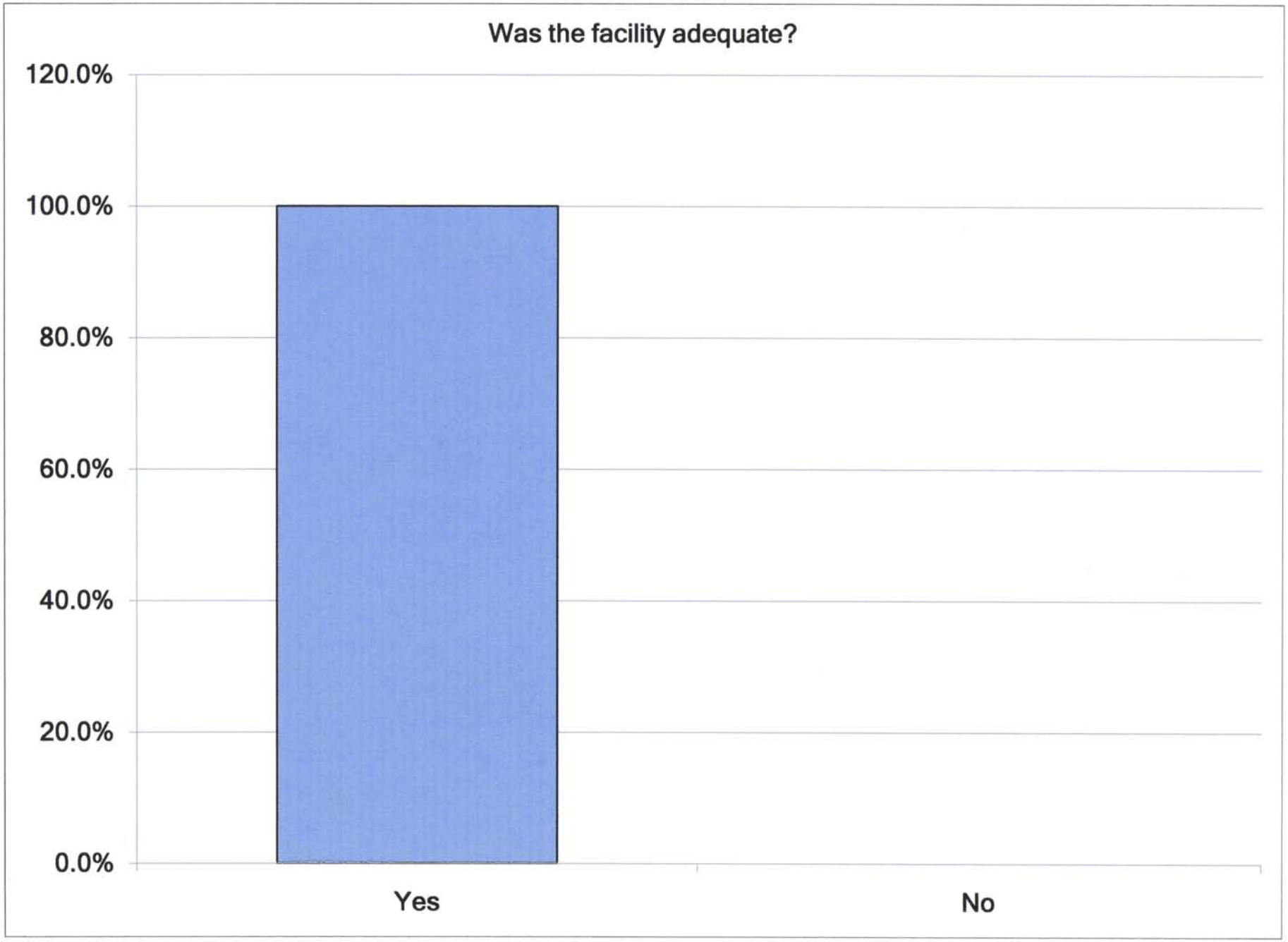
CM Program Course Survey

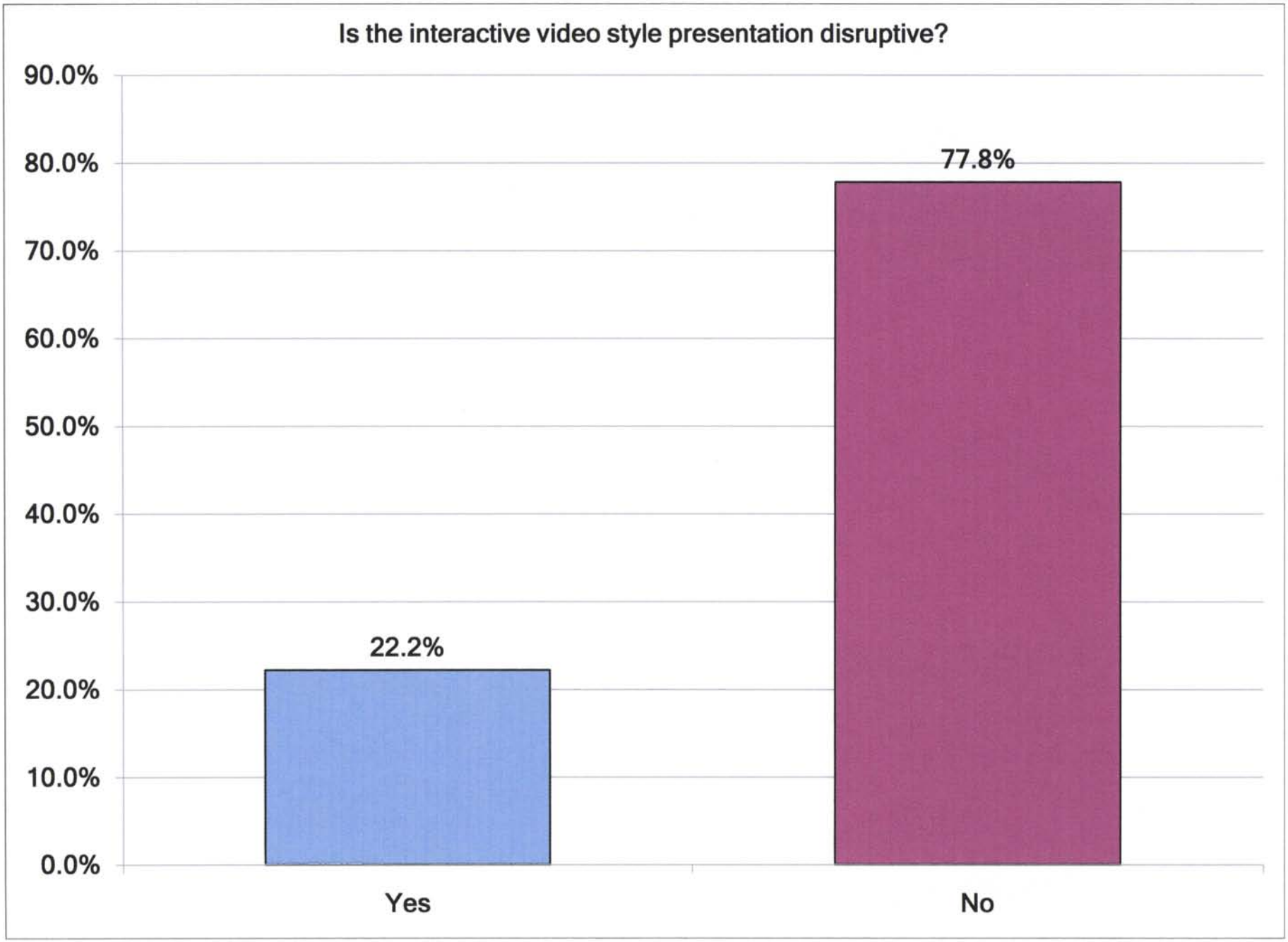
What times of the year should we avoid?

	Response Count
	17
answered question	17
skipped question	6

	Response Text	
1	All others.	Jul 23, 2010 5:00 AM
2	April thru Oct	Jul 23, 2010 2:37 PM
3	summer	Jul 23, 2010 5:00 PM
4	Summer	Jul 23, 2010 5:22 PM
5	Summer constuction season	Jul 23, 2010 5:56 PM
6	Summer	Jul 23, 2010 5:59 PM
7	Summary construction season and end of year holiday season.	Jul 23, 2010 6:09 PM
8	summer construction season	Jul 23, 2010 6:54 PM
9	Summer/Construction season.	Jul 23, 2010 7:00 PM
10	May, September, December Fairbanks is the most season-dependent place I have ever lived. When it's hunting season, everyone is gone. In May, everyone wants to get outside or is already out on their Construction sites.	Jul 23, 2010 8:01 PM
11	summer	Jul 23, 2010 8:08 PM
12	Thankgiving and Christmas weeks. would be nice to start mid November, so more courses could be taken in a given year.	Jul 24, 2010 5:32 PM
13	May, June, July, Aug	Jul 25, 2010 6:37 PM
14	construction season	Jul 26, 2010 2:52 PM
15	Summer, obviously	Jul 27, 2010 5:25 AM
16	Summer Construction - late spring through early fall.	Jul 27, 2010 5:38 PM
17	Summer	Jul 27, 2010 6:00 PM


Was the location convenient?
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
Yes
No


Was the facility adequate?
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
Yes
No


Is the interactive video style presentation disruptive?
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
22.2%
77.8%
Yes
No

CM Program Course Survey

Please add comments on schedule, location, facility, and the like.

	Response Count
	9
answered question	9
skipped question	14

	Response Text	
1	I appreciate the segmented class topics. The ability to pick and choose a one credit course allows me to manage what class I feel is the most time/commitment effective.	Jul 23, 2010 5:00 AM
2	Overall, interactive video style presentation was good but mildly disruptive due to technical issues (I think the issues had more to do with the facilities capabilities). Location of facility was convenient and the facility itself with the exception of the video conferencing issues was convenient as well. Timeframe was slightly disruptive to work scheule, but it was managable.	Jul 23, 2010 5:59 PM
3	None.	Jul 23, 2010 6:09 PM
4	See prior section concerning stretching the schedule a little to provide time for study and problem research.	Jul 23, 2010 6:54 PM
5	Caution with video presentation. Instructors must be more familiar with equipment to avoid disruptions.	Jul 23, 2010 7:00 PM
6	As all the participants are full time employees and many have families, please do not overlap the courses as this means the participant has class M T W & Th plus homework. Also, having a small gap between the classes, even if it's just means starting the next class on a Wednesday .vs. a Monday, would be helpful. This gives the student time to close-out and process the material from the previous class and mentally prepare for the next. Also, if we could get the reading material for the class ahead of time, this would be wonderful! Some classes have a lot of reading and it would be helpful to begin at least skimming this before the class. Repetition and practical application of the knowledge learned are the best ways to retain what has been taught.	Jul 23, 2010 8:01 PM
7	Please start earlier in the winter.	Jul 24, 2010 5:32 PM
8	In regard to question 9. The interactive video was occasionally disruptive when a microphone wasn't set up properly or the like.	Jul 26, 2010 8:08 AM
9	All things considered, this is an excellent system for delivering meaningful educational opportunities around the state. I suspect it could be effectively spread to other states if there is a need.	Jul 27, 2010 6:00 PM

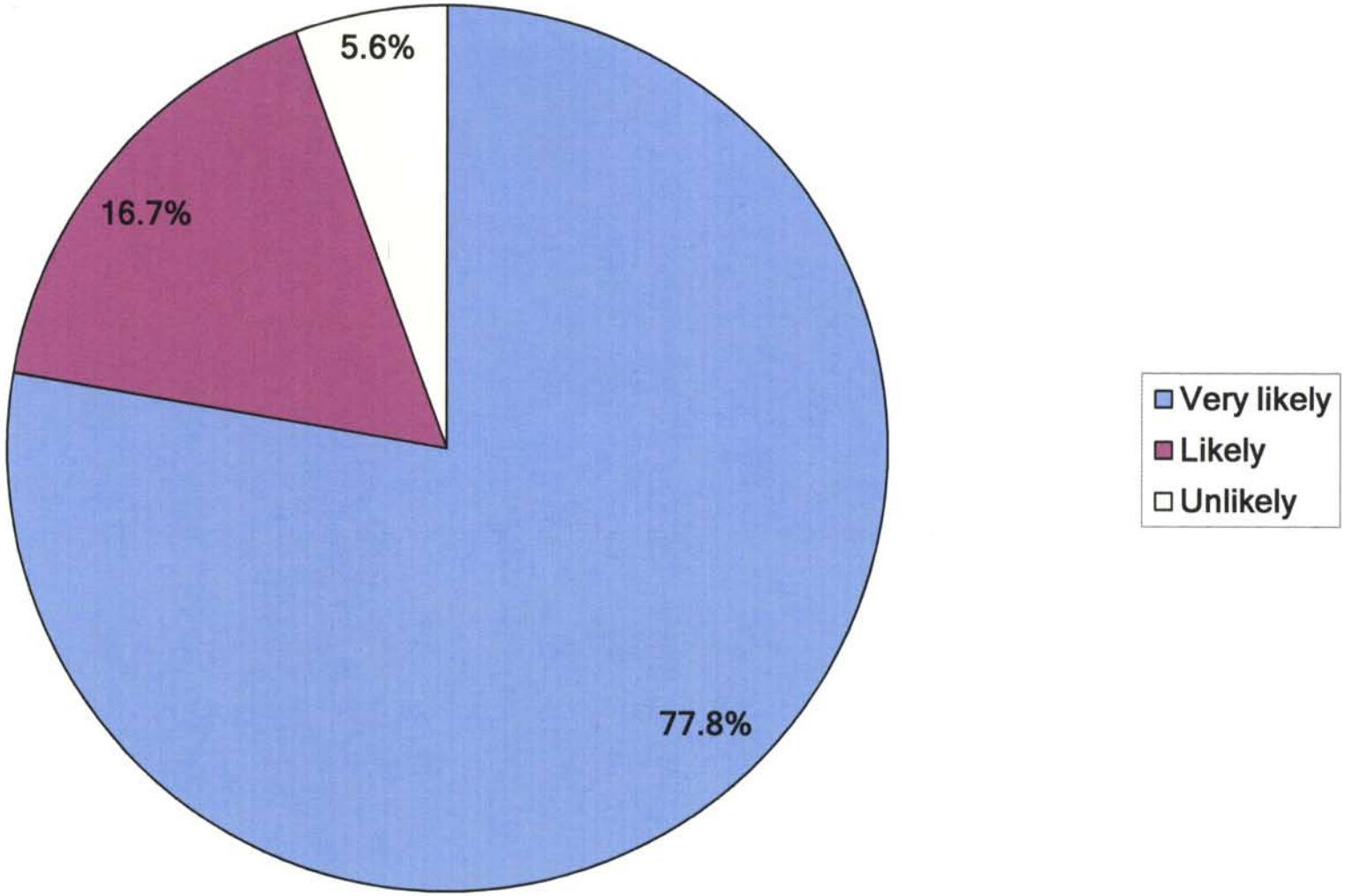
CM Program Course Survey

What course topics should we plan to give over the next few years?

	Response Count
	12
answered question	12
skipped question	11

	Response Text	
1	Managing Change. I was unable to take that course last spring due to a scheduling conference.	Jul 23, 2010 5:02 AM
2	Managing Multiple Projects Professional Communication Methods	Jul 23, 2010 2:38 PM
3	Claims, public interaction, contracts	Jul 23, 2010 5:02 PM
4	Alternate Procurement Methods, Arctic Engineering	Jul 23, 2010 5:22 PM
5	More in depth GPS surveying. How to use CPM in contract delay disputes.	Jul 23, 2010 6:49 PM
6	Actually, the list of various topics presented so far looks great. My problem is that they are not offered in S.E. AK as often as Anchorage or Fairbanks.	Jul 23, 2010 6:59 PM
7	- Collaborative Leadership for Engineering and Technical Projects and Programs	Jul 23, 2010 7:02 PM
8	same	Jul 23, 2010 8:08 PM
9	I will have to think about this and get back with you. This spring I had some ideas, but they have faded from memory right now.	Jul 23, 2010 8:25 PM
10	How to deal with personalities (they make the project succeed or fail). how to survive in a political world. Writing/analyzing change orders How to write a successful request for proposal. Advanced scheduling Advanced boot camp	Jul 24, 2010 5:35 PM
11	Faults and failures in construction. The gray area of changing/not changing PE's stamped drawing.	Jul 27, 2010 5:26 AM
12	Construction Claim Case Studies - may change over a few years. Construction Negotiation - any course in negotiation is good.	Jul 27, 2010 5:40 PM

How likely is it that you will take at least one course in the program during the next year, if its contents appeal and it is offered at a convenient time and place?

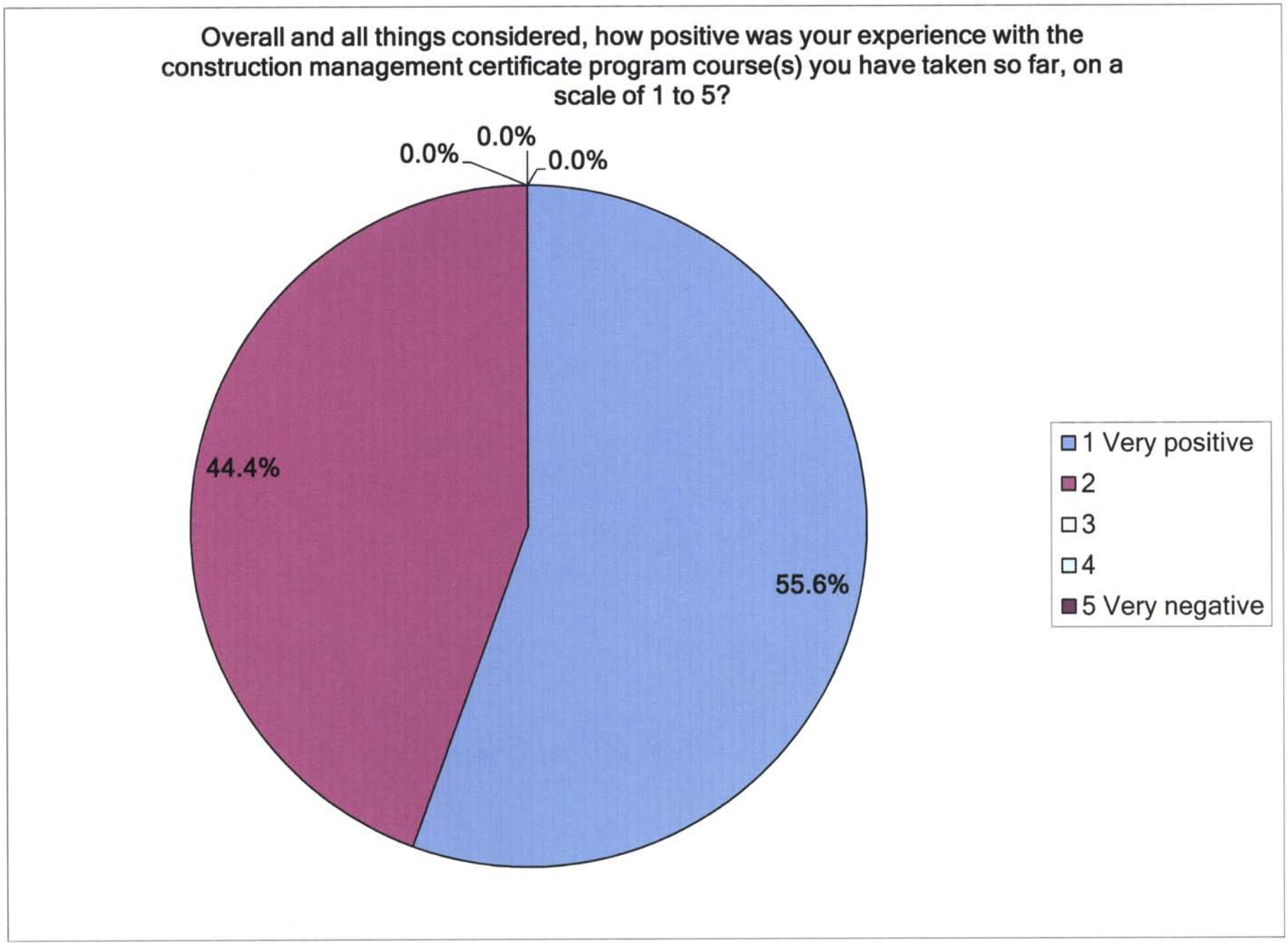


CM Program Course Survey

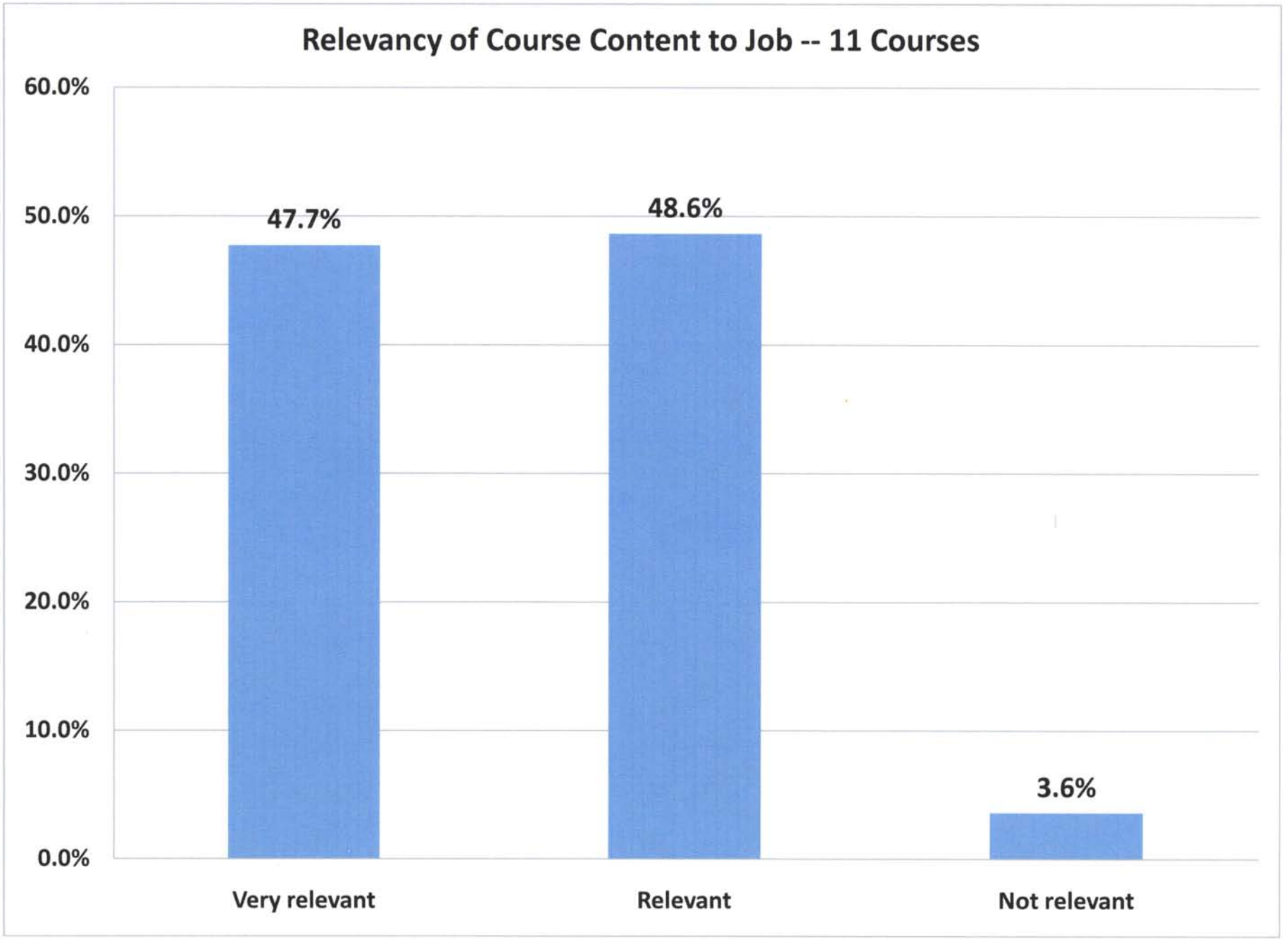
Please leave any other comments and suggestions in the box below.

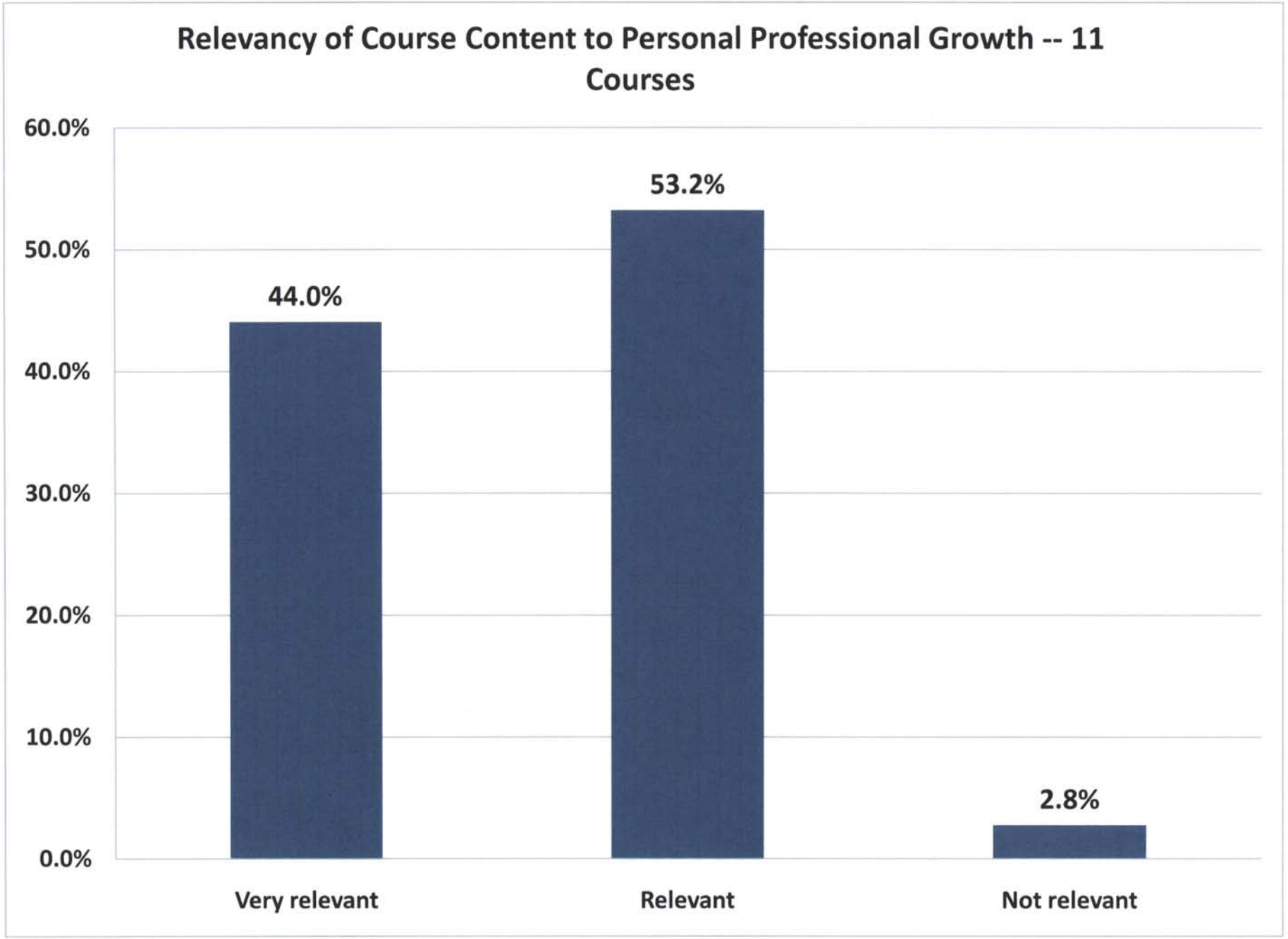
	Response Count
	8
answered question	**8**
skipped question	**15**

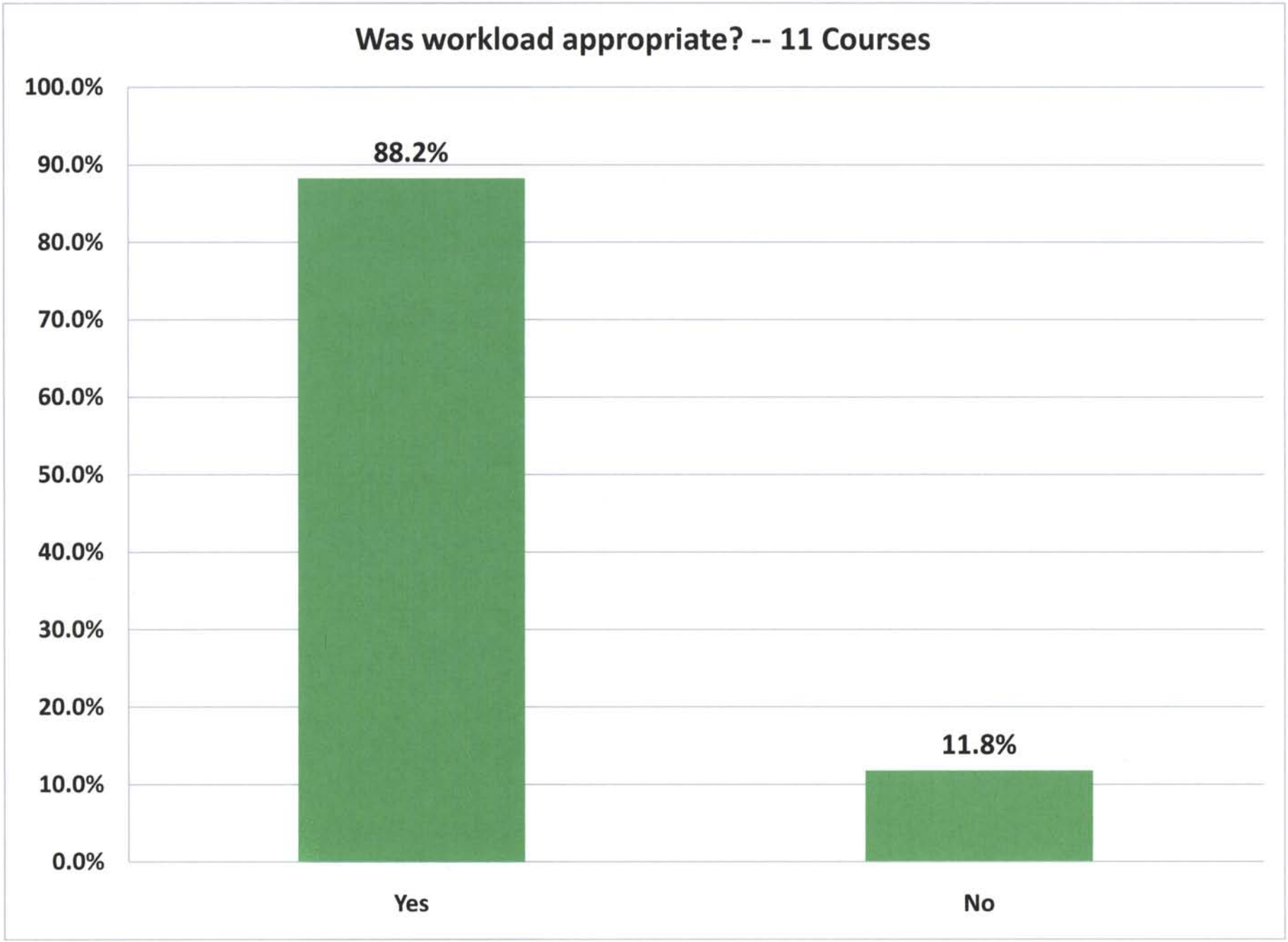
	Response Text	
1	Thanks for offering the courses.	Jul 23, 2010 5:02 AM
2	Keep up the good work!	Jul 23, 2010 2:38 PM
3	None	Jul 23, 2010 6:49 PM
4	The more statewide engineering education opportunities you can offer the better.	Jul 23, 2010 6:59 PM
5	Definitely need to work on improving outreach, marketing of this program. I couldn't find in catelog or online.	Jul 23, 2010 7:02 PM
6	This is a wonderful program! I hope it can be marketed to other sections of DOT, other government offices and consultants/contractors. I only found out about the program from a friend as I wasn't looking to take classes, therefore had not read a UAF catalogue lately.	Jul 23, 2010 8:25 PM
7	Keep it up. Would like the courses to meld with the graduate program in engineering management.	Jul 24, 2010 5:35 PM
8	Keep up the good work!	Jul 27, 2010 6:03 PM


Overall and all things considered, how positive was your experience with the construction management certificate program course(s) you have taken so far, on a scale of 1 to 5?
0.0%
0.0%
0.0%
44.4%
55.6%
1 Very positive
2
3
4
5 Very negative

Summary of Quantitative Questions for 11 Courses						
Relevant to Job				Relevant to Personal Professional Growth		
Very relevant	53	47.7%		Very relevant	48	44.0%
Relevant	54	48.6%		Relevant	58	53.2%
Not relevant	4	3.6%		Not relevant	3	2.8%
	111	100.0%			109	100.0%
Workload Appropriate				Instructor and Instruction		
Yes	90	88.2%		Very satisfied	50	46.7%
No	12	11.8%		Satisfied	53	49.5%
	102	100.0%		Not satisfied	4	3.7%
					107	100.0%


Relevancy of Course Content to Job -- 11 Courses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
47.7%
48.6%
3.6%
Very relevant
Relevant
Not relevant


Relevancy of Course Content to Personal Professional Growth -- 11 Courses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
44.0%
53.2%
2.8%
Very relevant
Relevant
Not relevant


Was workload appropriate? -- 11 Courses
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
88.2%
11.8%
Yes
No

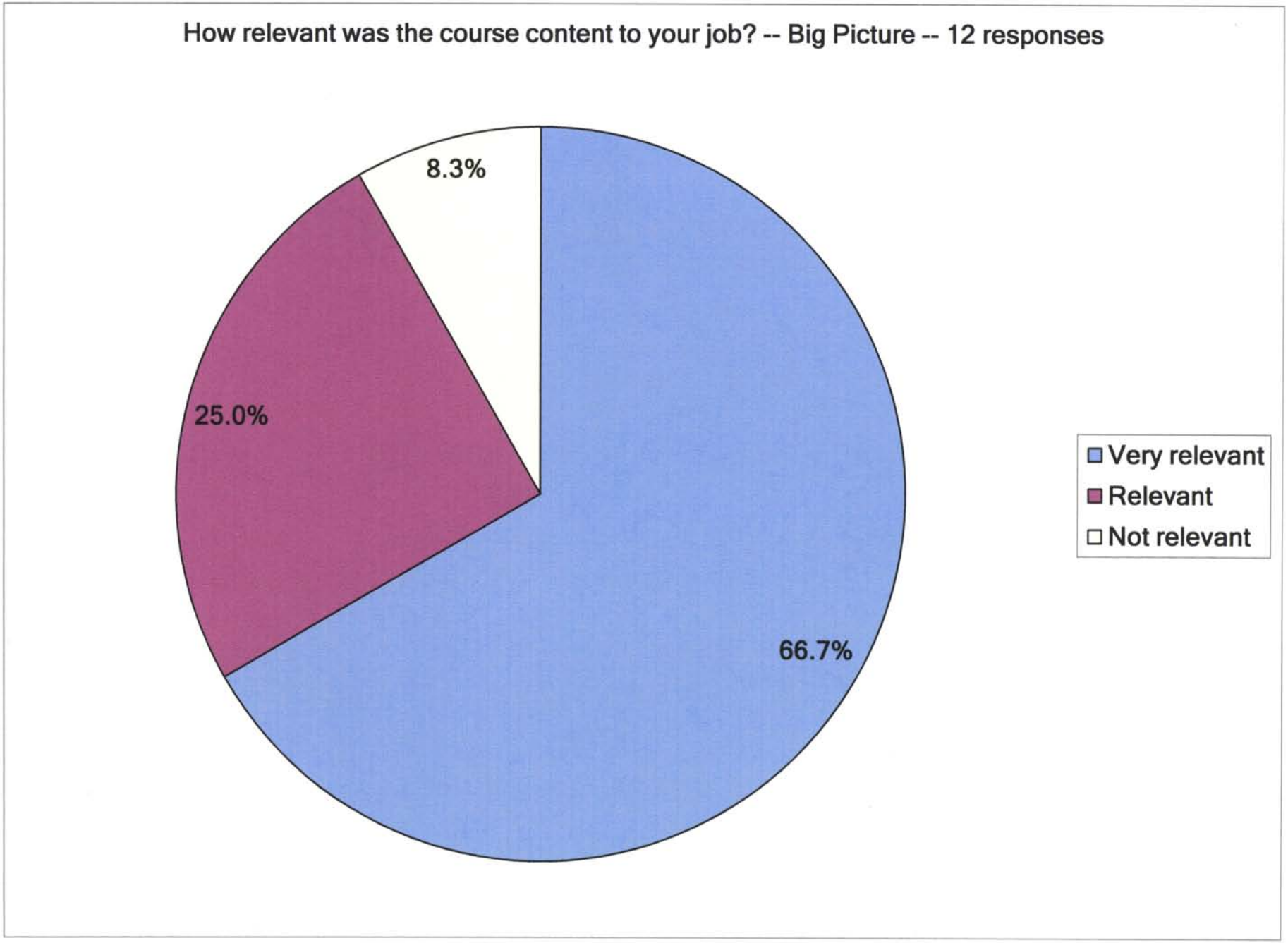

Satisfaction with Instruction and Instructor -- 11 Courses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
46.7%
49.5%
3.7%
Very satisfied
Satisfied
Not satisfied

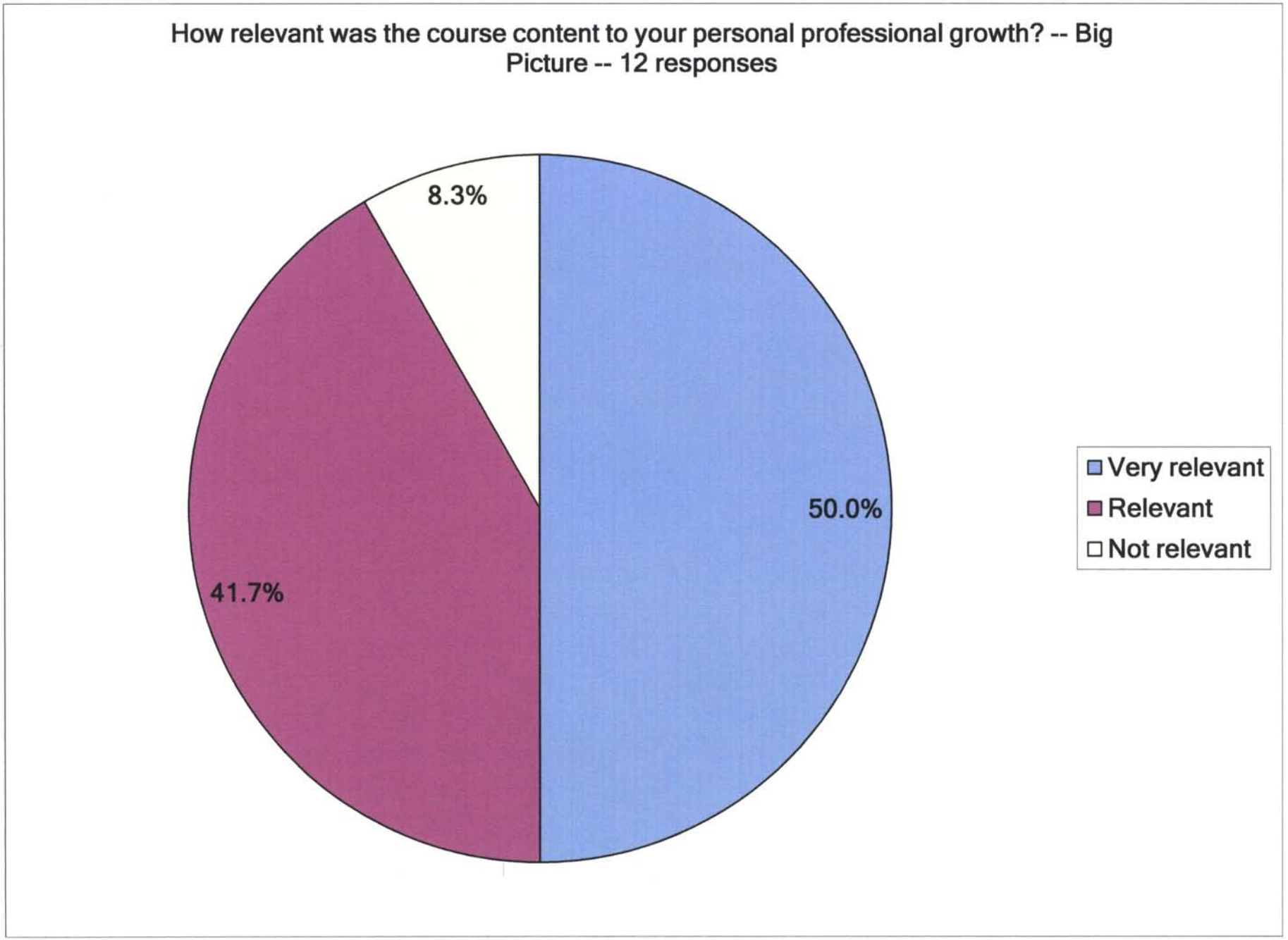
CM Program Course Survey

What was your primary reason for taking this course? - BIG PICTURE

	Response Count
	12
answered question	**12**
skipped question	**44**

	Response Text	
1	Interest, and it counted towards my graduate degree in Engineering Management.	Jul 23, 2010 4:55 AM
2	Improve leadership & management skills.	Jul 23, 2010 3:58 PM
3	I didn't take this course, but the survey would not let me go past this without answering	Jul 23, 2010 4:08 PM
4	Masters Degree and Continuing Education	Jul 23, 2010 8:06 PM
5	opportunity to better myself	Jul 24, 2010 12:23 AM
6	Desire for knowledge of the subject matter.	Jul 24, 2010 3:55 PM
7	See how other people deal with the typical construction management issues and gain from experience to possibly apply for personal practice.	Jul 29, 2010 10:23 PM
8	It was outside of the way I usually think and also touched on one of the Department's weak points.	Jul 30, 2010 7:29 PM
9	Job offered, and I wanted to expand my skill set.	Jul 31, 2010 3:51 PM
10	It was included in the program, and offered at the right time.	Aug 17, 2010 12:07 AM
11	To obtain continuing education credits for my professional registrations and for training for my job as a project manager	Aug 17, 2010 3:50 PM
12	To achieve better working relationships.	Aug 18, 2010 4:02 PM


How relevant was the course content to your job? -- Big Picture -- 12 responses
8.3%
25.0%
66.7%
Very relevant
Relevant
Not relevant

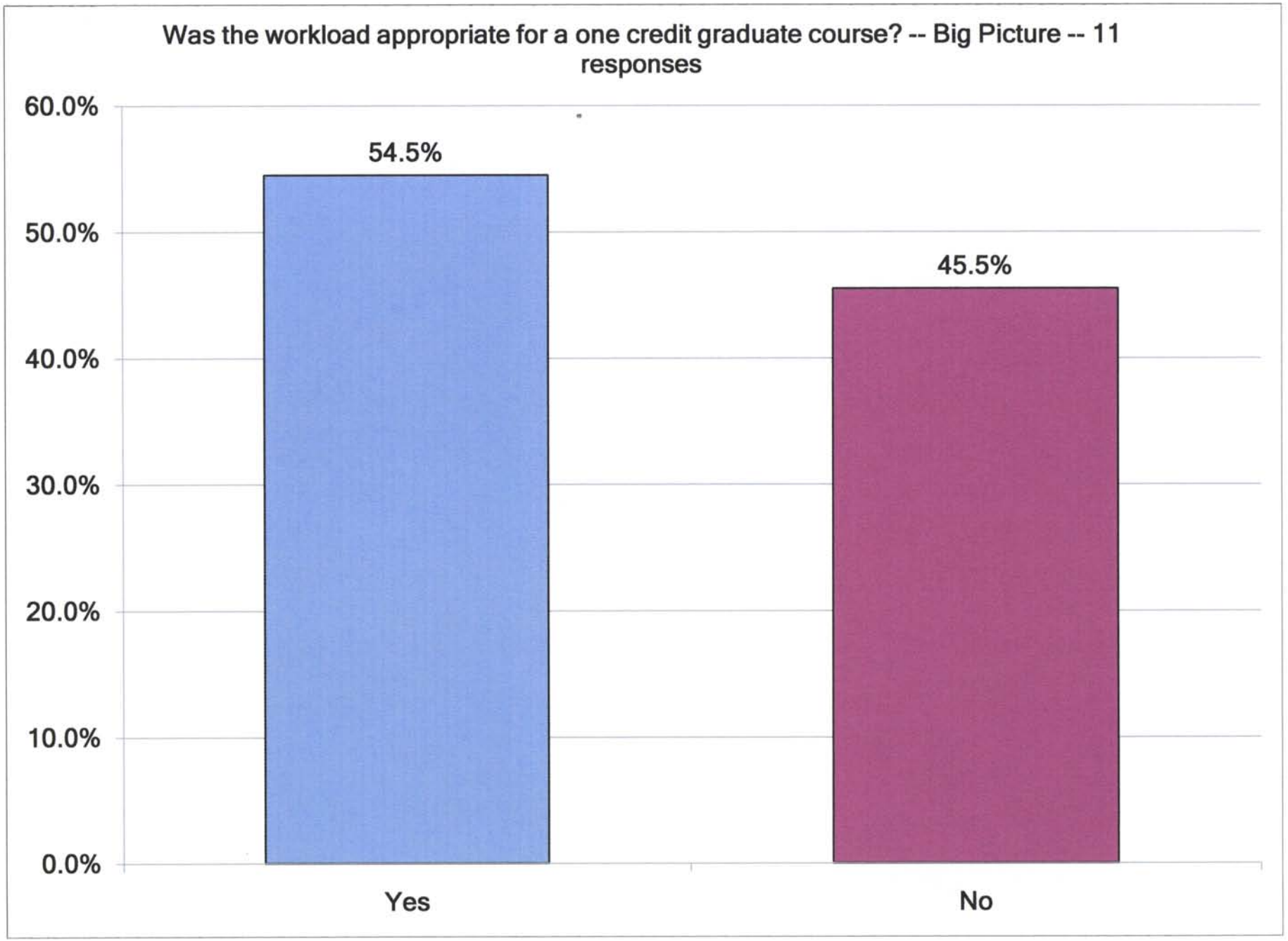

How relevant was the course content to your personal professional growth? -- Big Picture -- 12 responses
8.3%
50.0%
41.7%
Very relevant
Relevant
Not relevant

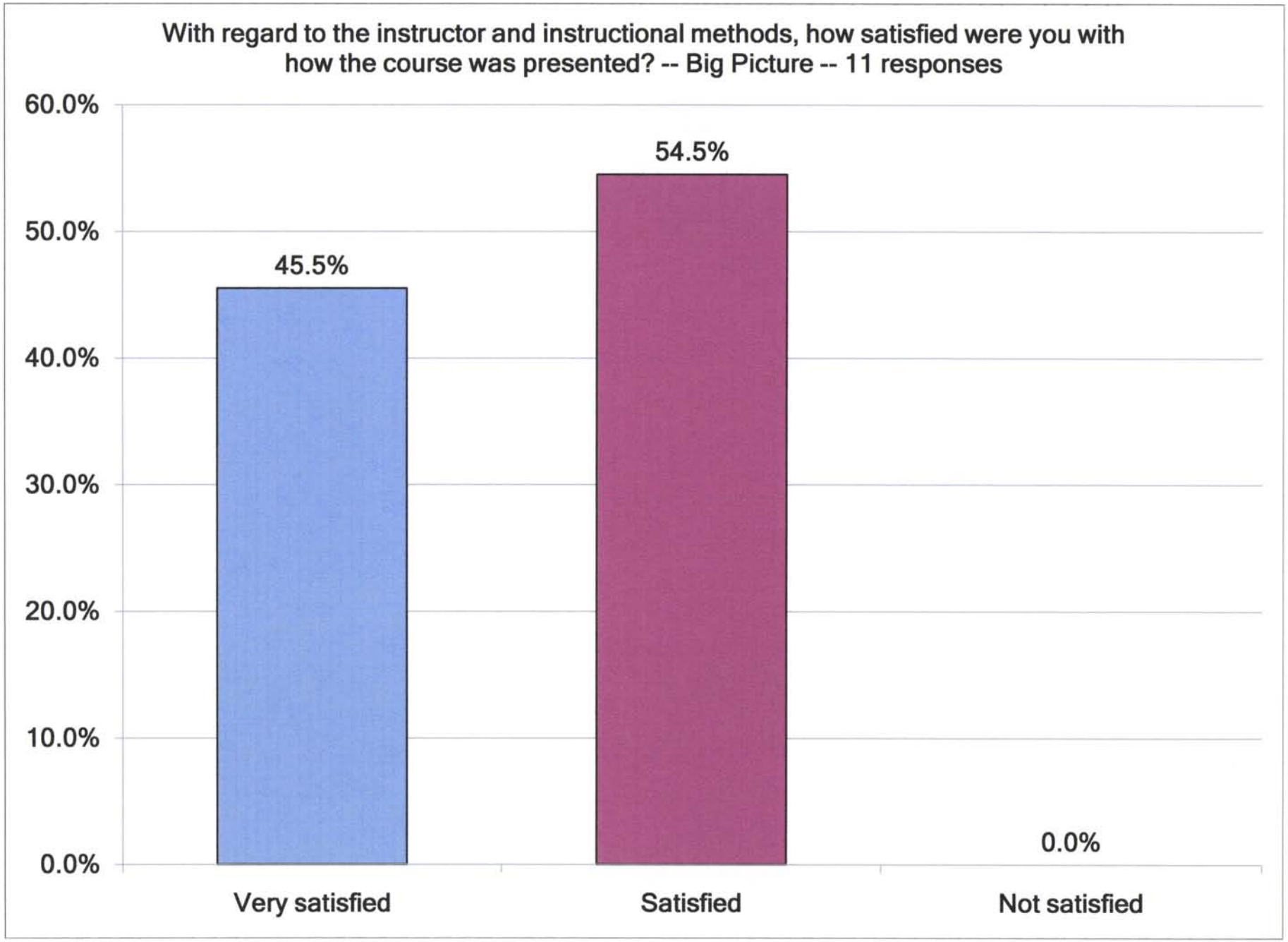
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. BIG PICTURE

	Response Count
	7
answered question	7
skipped question	49

	Response Text	
1	Excellent course. Instructor was a little neurotic, but did contribute to the overall purpose of the class.	Jul 23, 2010 4:55 AM
2	Excellent course and instructor was very knowledgable and credible.	Jul 23, 2010 3:58 PM
3	The course was very reading intensive with 2 textbooks to digest in 6 weeks. the final exam exercise was left to the student to create a scenario and analyze it with respect to the course content. This left me unsatisfied, and a bit confused on whether I performed correctly or not. I did not recieve a marked up version of the final paper. I would suggest a less reading intensive course, and a homework scheme that does not involve as much time and writing.	Jul 24, 2010 3:55 PM
4	Several homework assigments were very time-consuming. I did not have much time to adequately address the problems. April is a very busy time before construction season for DOT	Jul 29, 2010 10:23 PM
5	Keep it as is.	Jul 30, 2010 7:29 PM
6	This was a good basic class.	Aug 17, 2010 3:50 PM
7	A little more fleshed-out text.	Aug 18, 2010 4:02 PM


Was the workload appropriate for a one credit graduate course? -- Big Picture -- 11 responses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
54.5%
45.5%
Yes
No


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- Big Picture -- 11 responses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
45.5%
54.5%
0.0%
Very satisfied
Satisfied
Not satisfied

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements BIG PICTURE

	Response Count
	7
answered question	7
skipped question	49

	Response Text	
1	Expectations often changed without warning or purpose. Since everyone is already extremely busy, they should be clear throughout the course, starting with the syllabus - and not change based on whim.	Jul 23, 2010 4:55 AM
2	During the beginnning of the course, too much reading and homework for working professionals. This was remedied.	Jul 23, 2010 3:58 PM
3	The material presented was excellent. Very salient to the organization that I work for.	Jul 24, 2010 3:55 PM
4	Some topics (scheduling) -there was a distinct lack of time to cover material in breadth to prepare for the time-consuming (and confusing) homework.	Jul 29, 2010 10:23 PM
5	Dr. Herman did a great job. Workload was a bit much at first, but was fine tuned as the class went on (expected for first try and all).	Jul 30, 2010 7:29 PM
6	The course was well presented.	Aug 17, 2010 3:50 PM
7	Instructor developed a very good report with the class. Corporate and individual negotiations were part of the scope.	Aug 18, 2010 4:02 PM

CM Program Course Survey

Please offer other comments, reflections, suggestions, and the like about this course. BIG PICTURE

	Response Count
	5
answered question	5
skipped question	51

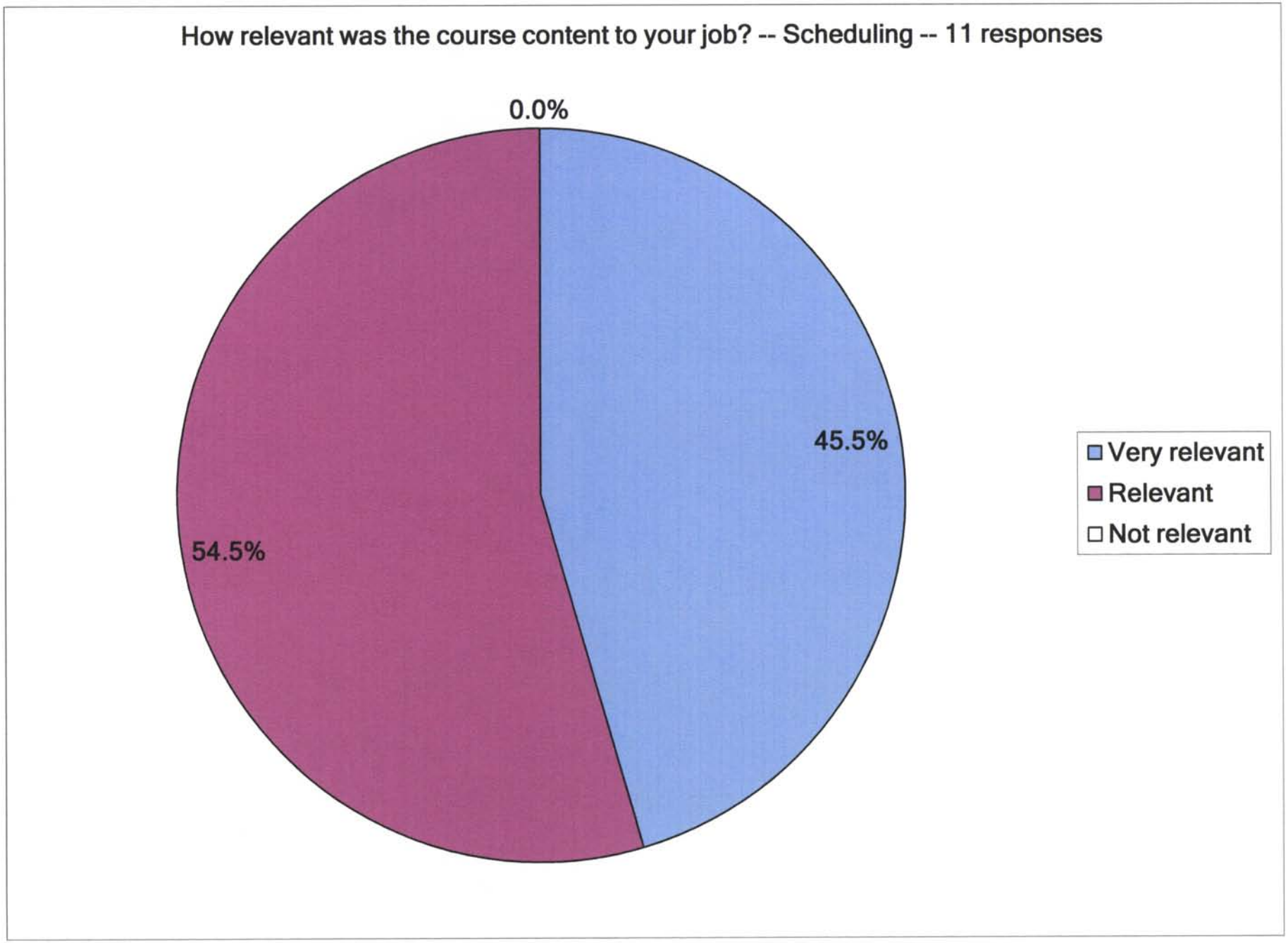
	Response Text	
1	It was an excellent course, overall. I took away a lot, and the knowledge has been directly applicable to my personal and professional life.	Jul 23, 2010 4:55 AM
2	Suggest focused marketing the need for this course to senior managers/executives - the people who truly need this course. These people are not participating.	Jul 23, 2010 3:58 PM
3	Courses in January-March work best for DOT and myslef personally. Interesting format, I will do it again for sure.	Jul 29, 2010 10:23 PM
4	Pretty much all technically minded engineers would benefit from Big Picture Thinking. This class should be emphasized. I believe that soft skills classes like this are more important then technical classes for the purposes of this program.	Jul 30, 2010 7:29 PM
5	Susan Herman was very gifted and had an ability to teach this course that few others have.	Aug 18, 2010 4:02 PM

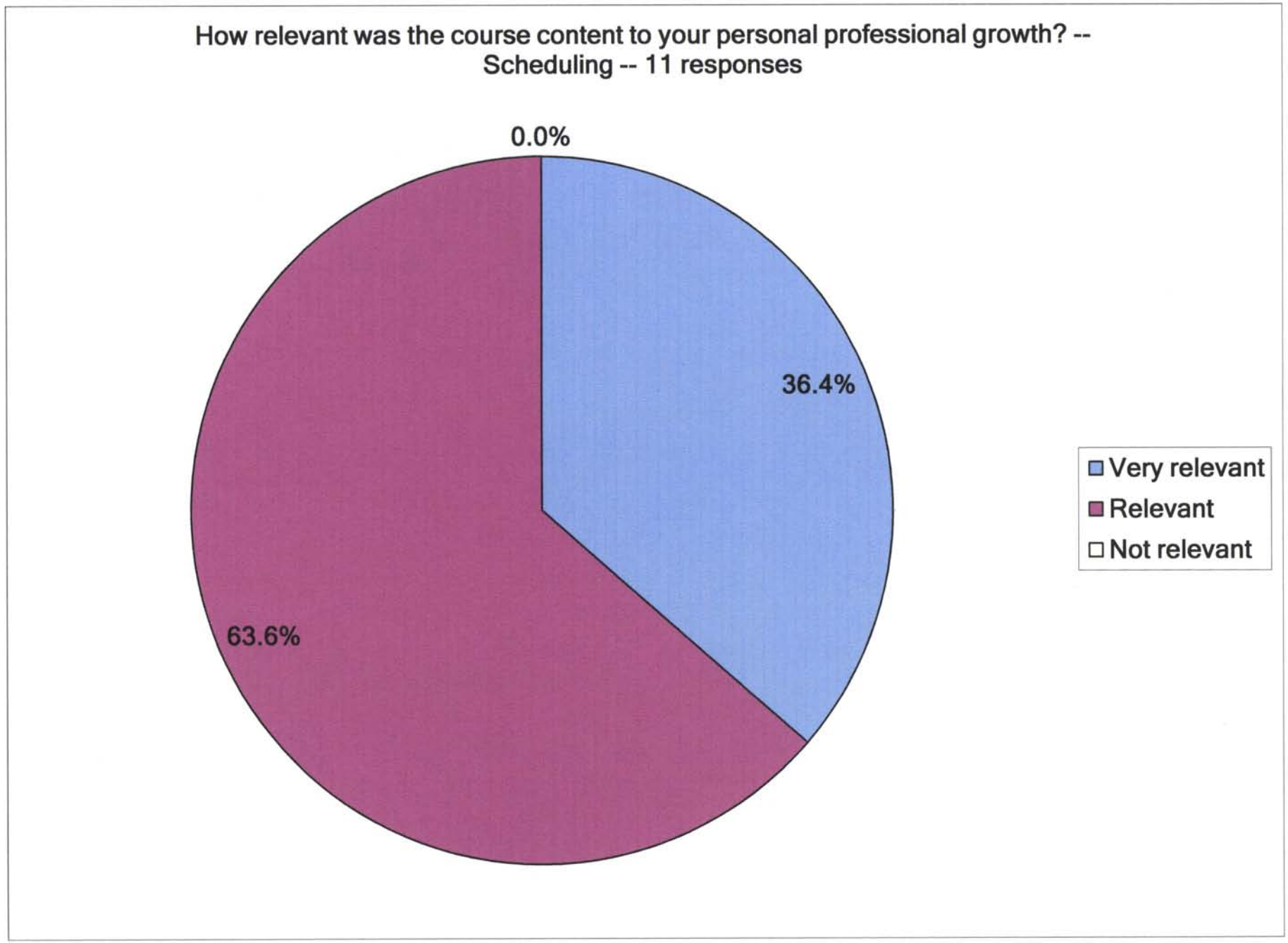
CM Program Course Survey

What was your primary reason for taking this course? SCHEDULING

	Response Count
	11
answered question	11
skipped question	46

	Response Text	
1	Trying to keep current with scheduling software use by contractors	Jul 23, 2010 4:10 PM
2	better my skills	Jul 24, 2010 12:24 AM
3	Interest in scheduling	Jul 24, 2010 5:16 PM
4	It sounded like it might be useful and it was at a time that worked for me.	Jul 29, 2010 10:06 PM
5	To brush up skills in scheduling	Jul 29, 2010 10:12 PM
6	Refresh what I knew	Jul 29, 2010 10:26 PM
7	Gain new skills and sharpen old ones.	Jul 29, 2010 11:00 PM
8	looking for a higher level of training on this issue.	Jul 31, 2010 3:52 PM
9	Interest in the use of CPM scheduling and how it can help with my occupation	Aug 10, 2010 3:14 PM
10	Significant job relevance.	Aug 17, 2010 12:08 AM
11	To learn the whole of CPM Scheduling - in order to keep the Contractor on task and avoid claims.	Aug 18, 2010 4:05 PM


How relevant was the course content to your job? -- Scheduling -- 11 responses
0.0%
45.5%
54.5%
Very relevant
Relevant
Not relevant

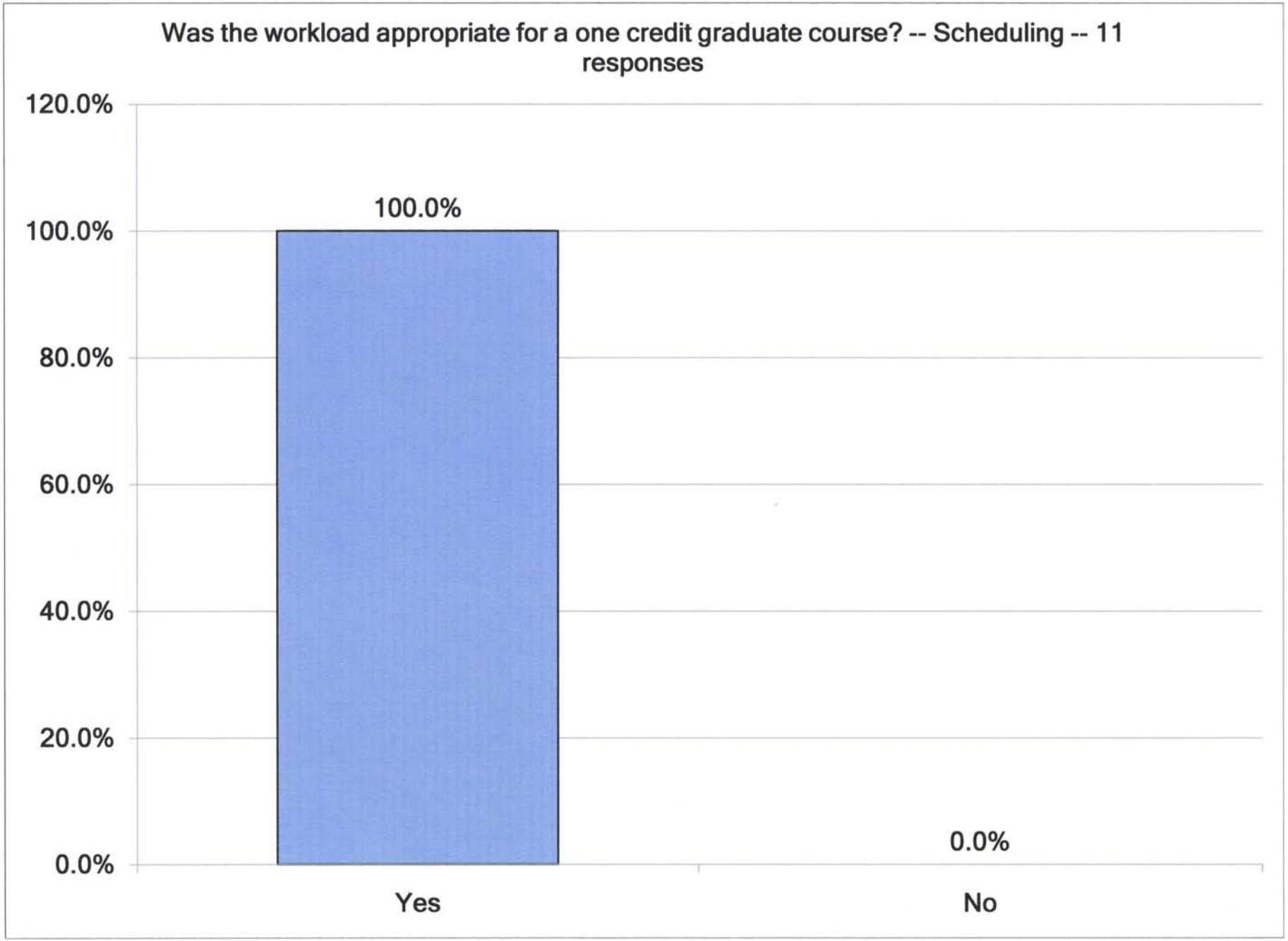

How relevant was the course content to your personal professional growth? -- Scheduling -- 11 responses
0.0%
36.4%
63.6%
Very relevant
Relevant
Not relevant

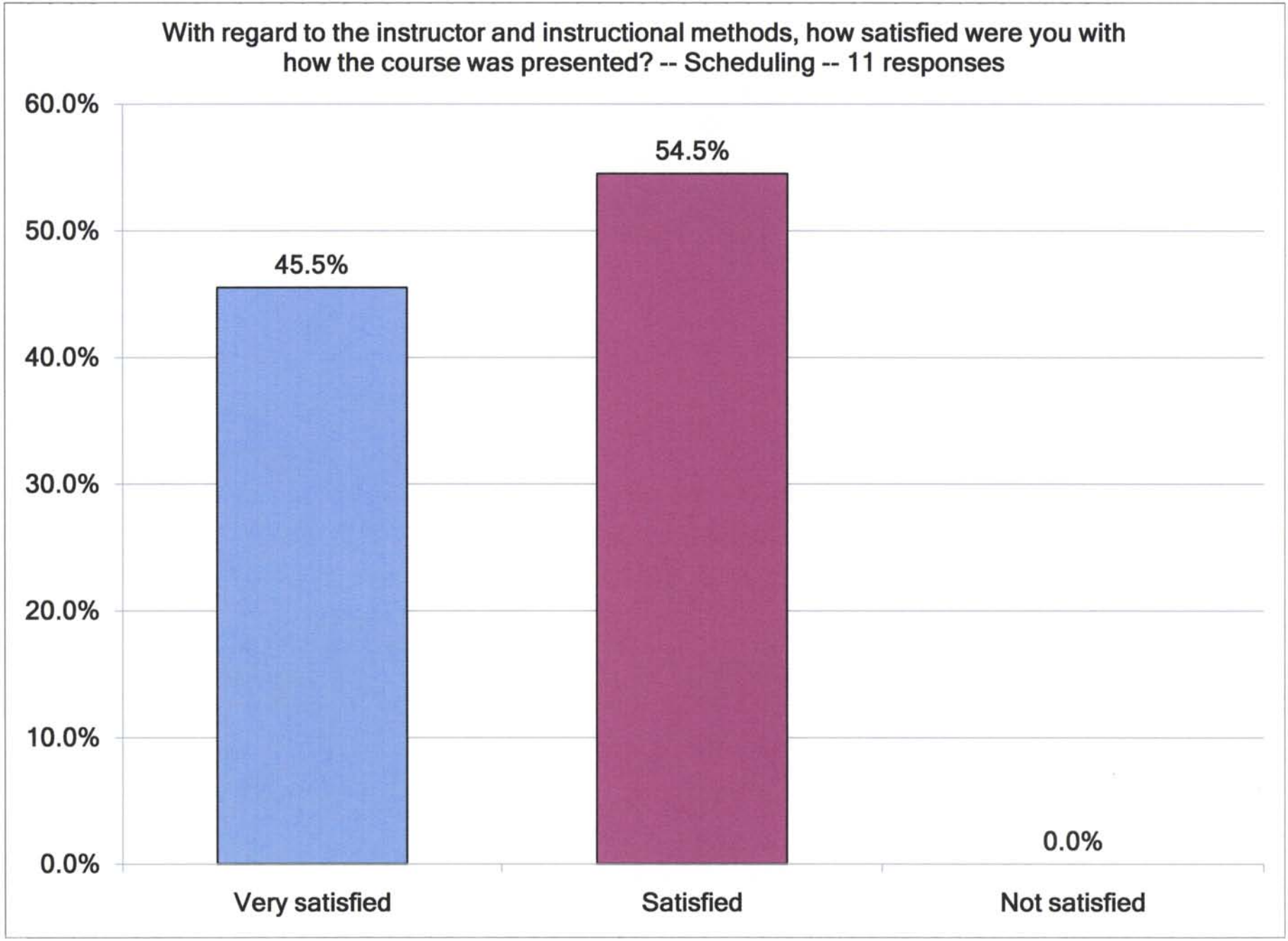
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. SCHEDULING

	Response Count
	3
answered question	3
skipped question	54

	Response Text	
1	course content was great. I would like to see a more advanced course on this subject matter, as the management of construction lies heavily in the ability to schedule it.	Jul 24, 2010 5:16 PM
2	Course Needs more clarity.	Jul 29, 2010 10:26 PM
3	Excellent course content.	Aug 18, 2010 4:05 PM


Was the workload appropriate for a one credit graduate course? -- Scheduling -- 11 responses
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
100.0%
0.0%
Yes
No


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- Scheduling -- 11 responses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
45.5%
54.5%
0.0%
Very satisfied
Satisfied
Not satisfied

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements SCHEDULING

	Response Count
	3
answered question	3
skipped question	54

	Response Text	
1	More advanced analysis and techniques, please.	Jul 24, 2010 5:16 PM
2	Instructor handled technical video issues with confidence and ingenuity.	Jul 29, 2010 10:26 PM
3	Excellent presentations and scope of learning.	Aug 18, 2010 4:05 PM

CM Program Course Survey

Please offer other comments, reflections, suggestions, and the like about this course. SCHEDULING

	Response Count
	3
answered question	3
skipped question	54

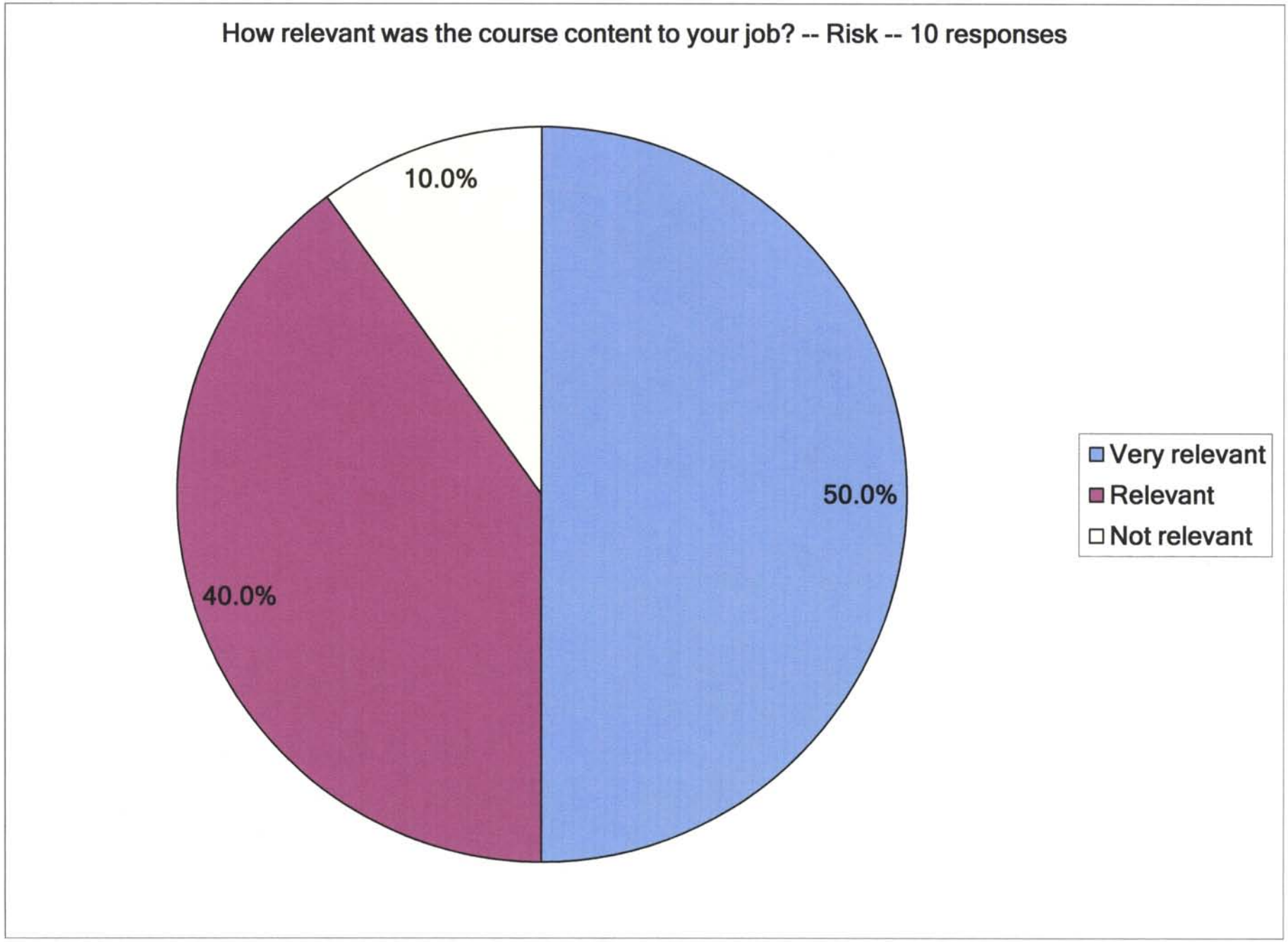
	Response Text	
1	Course offered excellent foundation for scheduling.	Jul 24, 2010 5:16 PM
2	General trend-too much information is being covered in too short of time. Better plan course scope and examples	Jul 29, 2010 10:26 PM
3	A wonderful instructor- the best!	Aug 18, 2010 4:05 PM

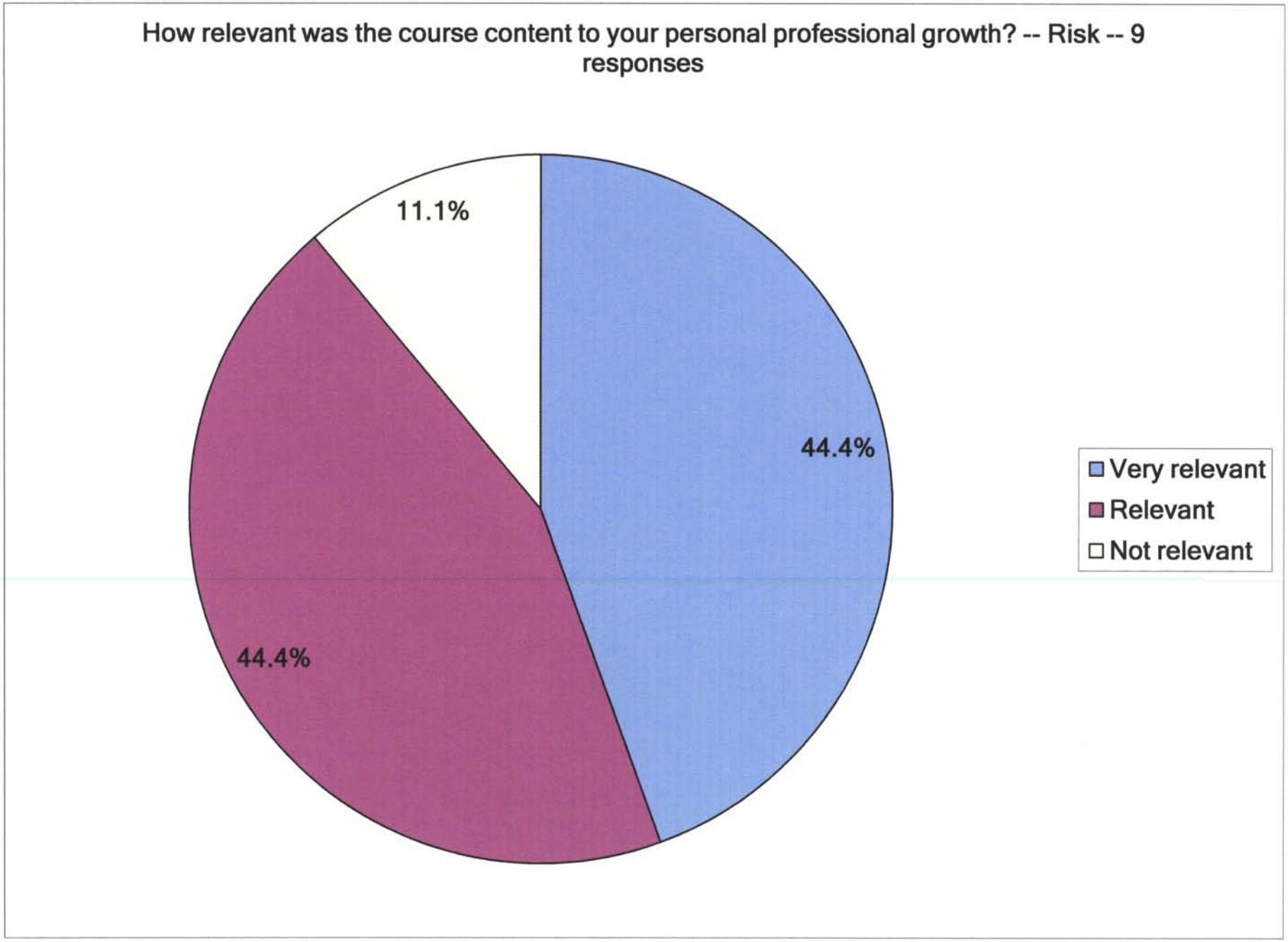
CM Program Course Survey

What was your primary reason for taking this course? Risk

	Response Count
	10
answered question	**10**
skipped question	**47**

	Response Text	
1	I didn't take this course either, but once again the survey would not let me advance without text in this box	Jul 23, 2010 4:12 PM
2	IIII	Jul 23, 2010 5:43 PM
3	job offered, hope to help with advancement	Jul 24, 2010 12:26 AM
4	Interest in the subject, and pursiut of the certificate	Jul 24, 2010 5:18 PM
5	The time fit my schedule and it sounded like it might be useful	Jul 29, 2010 10:08 PM
6	I needed to get a better understanding of how to quantify risk.	Jul 30, 2010 7:33 PM
7	an area of knowelge but little formal training	Jul 31, 2010 3:54 PM
8	Learn ways that the contractor and state manage risk.	Aug 10, 2010 3:15 PM
9	Offered at right time.	Aug 17, 2010 12:09 AM
10	To learn the perspectives on risk in the bidding and performance of contracts.	Aug 18, 2010 4:09 PM


How relevant was the course content to your job? -- Risk -- 10 responses
10.0%
50.0%
40.0%
Very relevant
Relevant
Not relevant

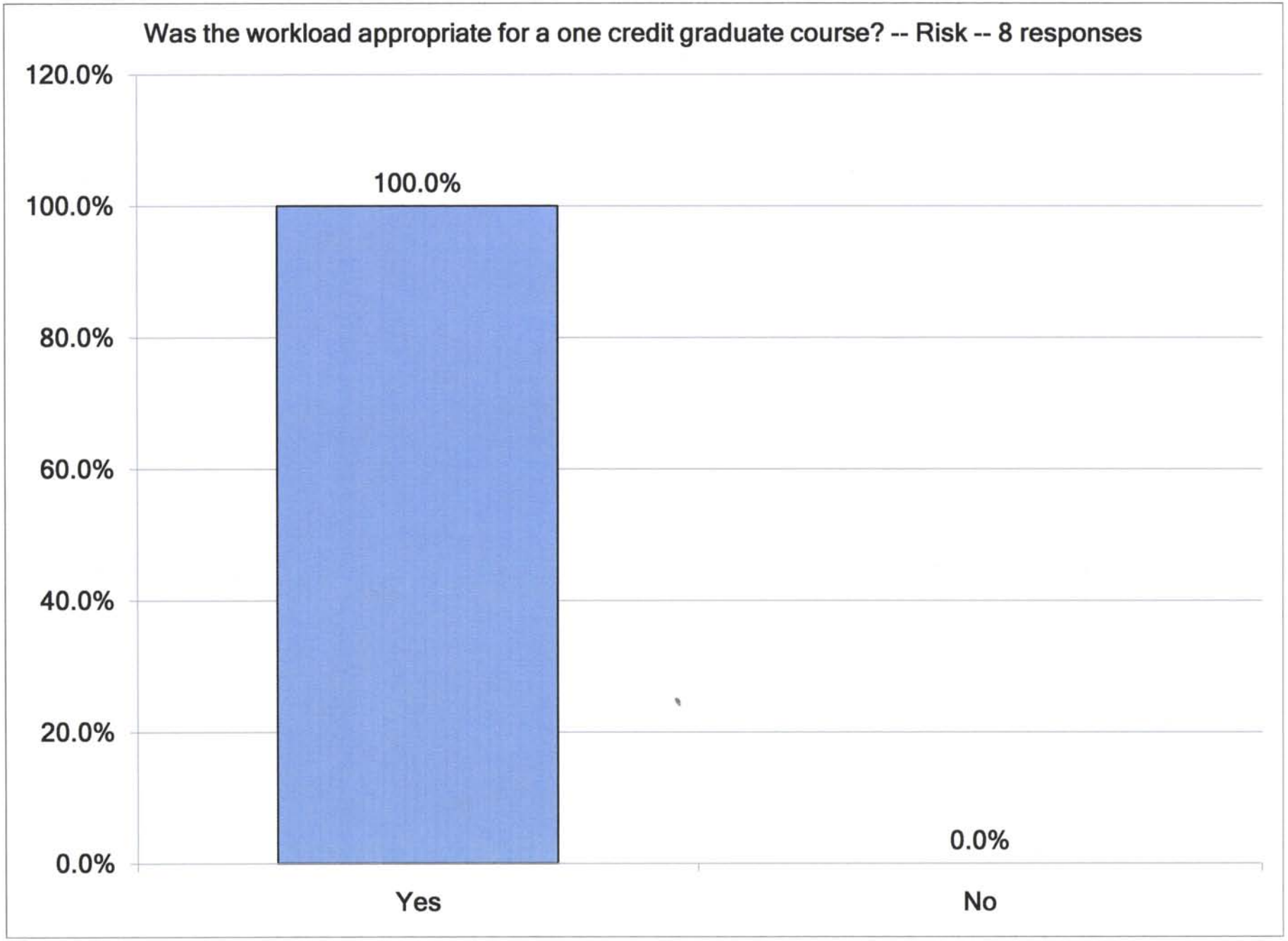

How relevant was the course content to your personal professional growth? -- Risk -- 9 responses
11.1%
44.4%
44.4%
Very relevant
Relevant
Not relevant

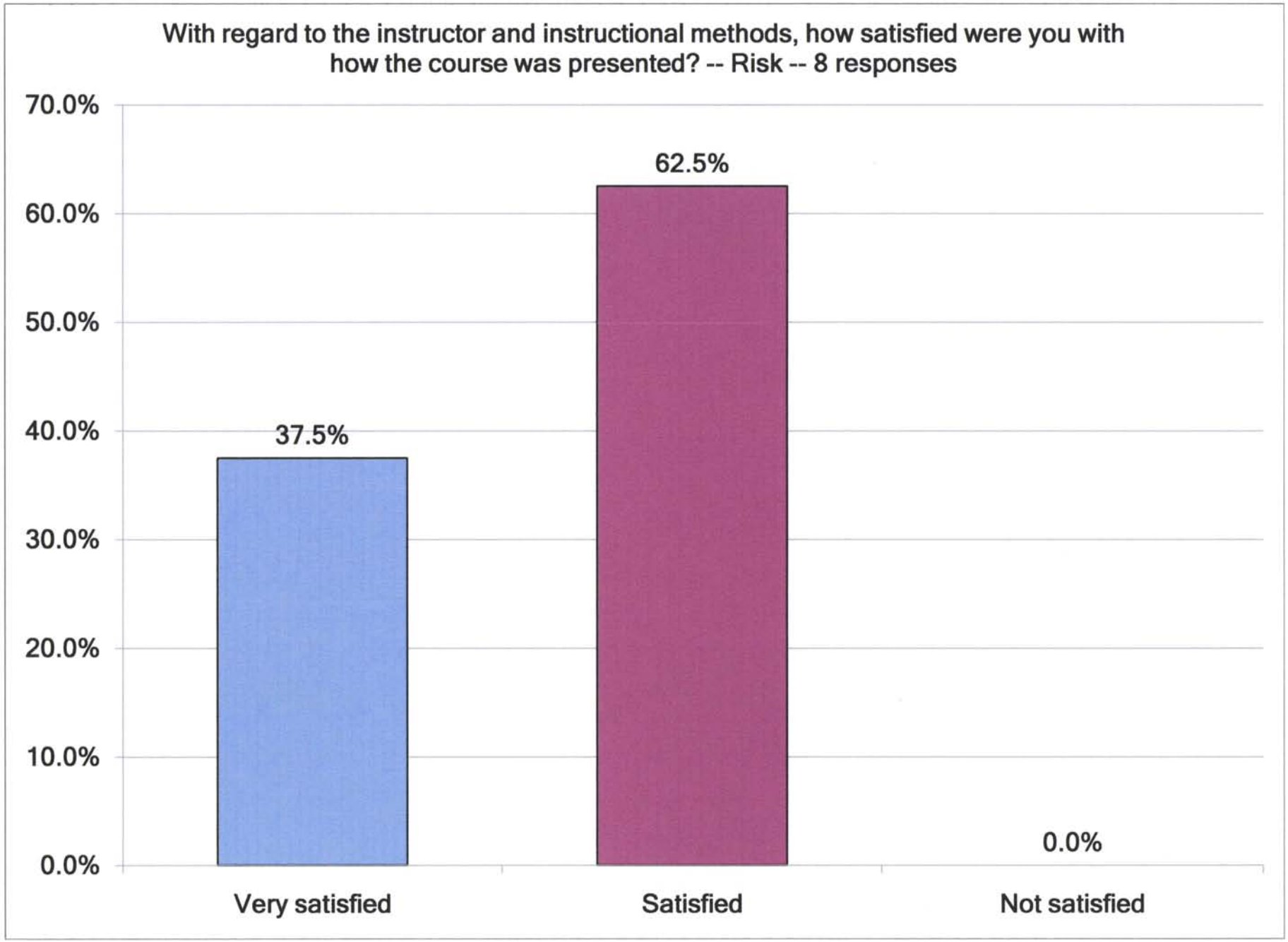
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. Risk

	Response Count
	3
answered question	3
skipped question	54

	Response Text	
1	the course content was good. more information on the value of risks would be nice. I would like to know how to change the risk into dollar amounts.	Jul 24, 2010 5:18 PM
2	Good content, could have been a little bit harder.	Jul 30, 2010 7:33 PM
3	A little more focus and less effort to cover the multitiude of theories would be helpful.	Aug 18, 2010 4:09 PM


Was the workload appropriate for a one credit graduate course? -- Risk -- 8 responses
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
100.0%
0.0%
Yes
No


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- Risk -- 8 responses
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
37.5%
62.5%
0.0%
Very satisfied
Satisfied
Not satisfied

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements Risk

	Response Count
	2
answered question	**2**
skipped question	**53**

	Response Text	
1	Excellent eye-opener to the many unknowns in the trade	Jul 24, 2010 5:18 PM
2	Was your first try at remote teaching if I remember correctly. It worked better than I thought it would but still was a bit weird looking at a screen rather than a person.	Jul 30, 2010 7:33 PM

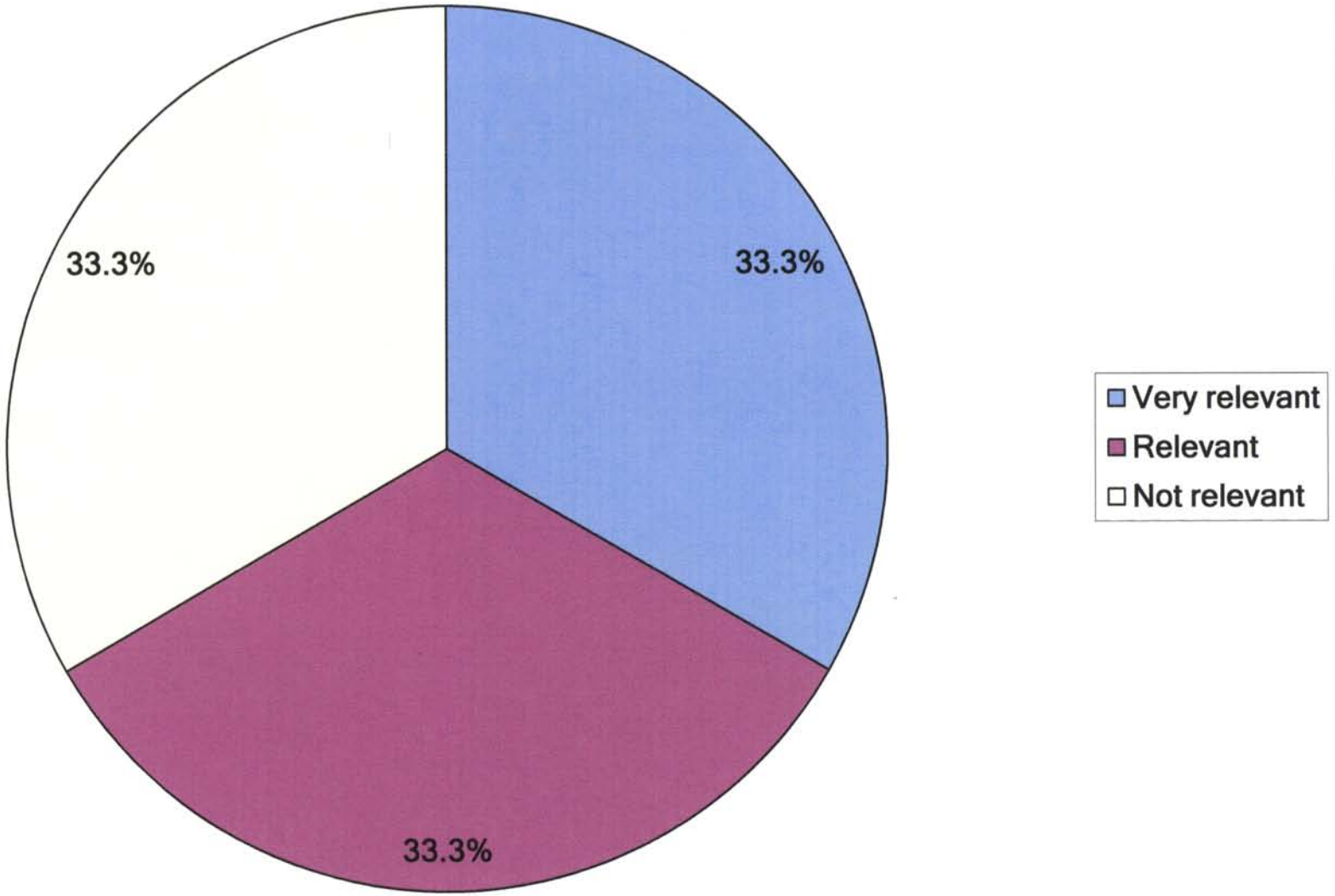
CM Program Course Survey

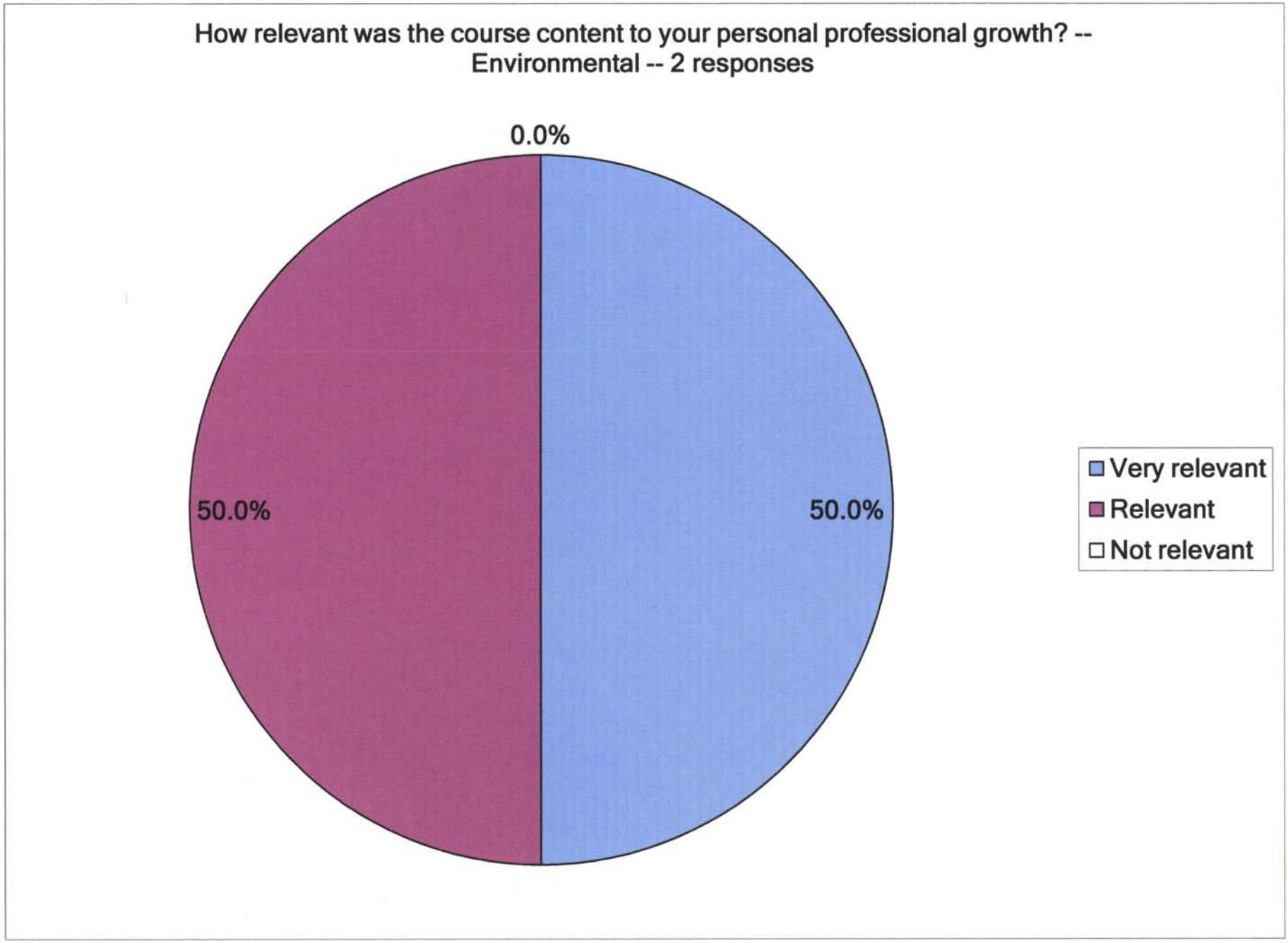
What was your primary reason for taking this course? ENVIRONMENTAL

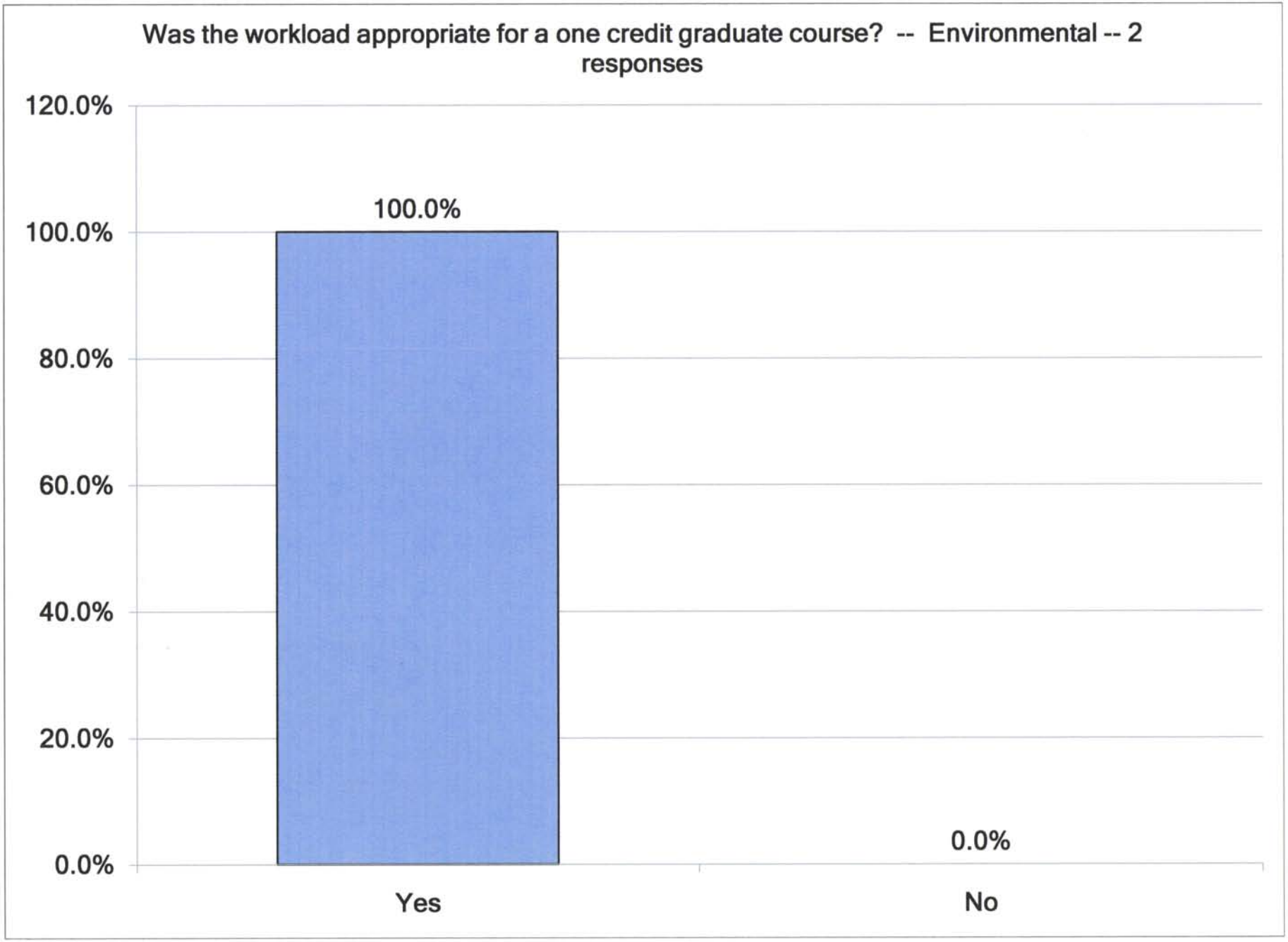
	Response Count
	5
answered question	**5**
skipped question	**50**

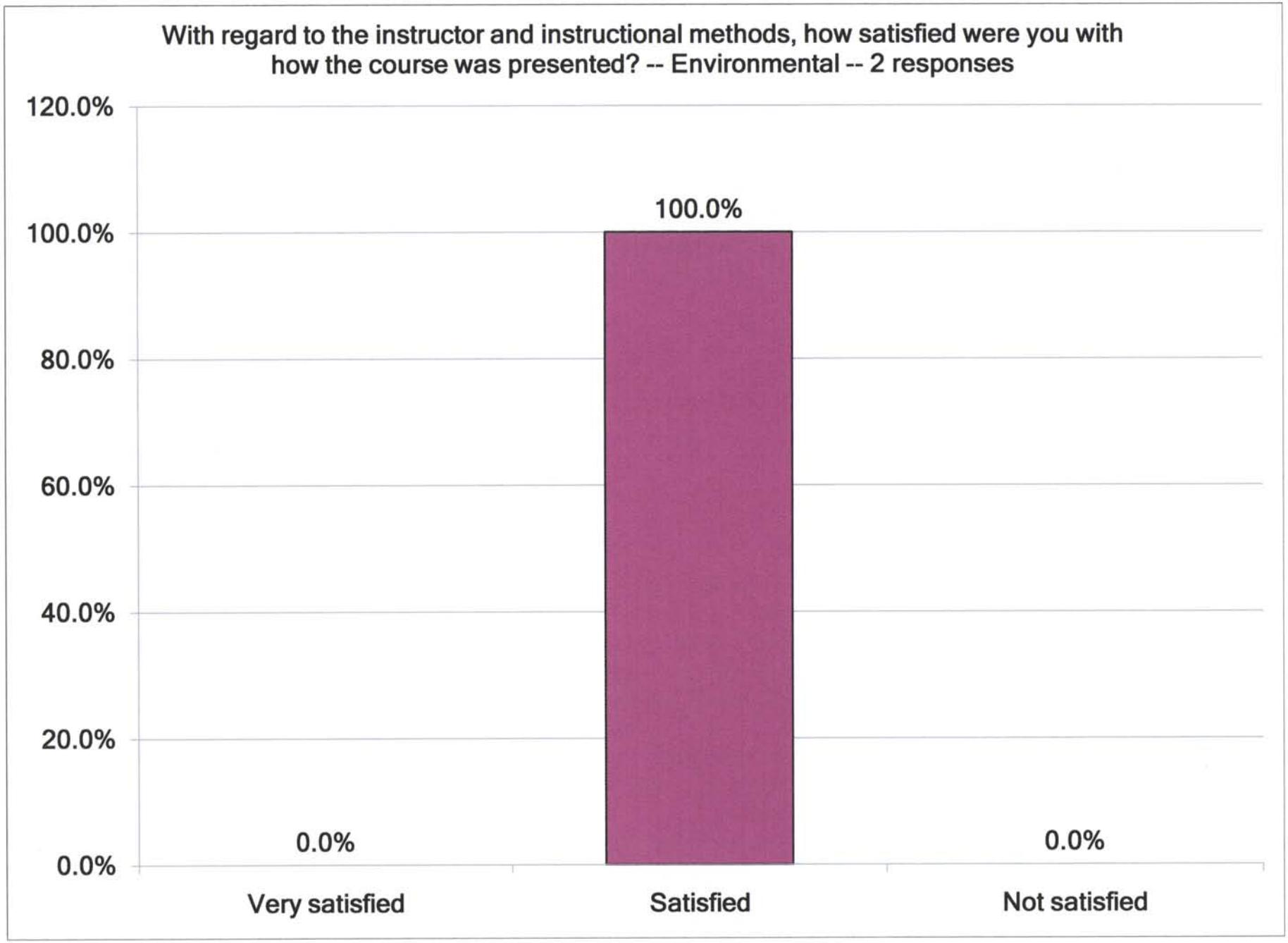
	Response Text	
1	see previous remarks	Jul 23, 2010 4:12 PM
2	Better my knowledge base	Jul 24, 2010 12:27 AM
3	didn't take course	Jul 29, 2010 11:01 PM
4	expand my knowelge base	Jul 31, 2010 3:56 PM
5	didn't take this course	Aug 17, 2010 12:10 AM

How relevant was the course content to your job -- Environmental -- 3 responses?




How relevant was the course content to your personal professional growth? -- Environmental -- 2 responses
0.0%
50.0%
50.0%
Very relevant
Relevant
Not relevant


Was the workload appropriate for a one credit graduate course? -- Environmental -- 2 responses
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
100.0%
0.0%
Yes
No

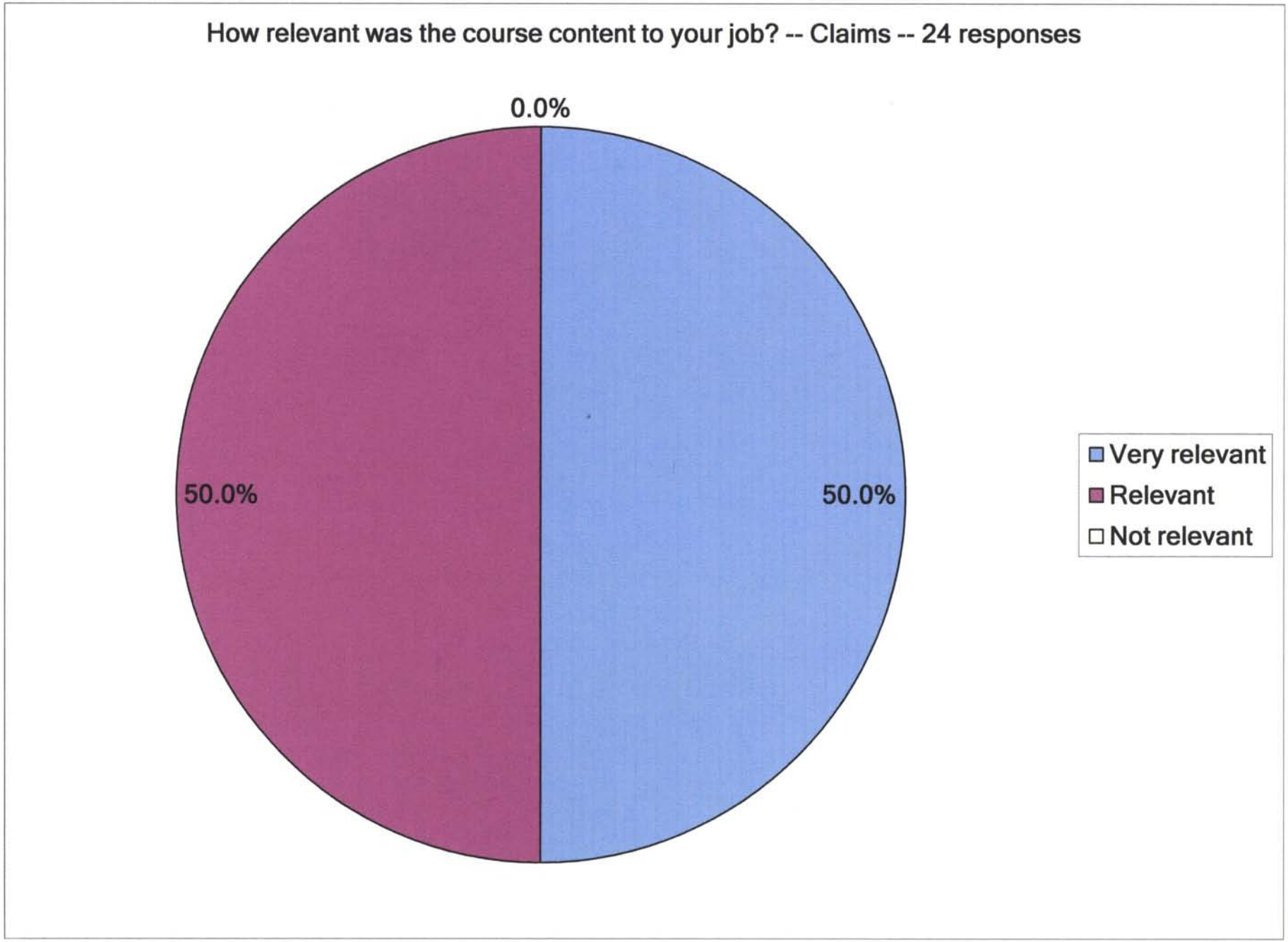

With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- Environmental -- 2 responses
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
100.0%
0.0%
0.0%
Very satisfied
Satisfied
Not satisfied

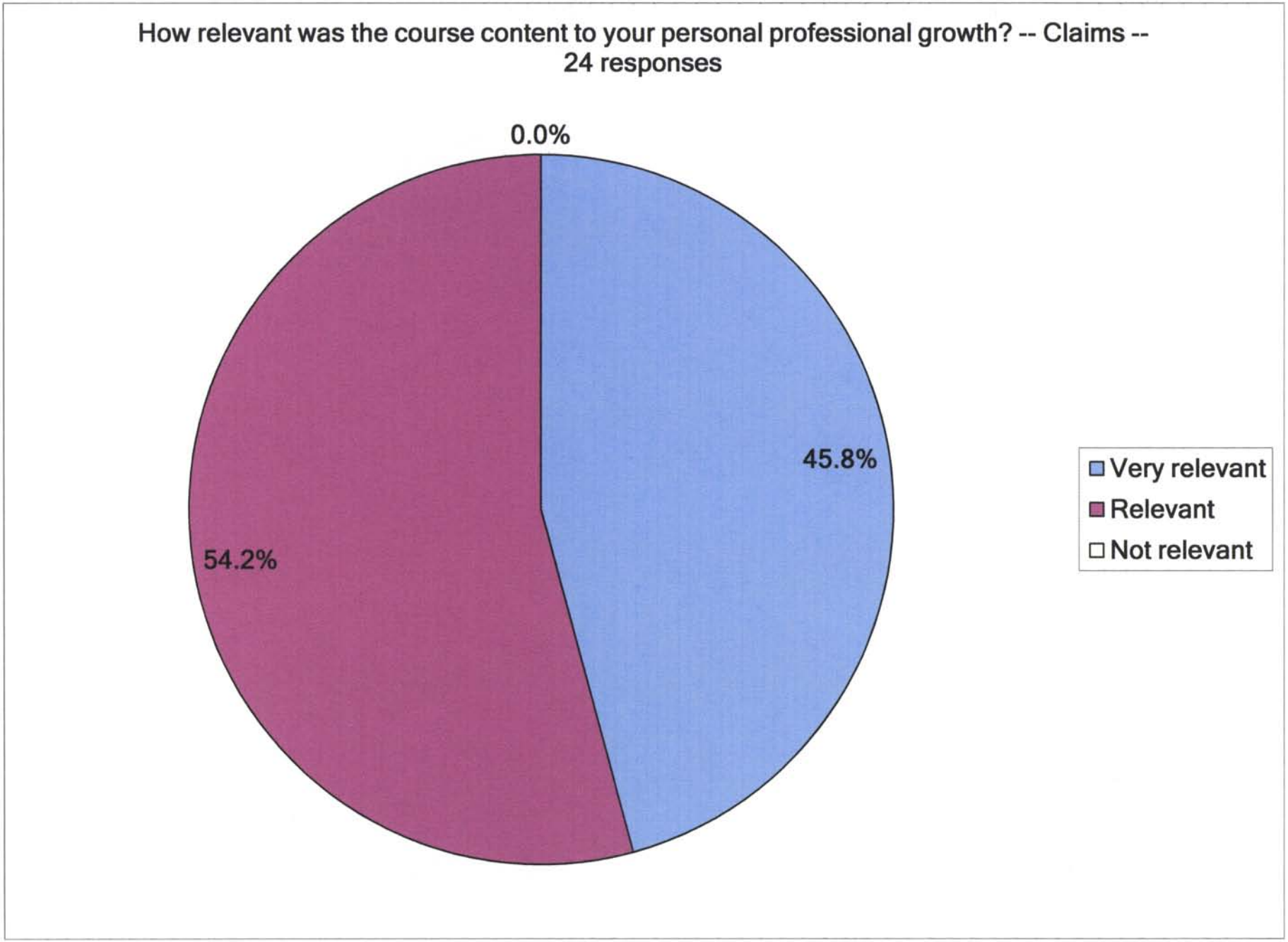
CM Program Course Survey

What was your primary reason for taking this course? CLAIMS

	Response Count
	24
answered question	**24**
skipped question	**33**

	Response Text	
1	Get ideas for claim advoidance	Jul 23, 2010 2:33 PM
2	To study the natutre of claims and learn from other aspects to look at claims.	Jul 23, 2010 6:06 PM
3	Work related	Jul 23, 2010 8:07 PM
4	for better understanding of the issue	Jul 24, 2010 12:28 AM
5	Interest in the subject matter	Jul 24, 2010 5:20 PM
6	Continuing education for PE requirements	Jul 25, 2010 6:35 PM
7	Work requirement	Jul 27, 2010 5:23 AM
8	To gain additional understanding of the construction claims process and be better prepared to deal with construction claims.	Jul 27, 2010 5:36 PM
9	To improve my understanding of construction contracts, changed conditions issues, and risks associated with claims. Interested in claims avaoidance as it relates to preparing construction contract documents.	Jul 27, 2010 5:57 PM
10	Sounded like it might be useful.	Jul 29, 2010 10:09 PM
11	to obtain my master degree in ESM	Jul 29, 2010 10:11 PM
12	Intrest in Construction claims from work experience.	Jul 29, 2010 11:26 PM
13	To gain knowledge in to avoid claims and how to evaluate a claim.	Jul 29, 2010 11:44 PM
14	The course was offered as office training	Jul 30, 2010 1:50 AM
15	Professional development	Jul 30, 2010 3:33 PM
16	Opportunity for formal education to further develop my skills in this field, while not seriously conflicting with my seasonal work load.	Jul 30, 2010 4:32 PM
17	An area of construction that I deal with a lot and wanted more "tools" to deal with the issue.	Jul 31, 2010 3:57 PM
18	job related educational enhancement	Aug 2, 2010 4:17 PM
19	Become more familiar with the problems that contract administrators face.	Aug 2, 2010 6:00 PM
20	I was involved with a relativley large claim in my job at DOT. Interest in other case studies of other claims.	Aug 3, 2010 12:02 AM
21	relevance to career	Aug 17, 2010 12:11 AM
22	To gain insight on avoiding claims and how to handle claims as a project engineer	Aug 17, 2010 12:30 AM
23	Required by employer.	Aug 17, 2010 8:09 PM
24	To study the case law and learn how to realize a management approach by which I can avoid claims and enhance contract compliance.	Aug 18, 2010 4:58 PM


How relevant was the course content to your job? -- Claims -- 24 responses
0.0%
50.0%
50.0%
Very relevant
Relevant
Not relevant

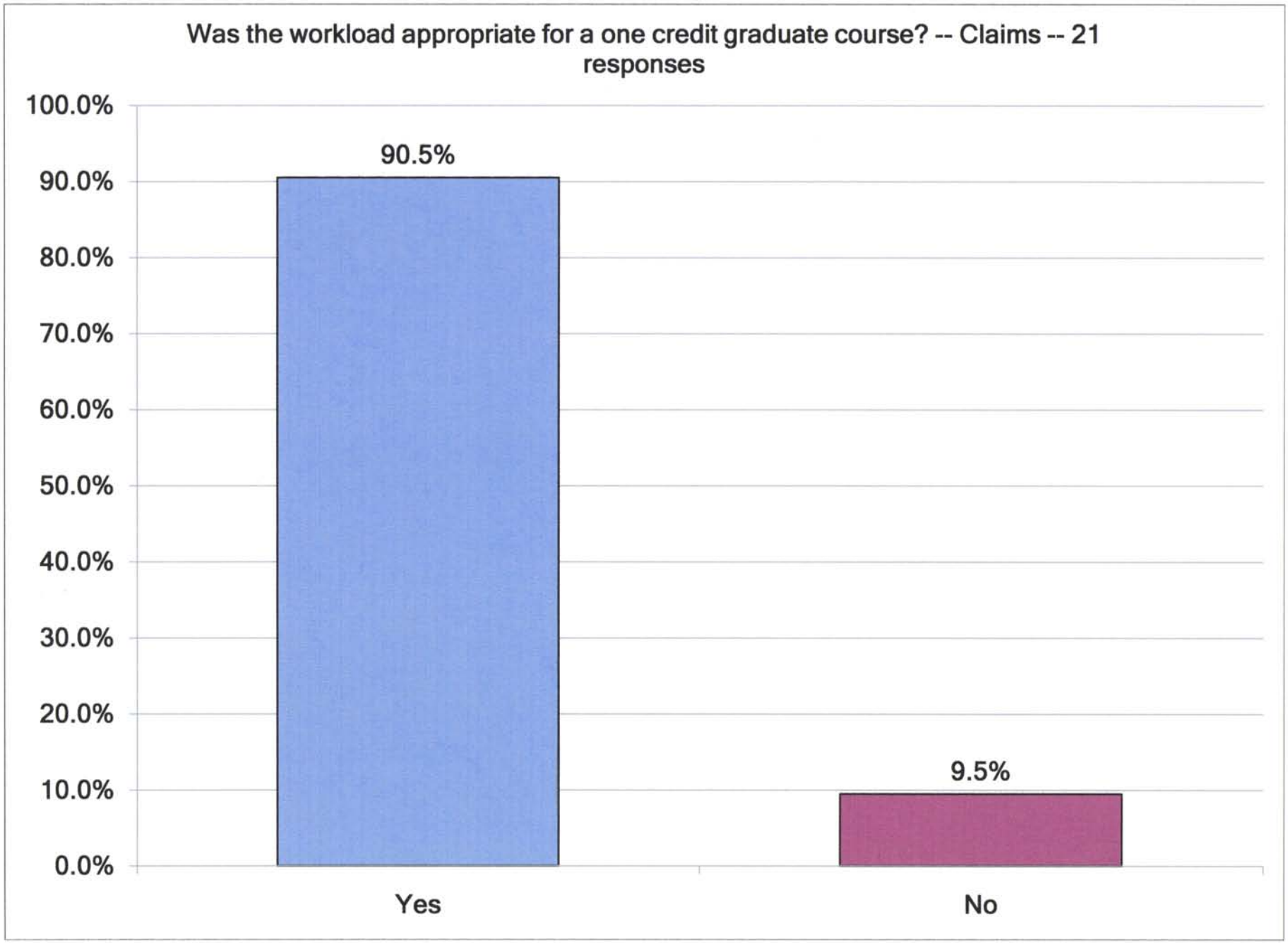

How relevant was the course content to your personal professional growth? -- Claims -- 24 responses
0.0%
45.8%
54.2%
Very relevant
Relevant
Not relevant

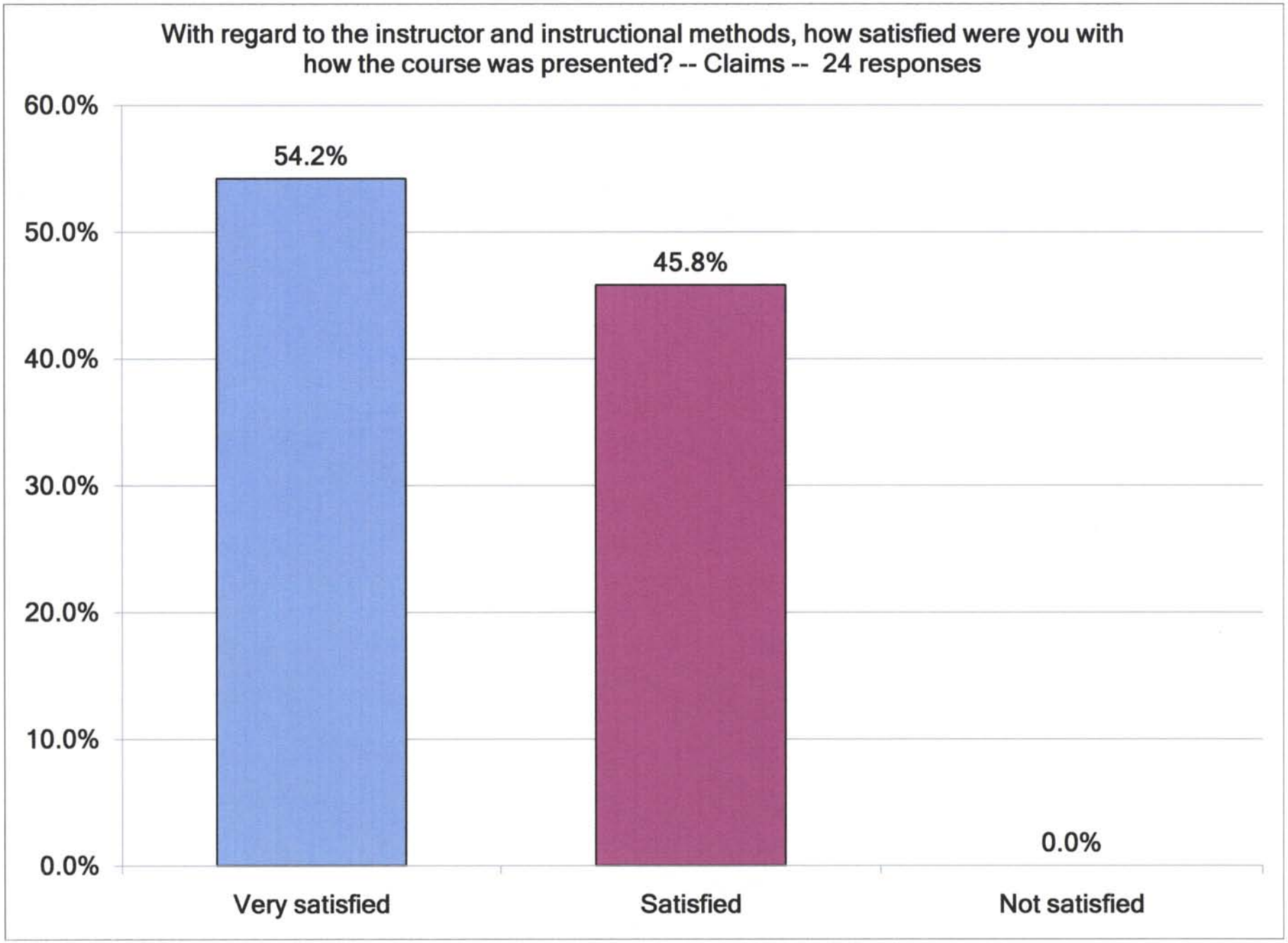
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. CLAIMS

	Response Count
	13
answered question	**13**
skipped question	**44**

	Response Text	
1	Lots of homework makes it difficult when working full time.	Jul 23, 2010 2:33 PM
2	Very good content. No suggestion.	Jul 23, 2010 6:06 PM
3	content was good. was nice to have bridge design included with their experience. Mr Ganley's experience was most valuable as well.	Jul 24, 2010 5:20 PM
4	Excellent course. Lots of new information.	Jul 25, 2010 6:35 PM
5	Add more from the legal aspect, such as having the AG's office involved.	Jul 27, 2010 5:23 AM
6	Some additional class time to discuss additional construction claim issues would be useful	Jul 27, 2010 5:36 PM
7	the course was well orchestrated, and the material was beyond my expectation .	Jul 29, 2010 10:11 PM
8	I was not able to attend all the sessions so I just was an audit for the course, and what I did attend was very applicable to my work	Jul 29, 2010 11:26 PM
9	Add more case law rather than case study.	Jul 30, 2010 1:50 AM
10	great variety	Aug 2, 2010 4:17 PM
11	Possibly more case studies from transportation projects.	Aug 3, 2010 12:02 AM
12	I thought it was good. I am fairly certain I provided constructive comments to the instructor following the completion of the course.	Aug 17, 2010 8:09 PM
13	Larry will keep our group on the forefront of the institutional thinking, with a pragmatic impact in the classroom. Mike Herbeck.	Aug 18, 2010 4:58 PM


Was the workload appropriate for a one credit graduate course? -- Claims -- 21 responses
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
90.5%
9.5%
Yes
No


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- Claims -- 24 responses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
54.2%
45.8%
0.0%
Very satisfied
Satisfied
Not satisfied

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements CLAIMS

	Response Count
	11
answered question	**11**
skipped question	**44**

	Response Text	
1	Excellent - Quite a motivator	Jul 23, 2010 2:33 PM
2	It was good to include different spectrum of people, especially the designer in the class. Real case study is a good approach.	Jul 23, 2010 6:06 PM
3	Presentation was excellent. video conferencing worked better than i thought it would.	Jul 24, 2010 5:20 PM
4	Excellent instructor. Professionals from the construction industry and government agencies did a superb job.	Jul 25, 2010 6:35 PM
5	Distance learning is difficult, but the instructor did a good job.	Jul 27, 2010 5:23 AM
6	Technical difficulties with setting up the video conferencing put a little damper on the class.	Jul 27, 2010 5:36 PM
7	Case studies present information in an interesting manner -- Makes learning more interesting than just reading a text book. The course delivery method worked very well.	Jul 27, 2010 5:57 PM
8	Material was well presented, and guest speakers were very helpful to understand the concept of the course.	Jul 29, 2010 10:11 PM
9	Providing materials by e-mail was a plus.	Jul 29, 2010 11:26 PM
10	The course was offered remotely to UAS. In general, remote courses are not as effective as in-person courses.	Jul 30, 2010 1:50 AM
11	it was a very intense several weeks, but then it was over.	Aug 2, 2010 4:17 PM

CM Program Course Survey

Please offer other comments, reflections, suggestions, and the like about this course. CLAIMS

	Response Count
	7
answered question	7
skipped question	48

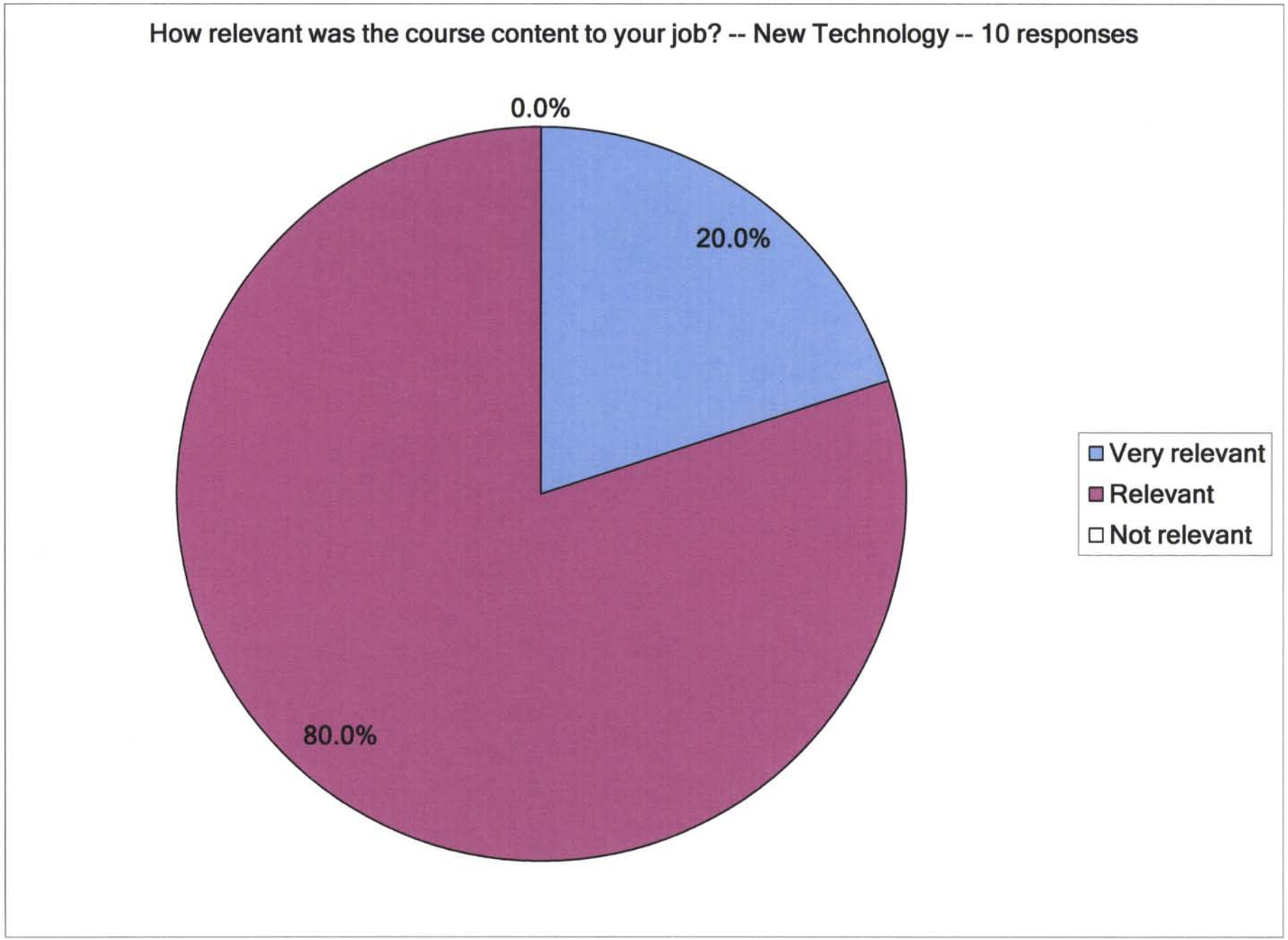
	Response Text	
1	Interesting having many presenters - from private industry, government agencies etc. All bring a slightly different perspective to the table - which if one can view the world from the other side of the table, see their needs, then it may be easier to come to an agreeable solution rather than claim.	Jul 23, 2010 2:33 PM
2	None.	Jul 23, 2010 6:06 PM
3	It's easy to talk about how to improve, but when the people making the big decisions aren't in the class talking about it too, there may not be an opportunity to use information from the class.	Jul 27, 2010 5:23 AM
4	Learned quit a lot, please keep up the outstanding job.	Jul 29, 2010 10:11 PM
5	Claims advoidance, in my humble experience, seems to be hinged on communication skills. Savey communication skills aren't a part of engineering curriculum, however communicating effectively makes or breaks the engineer as far as success goes.	Jul 29, 2010 11:26 PM
6	none	Jul 30, 2010 1:50 AM
7	thanks for the opportunity	Aug 2, 2010 4:17 PM

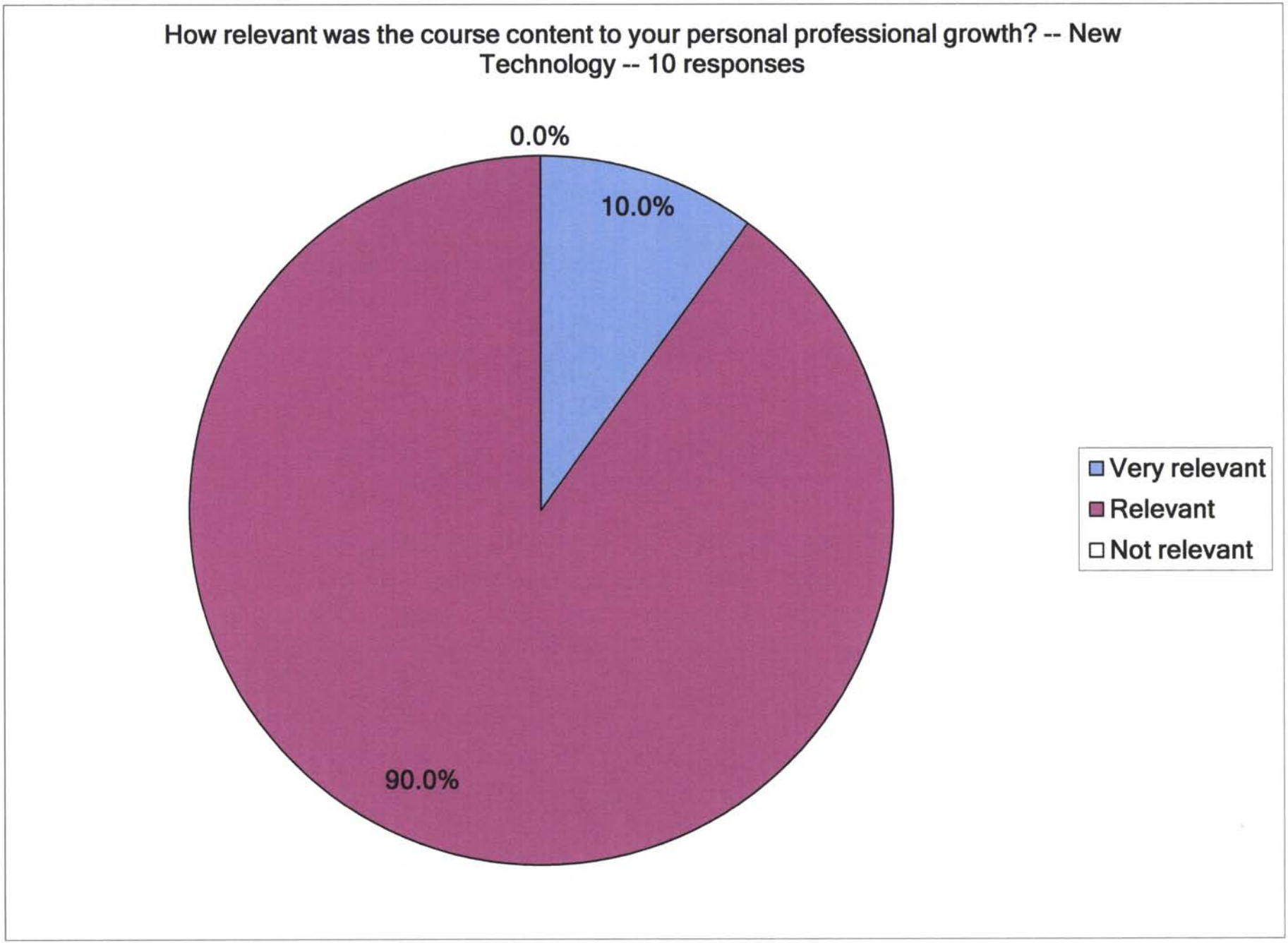
CM Program Course Survey

What was your primary reason for taking this course? NEW TECHNOLOGY

	Response Count
	10
answered question	**10**
skipped question	**45**

	Response Text	
1	See what was new	Jul 23, 2010 2:33 PM
2	expand my knowledge base.	Jul 24, 2010 12:29 AM
3	Interest in technology	Jul 24, 2010 5:22 PM
4	The primary purpose was to earn continuing education "credit" in order to maintain my Professional Engineers License.	Jul 26, 2010 8:04 AM
5	continuing education	Jul 26, 2010 2:50 PM
6	Continuing Education Units	Jul 28, 2010 12:43 AM
7	Relevance to my job.	Jul 29, 2010 10:44 PM
8	An area of the industry that is growing and wanted an overview.	Jul 31, 2010 3:59 PM
9	New ideas are always welcome	Aug 10, 2010 3:17 PM
10	To learn about new technologies being used in construction	Aug 17, 2010 12:31 AM


How relevant was the course content to your job? -- New Technology -- 10 responses
0.0%
20.0%
80.0%
Very relevant
Relevant
Not relevant

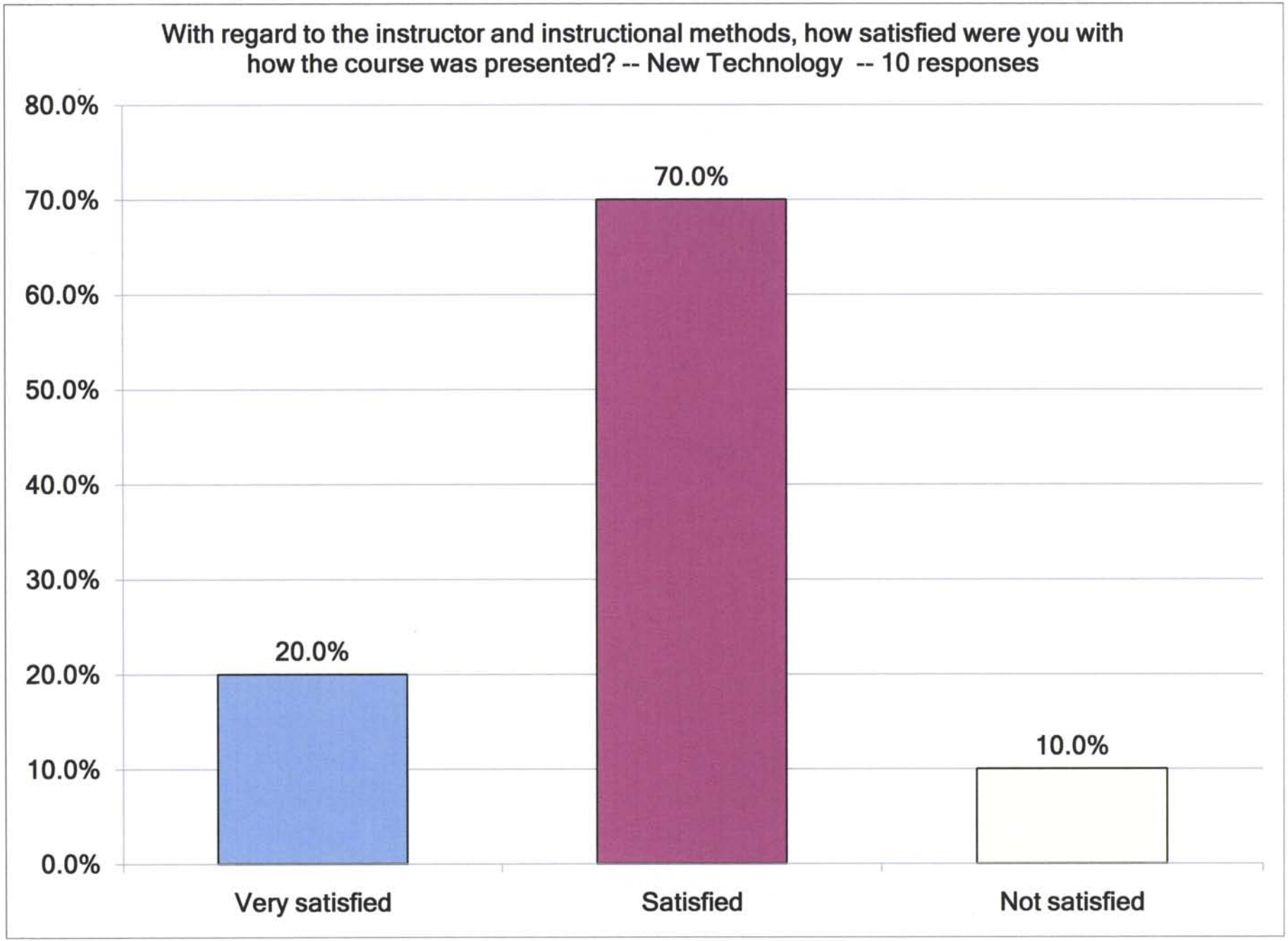

How relevant was the course content to your personal professional growth? -- New Technology -- 10 responses
0.0%
10.0%
90.0%
Very relevant
Relevant
Not relevant

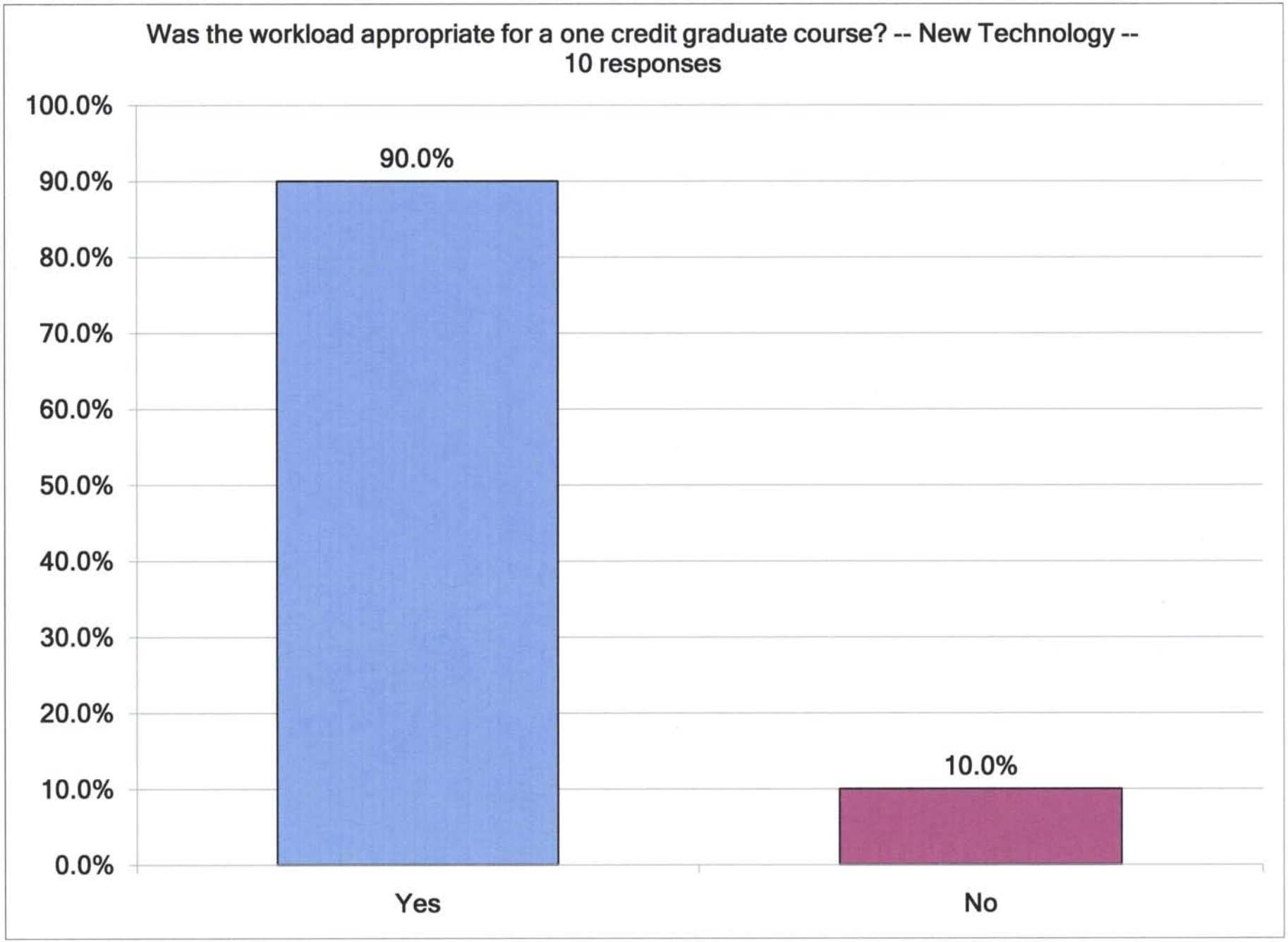
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. NEW TECHNOLOGY

	Response Count
	4
answered question	**4**
skipped question	**51**

	Response Text	
1	the technology presented was not found in every day life. Would like to learn about technologies that would help everyday production.	Jul 24, 2010 5:22 PM
2	Course content was fine. Since it was a survey of "new" technology the course would have to be updated for every new offering. It was oriented towards DOT and its construction and maintenance functions. If the course was to directed towards another group it would have to be substantially changed.	Jul 26, 2010 8:04 AM
3	Course was good. I have still not heard back or recieved credit for this course	Jul 26, 2010 2:50 PM
4	Course seemed unfocused and lacked direction.	Aug 10, 2010 3:17 PM


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- New Technology -- 10 responses
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
20.0%
70.0%
10.0%
Very satisfied
Satisfied
Not satisfied


Was the workload appropriate for a one credit graduate course? -- New Technology -- 10 responses
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
90.0%
10.0%
Yes
No

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements NEW TECHNOLOGY

	Response Count
	3
answered question	3
skipped question	52

	Response Text	
1	Presentation was good. No suggestions for improvement	Jul 24, 2010 5:22 PM
2	Presentation was fine for a "general" class. The guest presenters were interesting and informative. The class projects and related presentations were for the most part informative.	Jul 26, 2010 8:04 AM
3	I actually never received a grade for this course.	Jul 29, 2010 10:44 PM

CM Program Course Survey

Please offer other comments, reflections, suggestions, and the like about this course. NEW TECHNOLOGY

	Response Count
	2
answered question	2
skipped question	53

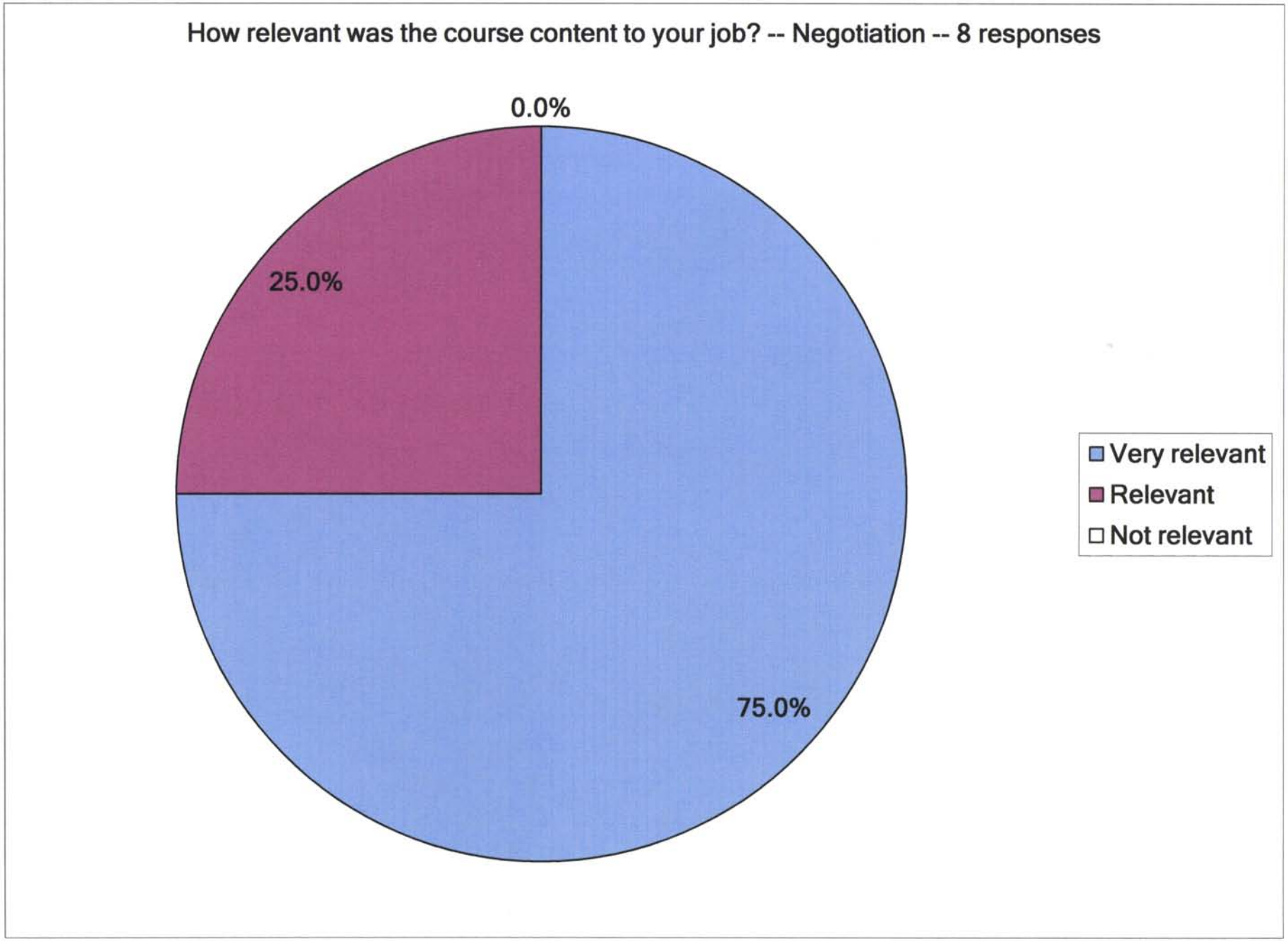
	Response Text	
1	Would like to see more pertinent technologies for everyday use. computers, productivity application, how to improve productivity with smart phones, the like.	Jul 24, 2010 5:22 PM
2	If the course if offered again and the primary audience is DOT then maybe a few more speakers could be brought in to talk about Departmental initiatives.	Jul 26, 2010 8:04 AM

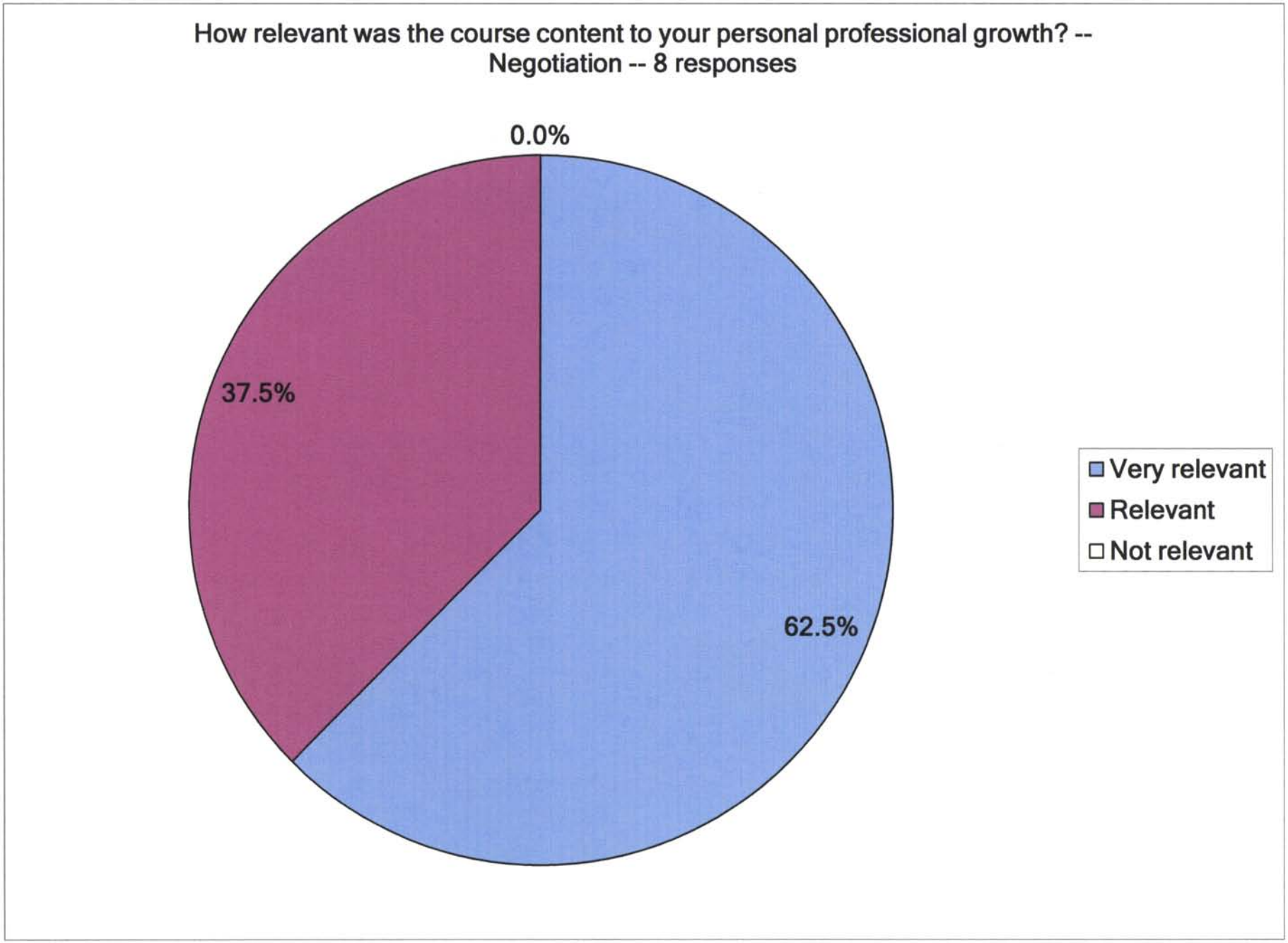
CM Program Course Survey

What was your primary reason for taking this course? NEGOTIATION

	Response Count
	8
answered question	8
skipped question	47

	Response Text	
1	Always need to know how to negotiate	Jul 23, 2010 2:34 PM
2	To gain a broader knowledge in negotiation techniques and practices.	Jul 23, 2010 4:59 PM
3	This skill is incredibly important for Construction Managers! Many situations that arise in Construction are unplanned and require cost and description of work adjustments. Skill and tact in handling these issues is very important in order for the Department to obtain a safe and useable product at a fair cost and in a timely manner.	Jul 23, 2010 7:12 PM
4	Desire to improve negotiation skills	Jul 24, 2010 5:24 PM
5	An area that is used by me a lot as part of my job.	Jul 31, 2010 4:00 PM
6	Improve my negotiating skills	Aug 10, 2010 3:17 PM
7	To learn techniques of effective negotiating	Aug 17, 2010 12:33 AM
8	gather knowledge/experience	Aug 17, 2010 7:44 PM


How relevant was the course content to your job? -- Negotiation -- 8 responses
0.0%
25.0%
75.0%
Very relevant
Relevant
Not relevant

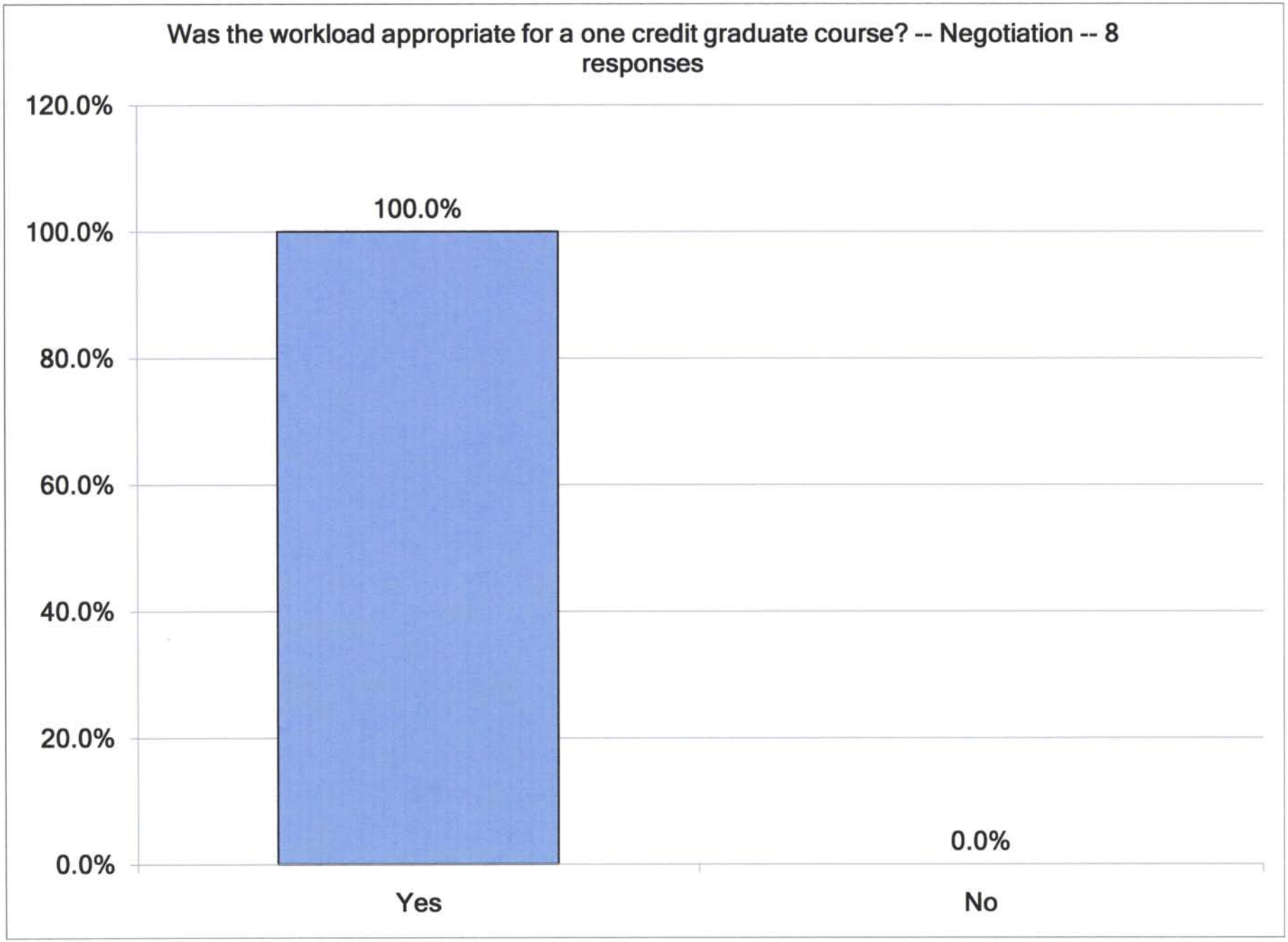

How relevant was the course content to your personal professional growth? -- Negotiation -- 8 responses
0.0%
37.5%
62.5%
Very relevant
Relevant
Not relevant

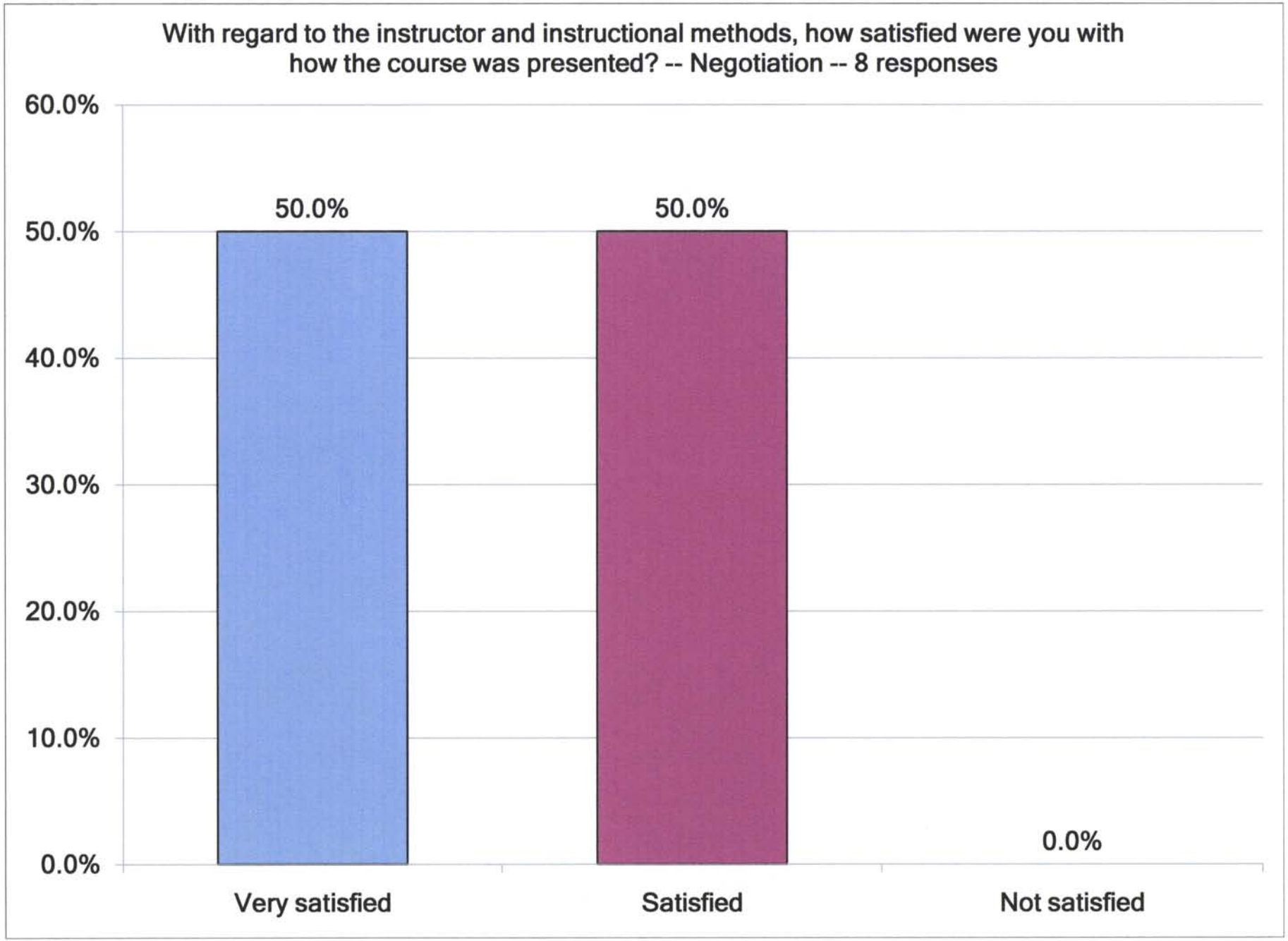
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. NEGOTIATION

	Response Count
	3
answered question	3
skipped question	52

	Response Text	
1	Role playing out situations and evaluating the outcomes was very instructional in this class. Reading literature about negotiating can't compare with actually practicing it with a mentor who can skillfully assess what went right and what went wrong. My only comment would be that some of the examples be more work related. Field inspectors in the Construction Section, especially the seasoned ones, could probably provide the instructor with many actual scenarios that could be changed slightly to teach specific principles.	Jul 23, 2010 7:12 PM
2	Would like to see better negotiation practice. The practice examples were not pertinent to the construction industry.	Jul 24, 2010 5:24 PM
3	all in all good, it would have been nice to have a wider range of student backgrounds (most were AKDOT and PF). could have added more work without undue burden.	Aug 17, 2010 7:44 PM


Was the workload appropriate for a one credit graduate course? -- Negotiation -- 8 responses
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
100.0%
0.0%
Yes
No


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- Negotiation -- 8 responses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
50.0%
50.0%
0.0%
Very satisfied
Satisfied
Not satisfied

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements NEGOTIATION

	Response Count
	2
answered question	**2**
skipped question	**53**

	Response Text	
1	Wonderful class that taught useful skills! This class had a lot of homework, but I enjoyed it.	Jul 23, 2010 7:12 PM
2	Presentation was good. Need better examples/mock ups.	Jul 24, 2010 5:24 PM

CM Program Course Survey

Please offer other comments, reflections, suggestions, and the like about this course. NEGOTIATION

	Response Count
	2
answered question	**2**
skipped question	**53**

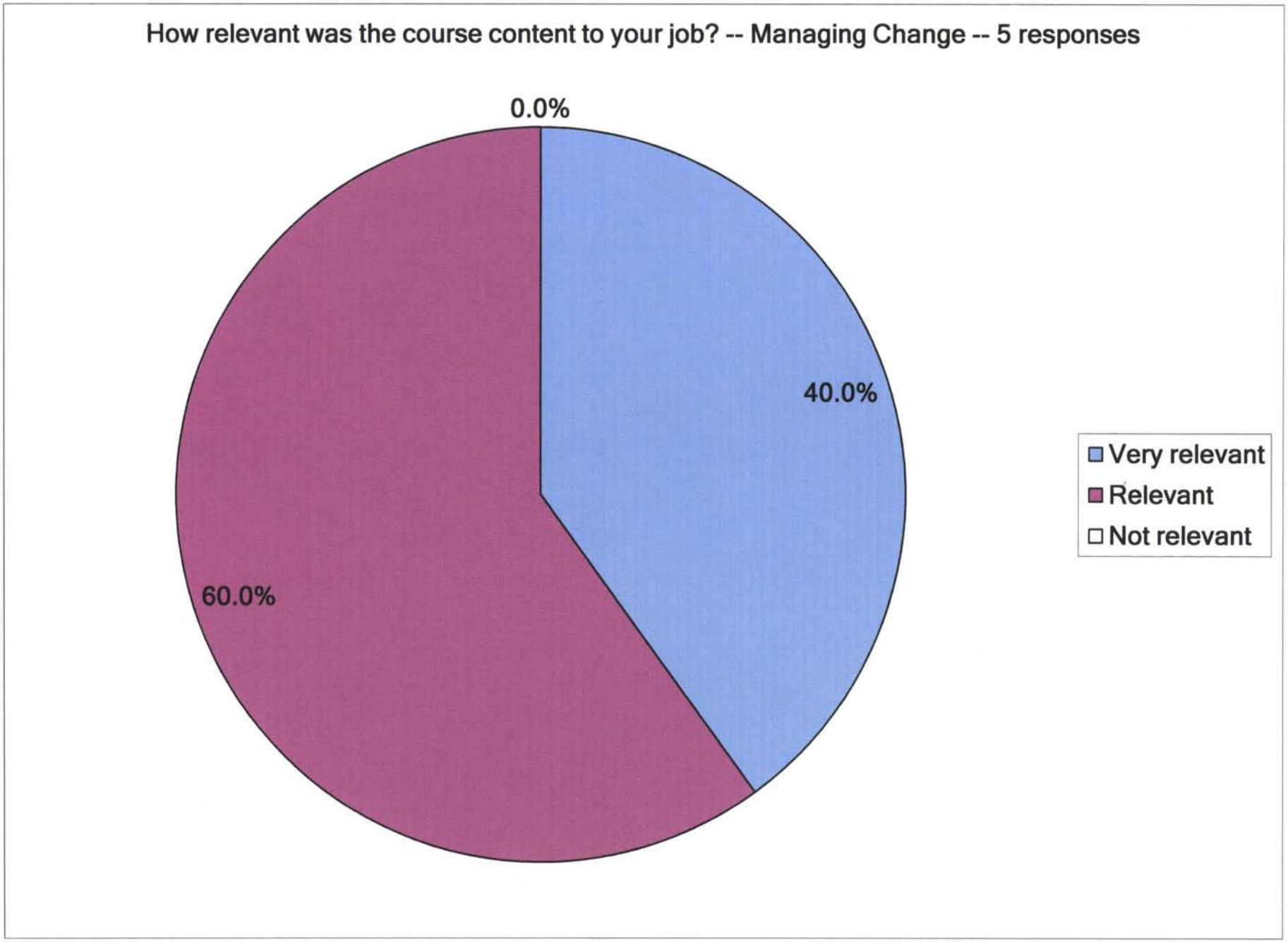
	Response Text	
1	There is a lot to be known about this subject. A one credit class can only scratch the surface. I would like to see more classes on this subject as good negotiating skills can make or break a project.	Jul 23, 2010 7:12 PM
2	would like to see actual construction examples of negotiations. Would be easy to work with Construction Managers to get good examples of negotiation issues and techniques.	Jul 24, 2010 5:24 PM

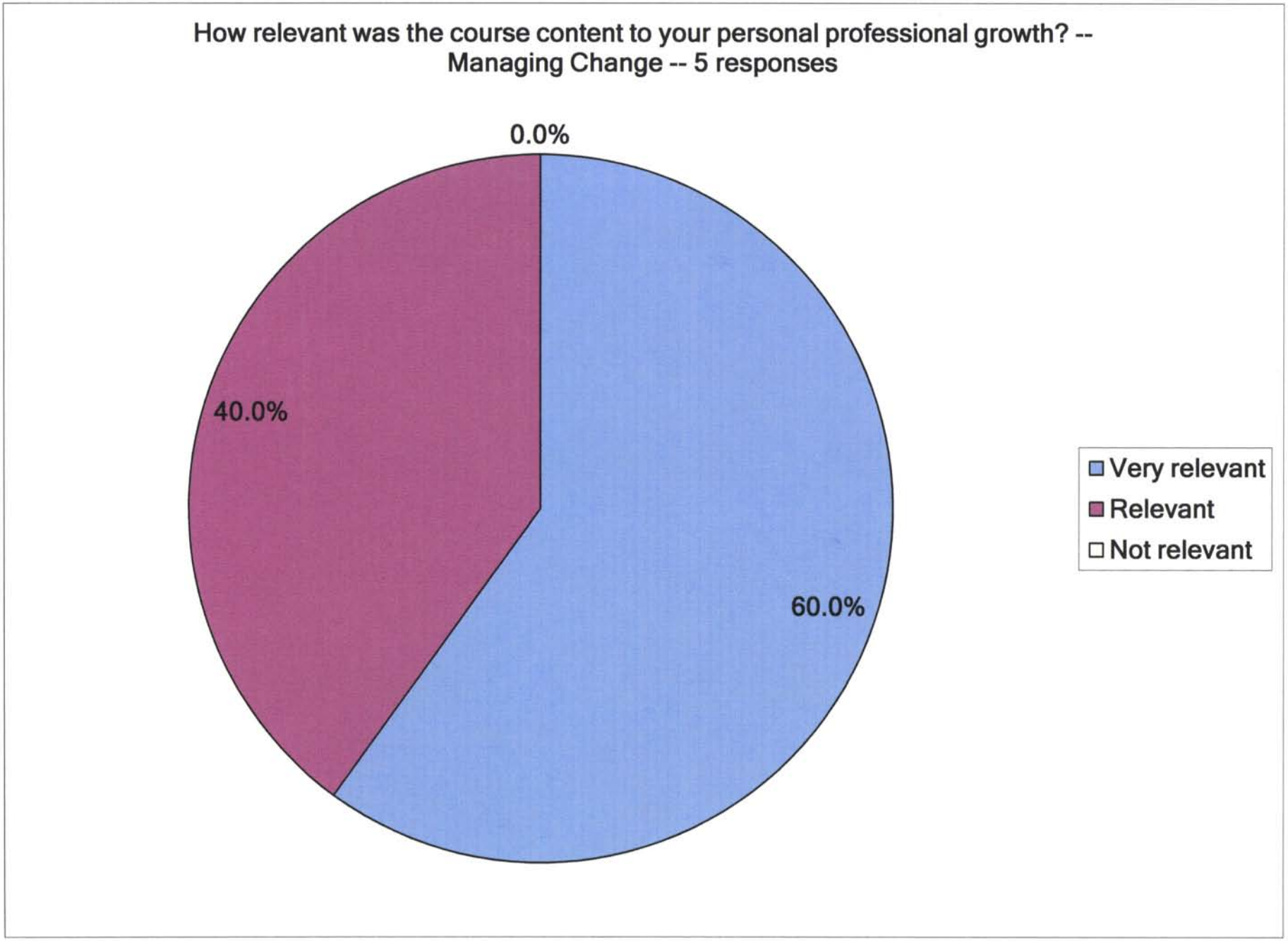
CM Program Course Survey

What was your primary reason for taking this course? MANAGINGCHANGE

	Response Count
	5
answered question	**5**
skipped question	**50**

	Response Text	
1	Improve leadership/management skills.	Jul 23, 2010 6:55 PM
2	This subject is very relevant in our constantly changing times.	Jul 23, 2010 7:21 PM
3	No schedule conflicts.	Jul 30, 2010 4:48 PM
4	Continueing grow in my field.	Jul 31, 2010 4:01 PM
5	I thought it would be relevant to my work.	Aug 16, 2010 11:16 PM


How relevant was the course content to your job? -- Managing Change -- 5 responses
0.0%
40.0%
60.0%
Very relevant
Relevant
Not relevant

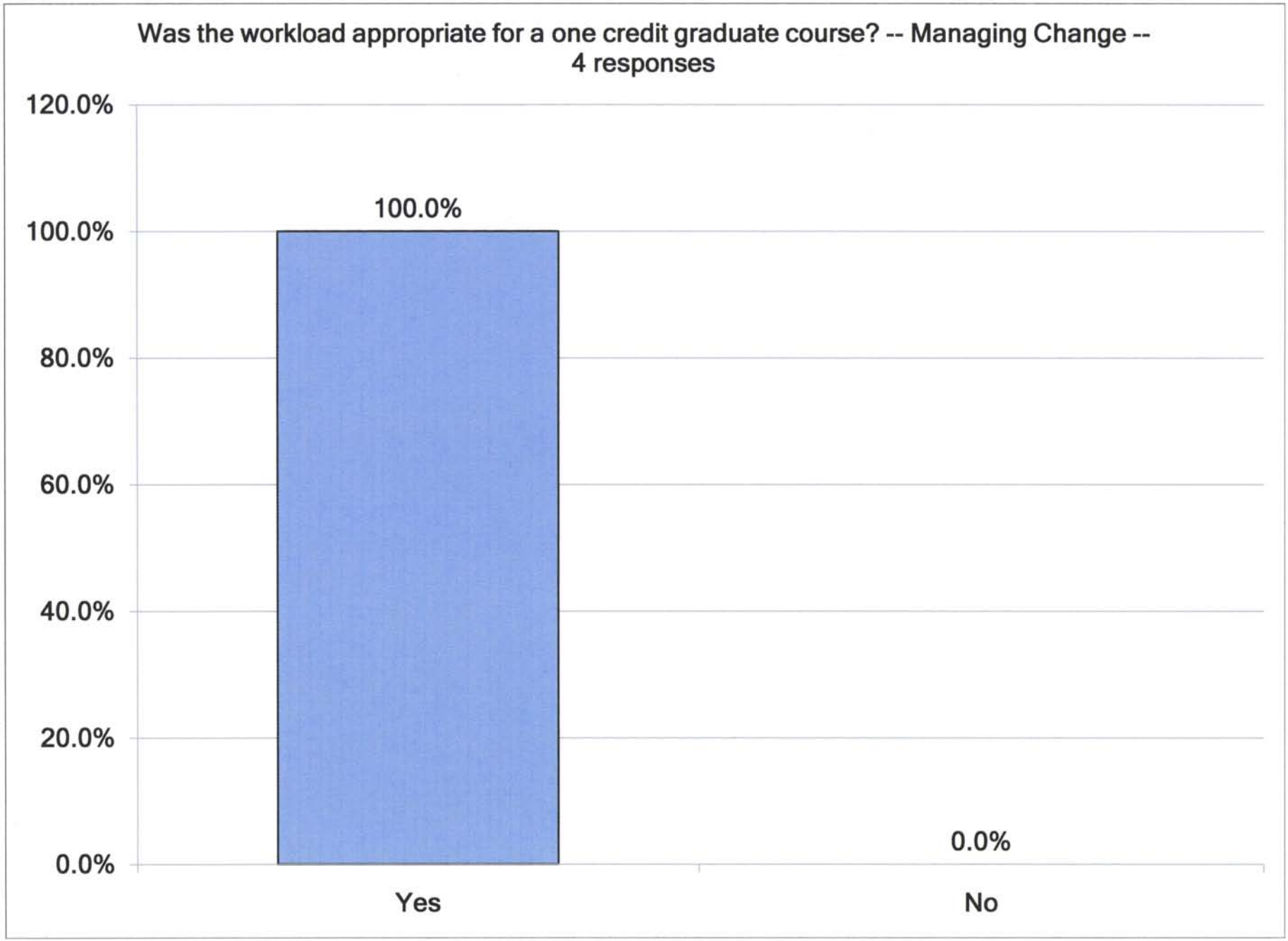

How relevant was the course content to your personal professional growth? -- Managing Change -- 5 responses
0.0%
40.0%
60.0%
Very relevant
Relevant
Not relevant

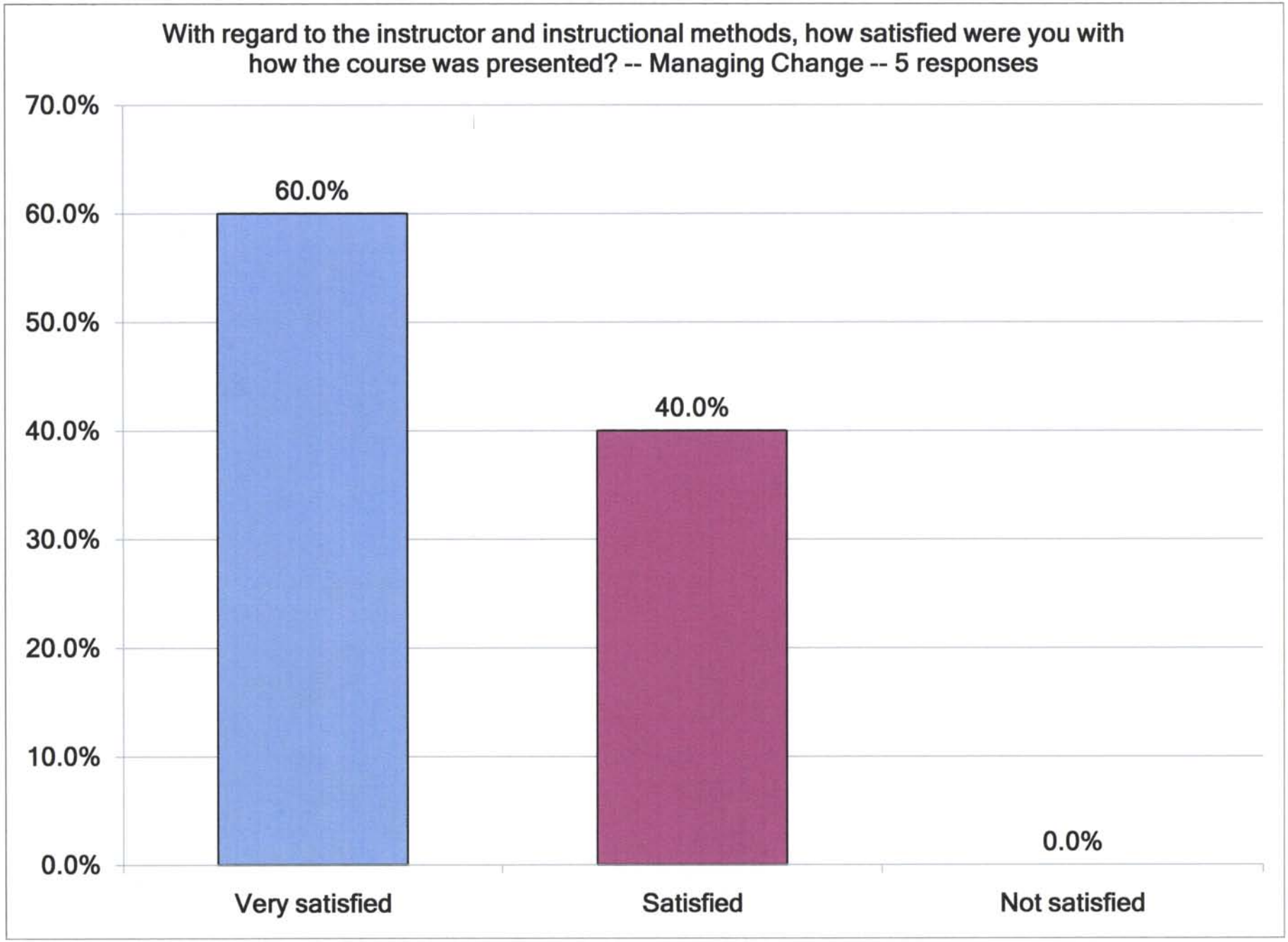
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. MANAGING CHANGE

	Response Count
	4
answered question	**4**
skipped question	**51**

	Response Text	
1	Suggest increased focus on contemporary situations and very illustrative case studies.	Jul 23, 2010 6:55 PM
2	The instructor made the course very job relevant by having participants use examples from the workplace. I thought the topic was well covered.	Jul 23, 2010 7:21 PM
3	While my original reason for attending this course was its and my mutual availability, both the content and the enthusiasm presented by the instructor were very engaging. The instructor's background, both professionally and academically, in the subject of the class contributed greatly to the success of the class.	Jul 30, 2010 4:48 PM
4	Good presenter.	Aug 16, 2010 11:16 PM


Was the workload appropriate for a one credit graduate course? -- Managing Change -- 4 responses
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
100.0%
0.0%
Yes
No


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- Managing Change -- 5 responses
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
60.0%
40.0%
0.0%
Very satisfied
Satisfied
Not satisfied

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements MANAGING CHANGE

	Response Count
	4
answered question	4
skipped question	51

	Response Text	
1	The presentation was somewhat haphazard. We seemed to jump around. Suggest increasing the structure of the course and its presentation.	Jul 23, 2010 6:55 PM
2	The material was presented in a very work-relevant manner, which helped students put the principles into practice.	Jul 23, 2010 7:21 PM
3	The energy and techniques used by the instructor to involve each member of the class were very impressive.	Jul 30, 2010 4:48 PM
4	Add more homework.	Aug 16, 2010 11:16 PM

CM Program Course Survey

Please offer other comments, reflections, suggestions, and the like about this course. MANAGING CHANGE

	Response Count
	3
answered question	3
skipped question	52

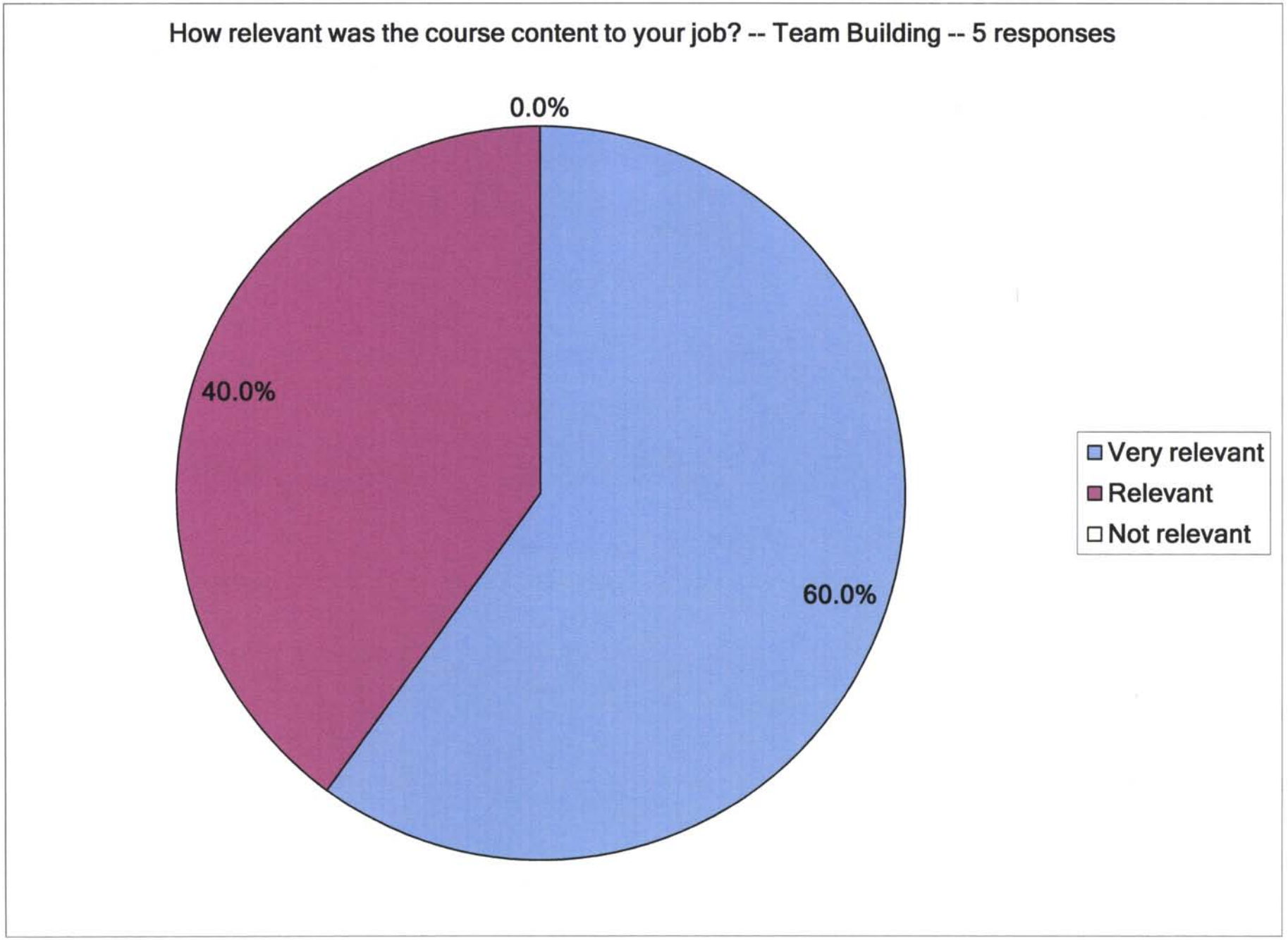
	Response Text	
1	For meaninful interaction/participation, the students ideally should have leadership/management background or be serioulsly engaged in those issues. Consider emphasizing prerequisites.	Jul 23, 2010 6:55 PM
2	This was a wonderful class! My only regret was that more employees with the authority to make changes did not take it as some changes recently implemented by DOT/PF have not been received well. Maybe it could be marketed differently with a different course title as many managers I asked to take the course said that they did not have time and that they had already done other trainings with a similar name. Maybe the name could be more descriptive of the course content and how it directly affects managers.	Jul 23, 2010 7:21 PM
3	While I first sat down in the class without a good understanding of the direction of the course, the message and universal value of the subject matter quickly became apparent. I would recommend this course to almost anyone, however I honestly can not say whether another instructor could develop the same buy-in, in such a short time.	Jul 30, 2010 4:48 PM

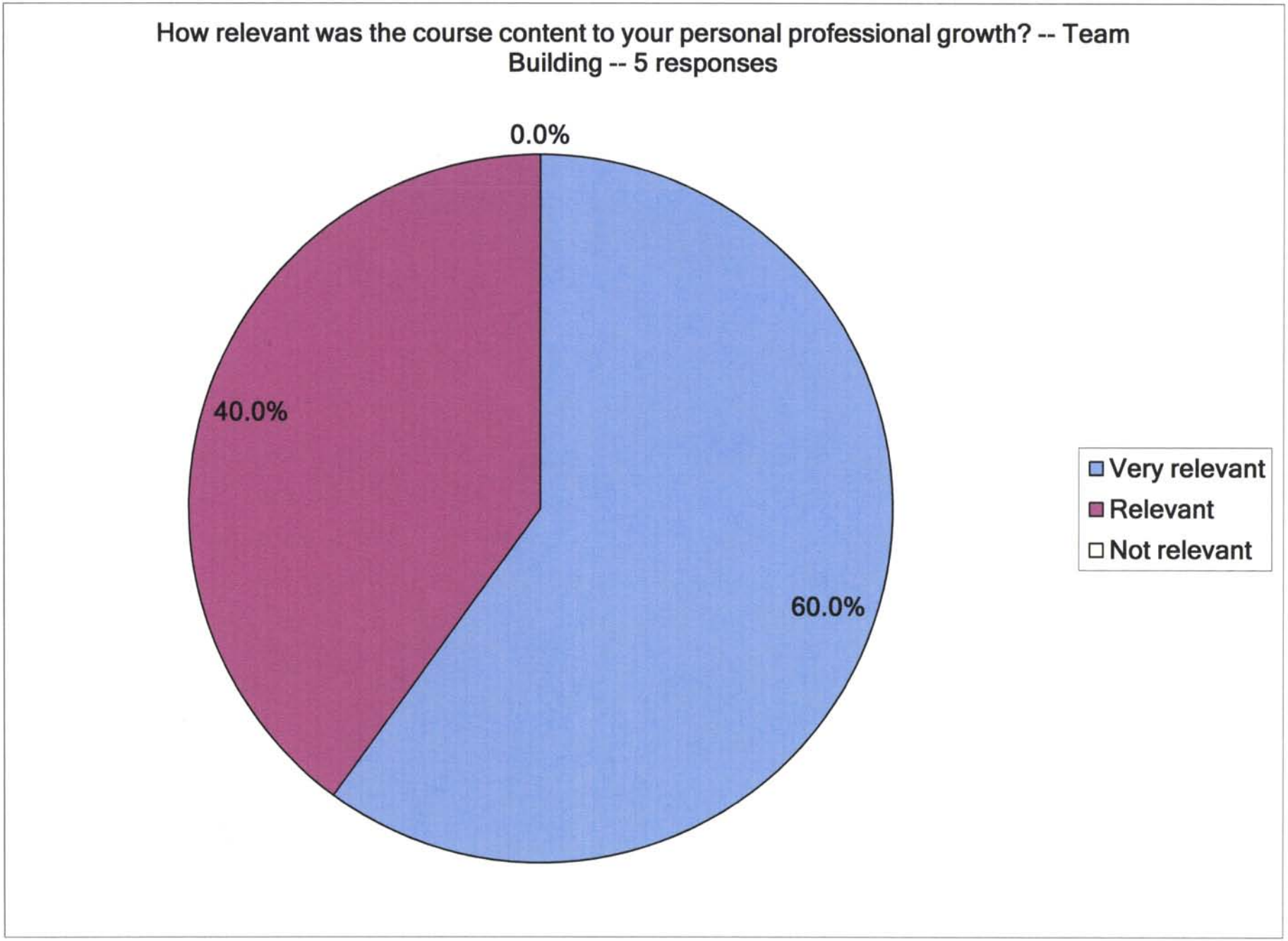
CM Program Course Survey

What was your primary reason for taking this course? TEAM BUILDING

	Response Count
	5
answered question	5
skipped question	51

	Response Text	
1	X	Jul 23, 2010 4:57 AM
2	We work in teams as a work unit - each season it's a different team	Jul 23, 2010 2:36 PM
3	Enhance leadership skills	Jul 23, 2010 6:58 PM
4	Our section had no team concept and little information sharing. This was causing frustration.	Jul 23, 2010 7:31 PM
5	well taught class by instructor before on other classes, looking for more tools.	Jul 31, 2010 4:04 PM


How relevant was the course content to your job? -- Team Building -- 5 responses
0.0%
40.0%
60.0%
Very relevant
Relevant
Not relevant

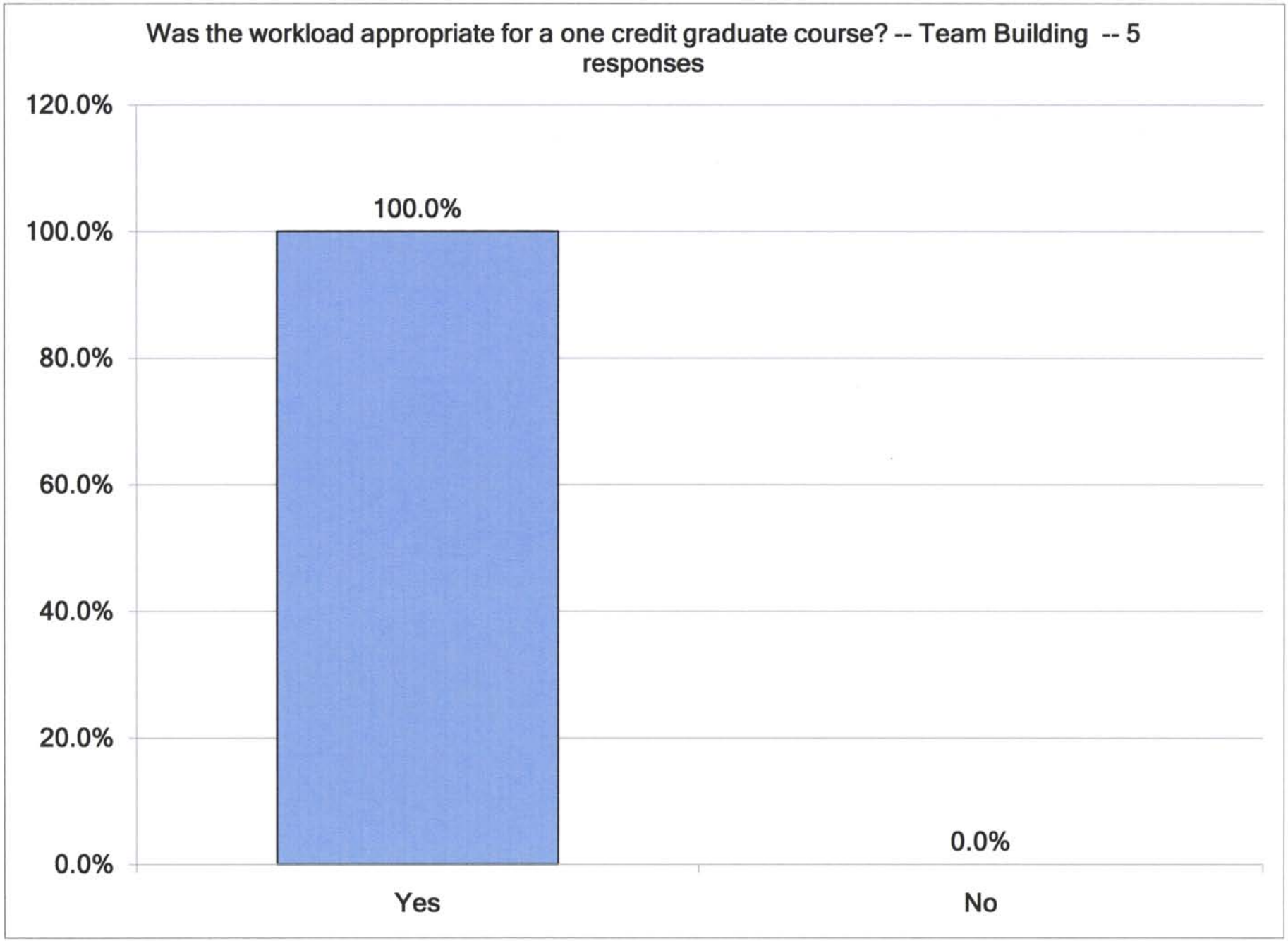

How relevant was the course content to your personal professional growth? -- Team Building -- 5 responses
0.0%
40.0%
60.0%
Very relevant
Relevant
Not relevant

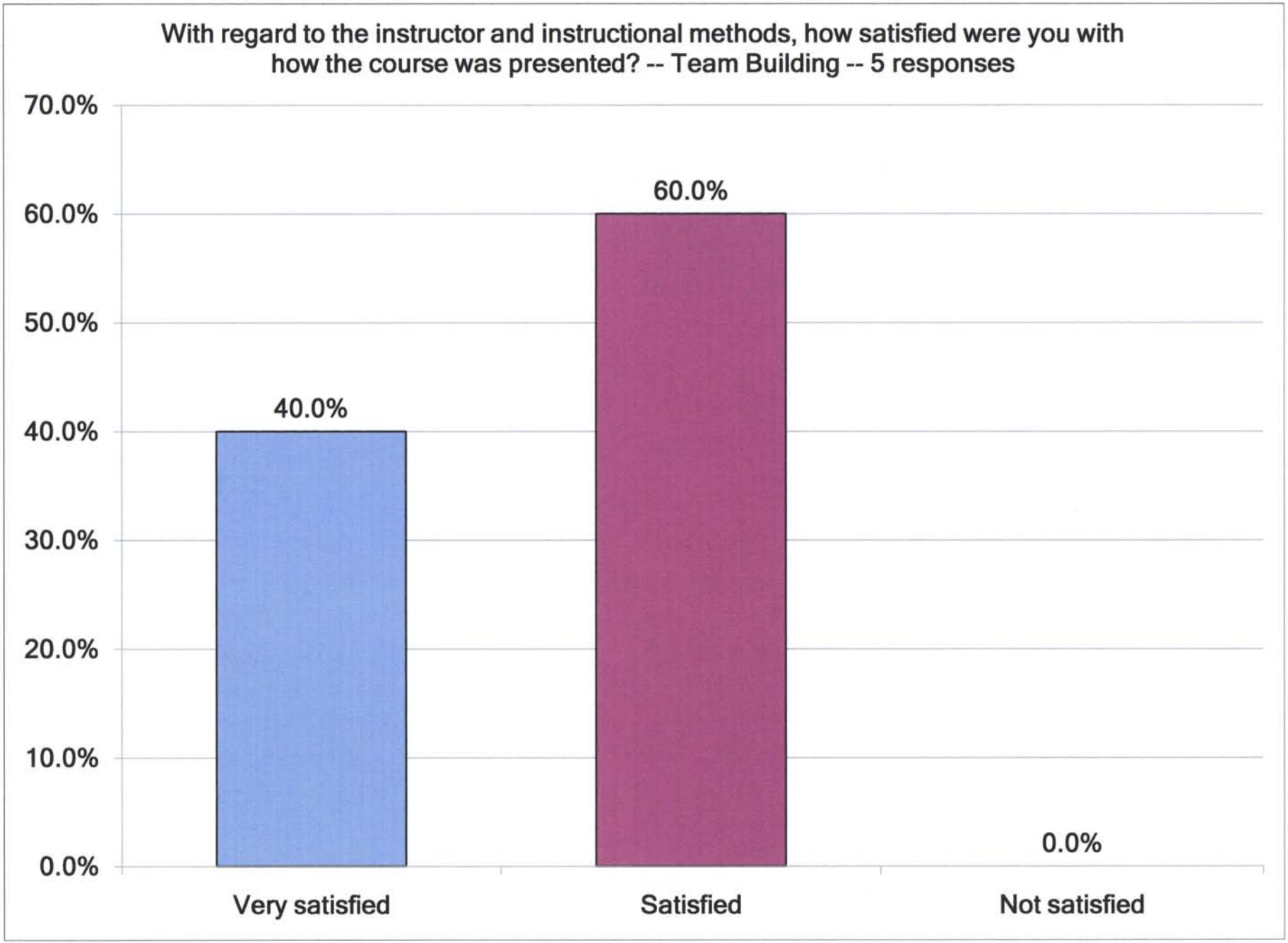
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. TEAM BUILDING

	Response Count
	3
answered question	3
skipped question	53

	Response Text	
1	X	Jul 23, 2010 4:57 AM
2	Content very good.	Jul 23, 2010 6:58 PM
3	The course content was very relevant to the workplace.	Jul 23, 2010 7:31 PM


Was the workload appropriate for a one credit graduate course? -- Team Building -- 5 responses
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
100.0%
0.0%
Yes
No


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- Team Building -- 5 responses
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
40.0%
60.0%
0.0%
Very satisfied
Satisfied
Not satisfied

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements TEAM BUILDING

	Response Count
	3
answered question	3
skipped question	53

	Response Text	
1	X	Jul 23, 2010 4:57 AM
2	Need greater organization and structure. Especially on transitions to new topics.	Jul 23, 2010 6:58 PM
3	As in the Managing Change class, we were required to chose a work-related project. This was very good and gave us practical applications of principles taught.	Jul 23, 2010 7:31 PM

CM Program Course Survey

Please offer other comments, reflections, suggestions, and the like about this course. TEAM BUILDING

	Response Count
	2
answered question	2
skipped question	54

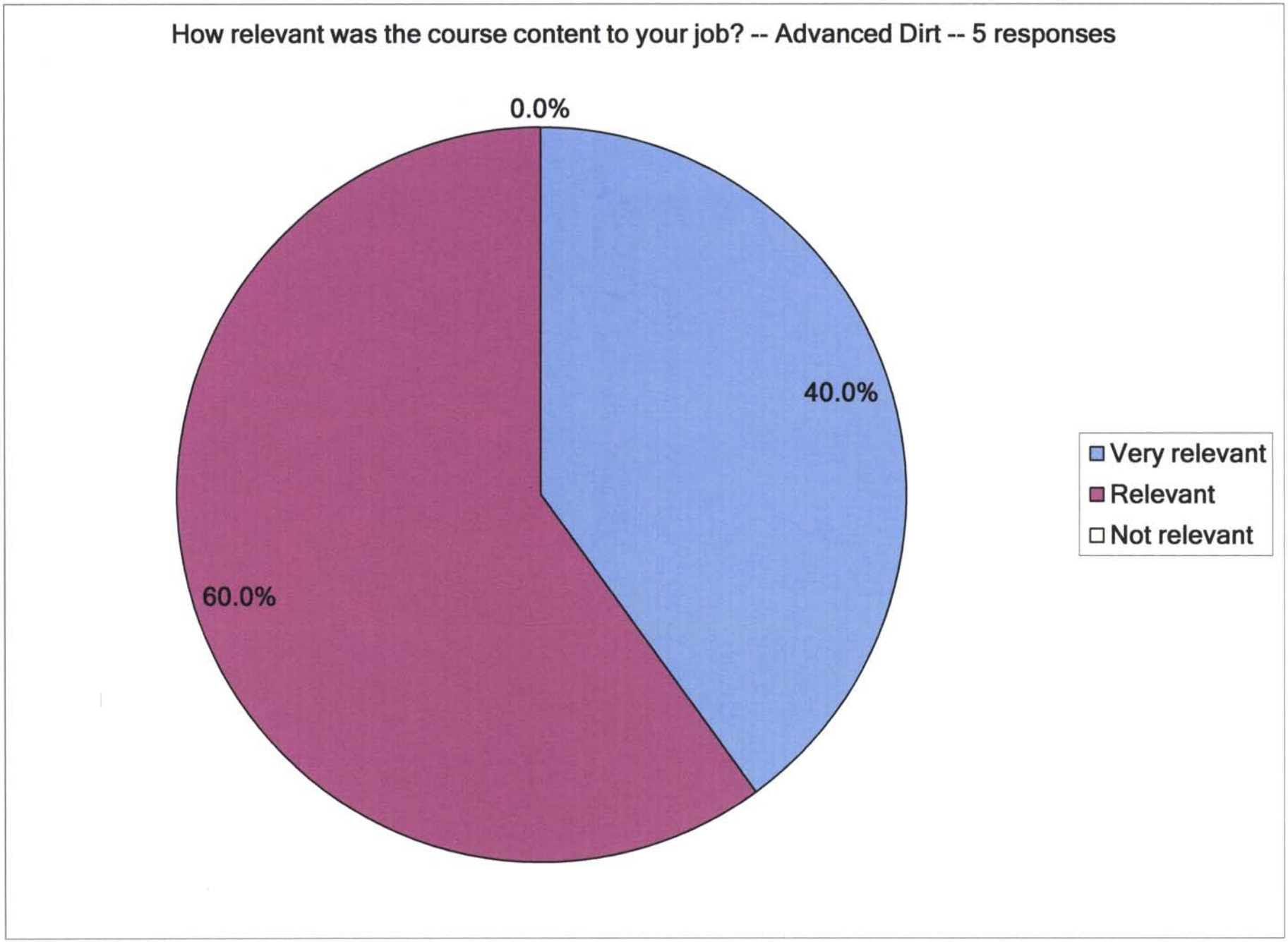
	Response Text	
1	I did not take this class. The survey will not let me go "back" and change my selection.	Jul 23, 2010 4:57 AM
2	This class is very relevant for large organizations such as DOT/PF and consultants. In large organizations, the team concept can very often get lost as each section has their own goals.	Jul 23, 2010 7:31 PM

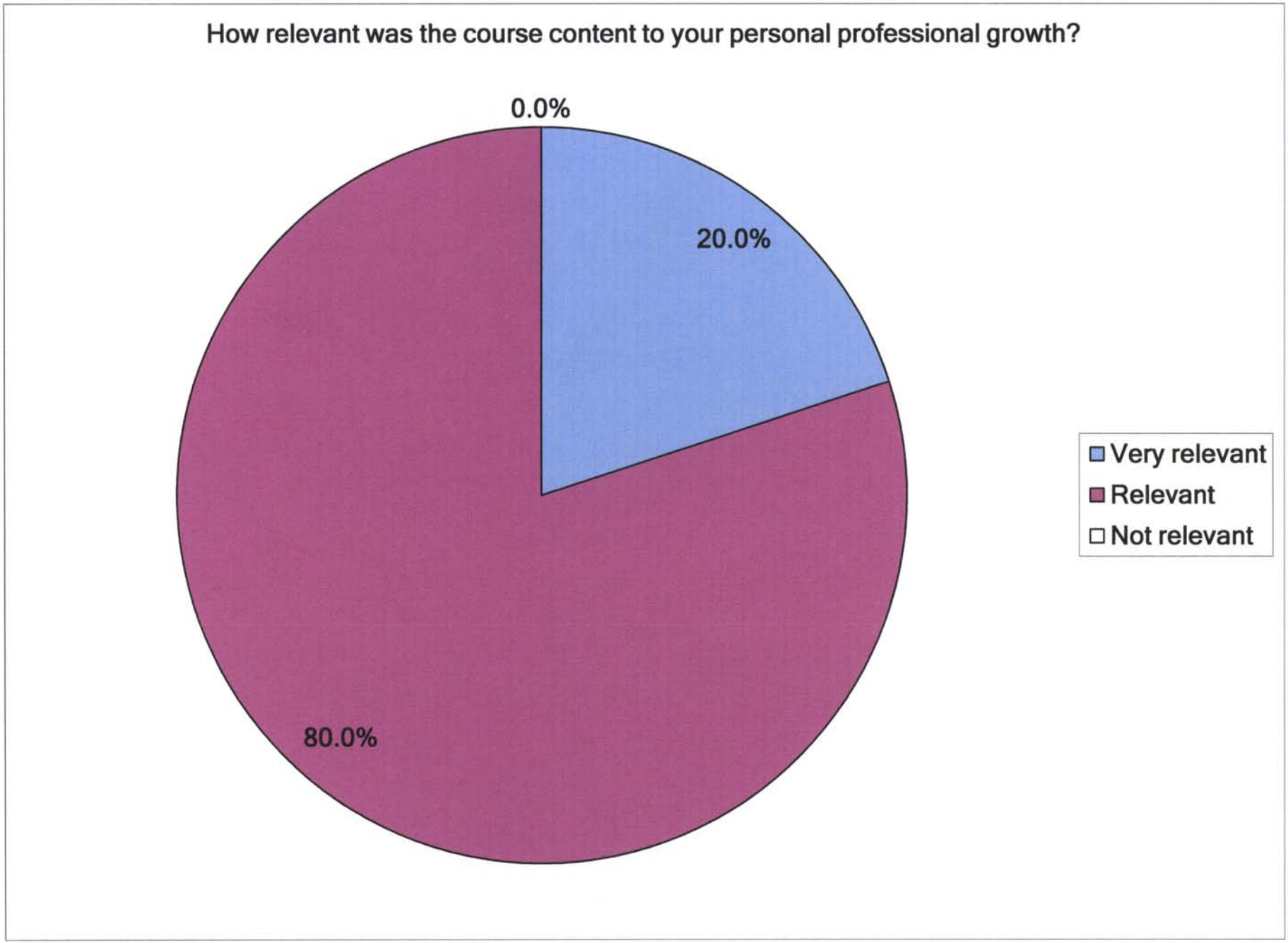
CM Program Course Survey

What was your primary reason for taking this course? ADVANCED DIRT

	Response Count
	5
answered question	5
skipped question	51

	Response Text	
1	Interest in subject matter	Jul 24, 2010 5:29 PM
2	Get more familiar with contractor practices	Jul 29, 2010 10:29 PM
3	an aspect of my job that I doo a lot, wanted more info.	Jul 31, 2010 4:05 PM
4	Learn about dirt estimating	Aug 10, 2010 3:19 PM
5	Relevant to my position.	Aug 16, 2010 11:22 PM


How relevant was the course content to your job? -- Advanced Dirt -- 5 responses
0.0%
40.0%
60.0%
Very relevant
Relevant
Not relevant

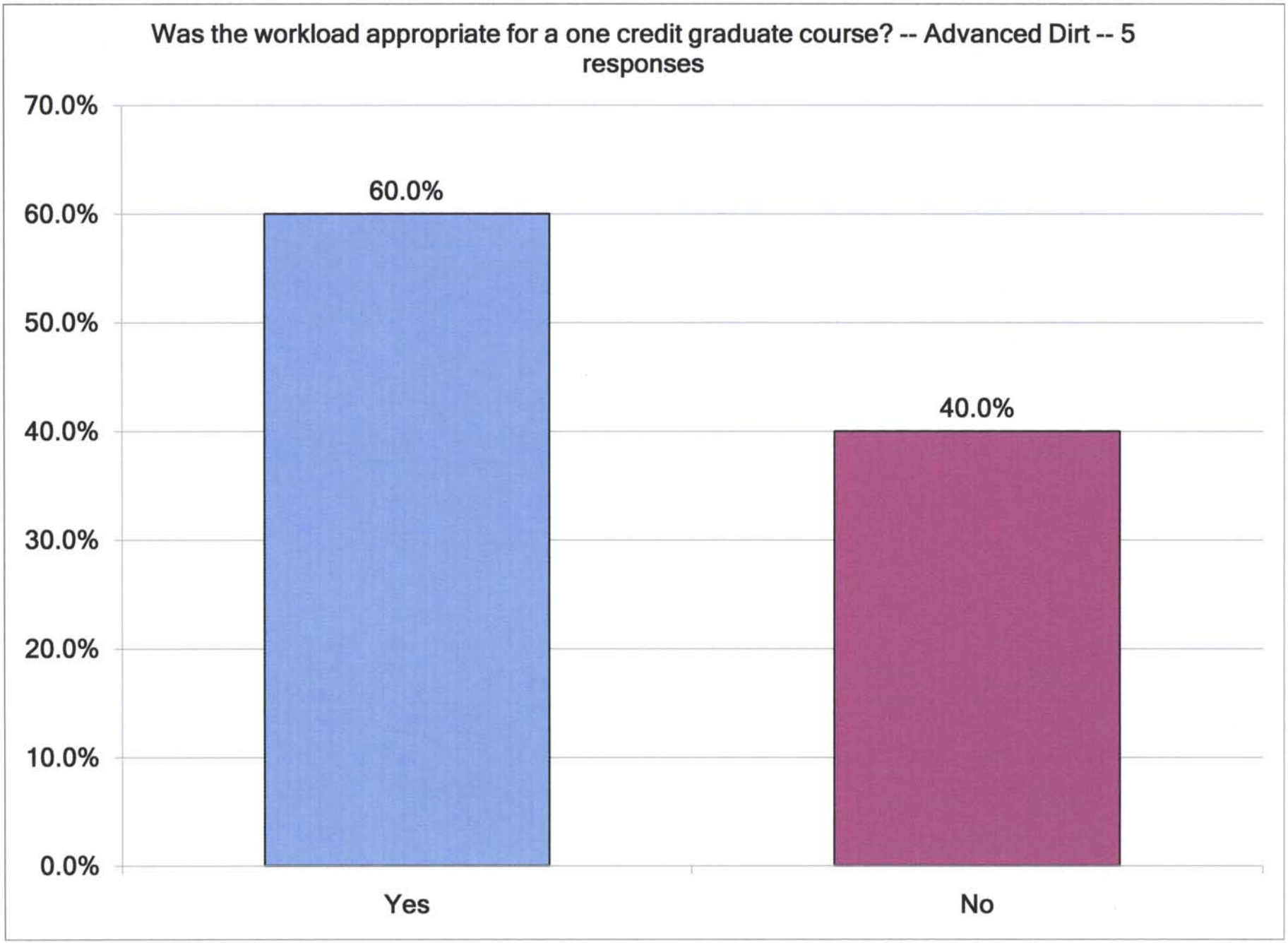

How relevant was the course content to your personal professional growth?
0.0%
20.0%
80.0%
Very relevant
Relevant
Not relevant

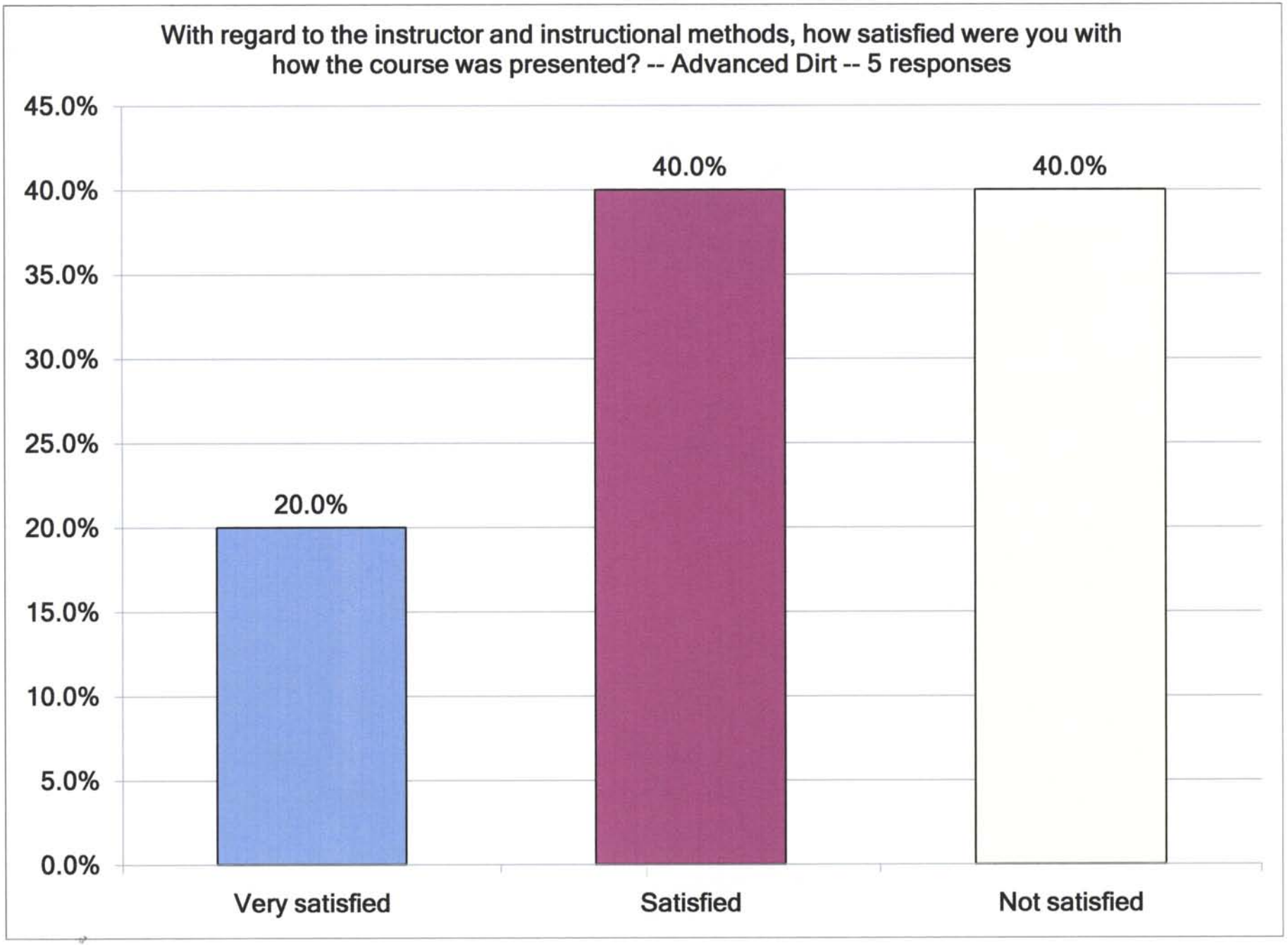
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. ADVANCED DIRT

	Response Count
	4
answered question	4
skipped question	52

	Response Text	
1	The instructor was not prepared with material/ideas for presentation of content. He left it up to the class to come up with content for him to present on. Good idea if the class did not have such a range of experience with estimating. Gave us the inside scoop on bidding practices and how they vary from one outfit to another.	Jul 24, 2010 5:29 PM
2	Course content was hastily put together. There was no powerpoint slides. Information need to be oresented more clearly to get good results.	Jul 29, 2010 10:29 PM
3	Discussion seemed to drift off topic. The dirt estimating levels of the participants seemed too varied.	Aug 10, 2010 3:19 PM
4	The presenter was very experienced with a wealth of experience on estimating.	Aug 16, 2010 11:22 PM


Was the workload appropriate for a one credit graduate course? -- Advanced Dirt -- 5 responses
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
60.0%
40.0%
Yes
No


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- Advanced Dirt -- 5 responses
45.0%
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
20.0%
40.0%
40.0%
Very satisfied
Satisfied
Not satisfied

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements ADVANCED DIRT

	Response Count
	3
answered question	3
skipped question	53

	Response Text	
1	The material presentation was lacking relevance with estimating quantities. No examples were presented. In class discussions were very educational. Estimating examples were excellent.	Jul 24, 2010 5:29 PM
2	April was n ot a good month to have this class for DOT-too busy with projects starting in field.	Jul 29, 2010 10:29 PM
3	The agenda should be more fully developed ahead of time. It was difficult to know what to expect.	Aug 16, 2010 11:22 PM

CM Program Course Survey

Please offer other comments, reflections, suggestions, and the like about this course. ADVANCED DIRT

	Response Count
	3
answered question	3
skipped question	53

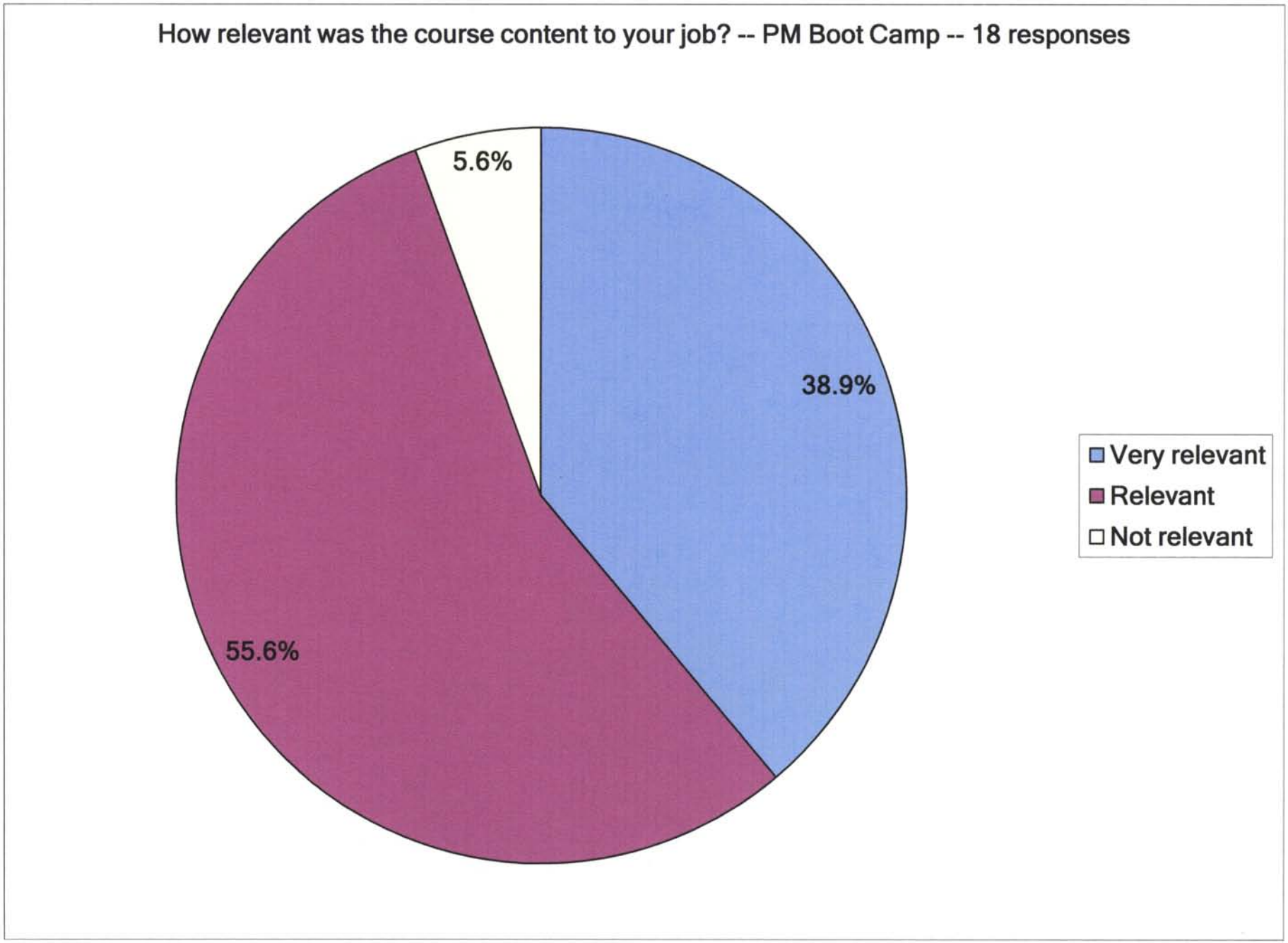
	Response Text	
1	If the instructor had more time to prepare lesson plans class may have been more fulfilling	Jul 24, 2010 5:29 PM
2	Positive-Tony provided all with the copy of training course for grade checkers.	Jul 29, 2010 10:29 PM
3	Include more about current use of computers in estimating.	Aug 16, 2010 11:22 PM

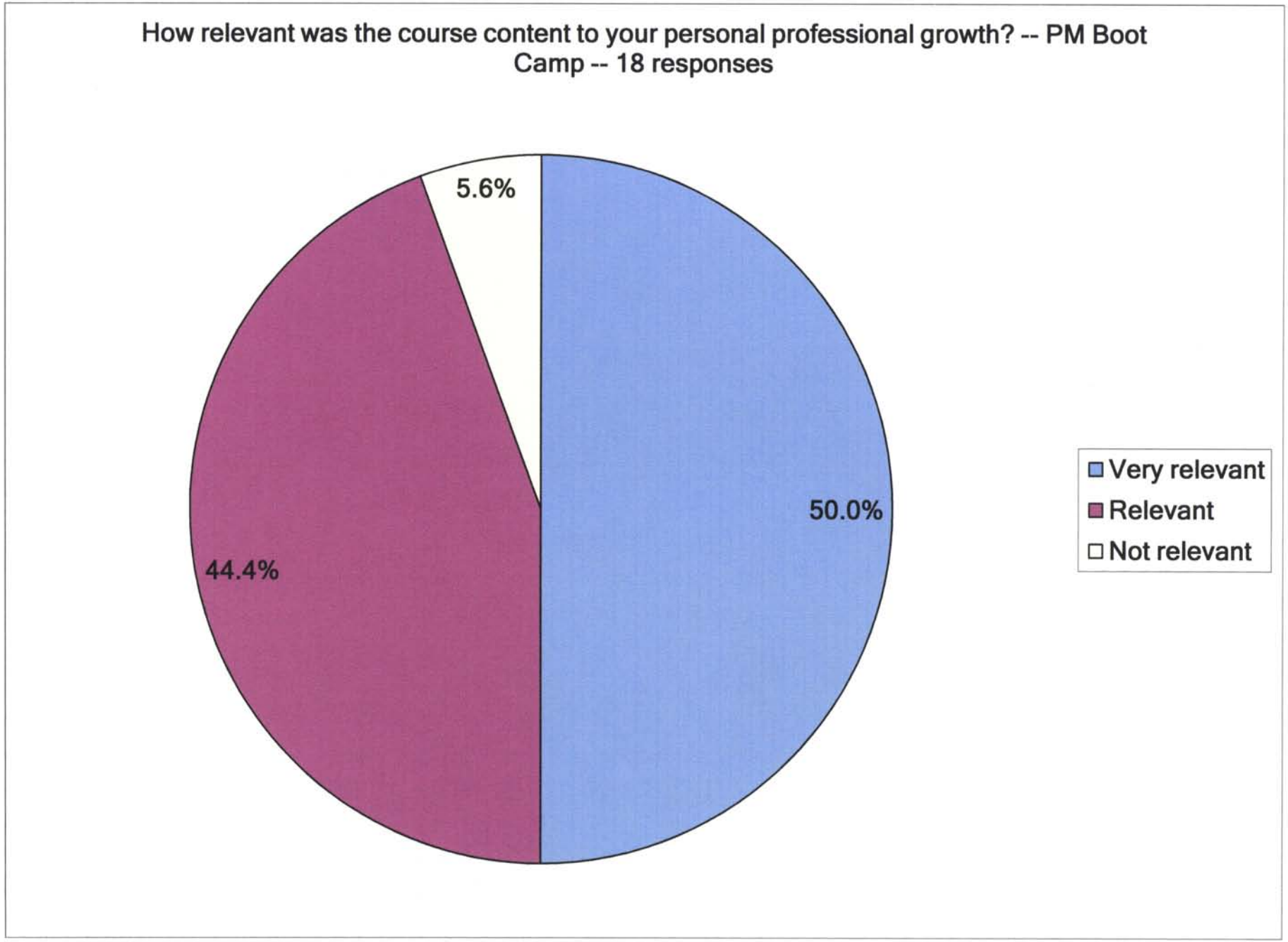
CM Program Course Survey

What was your primary reason for taking this course? PM Boot Camp

	Response Count
	18
answered question	18
skipped question	38

	Response Text	
1	Continuing education requiements for Professional Registration	Jul 23, 2010 5:04 PM
2	To better understand the different elements involved with running a construction project.	Jul 23, 2010 5:21 PM
3	I wanted to learn more about project management as a whole system.	Jul 23, 2010 5:55 PM
4	Continuing education credit for professional engineering license.	Jul 23, 2010 6:52 PM
5	My position description requires this skill at times.	Jul 23, 2010 7:48 PM
6	desire to further management knowledge	Jul 24, 2010 5:30 PM
7	To learn more about Project Management	Jul 27, 2010 11:03 PM
8	To gain knowledge in project management.	Jul 29, 2010 10:08 PM
9	My primary reason for taking the course was get a broad overview of the pertinent elements that make up Construction Project Management.	Jul 29, 2010 10:18 PM
10	Refresher	Jul 29, 2010 10:31 PM
11	Learn new skills	Jul 29, 2010 11:02 PM
12	Subject matter pertained to job development/advancement.	Jul 30, 2010 4:52 PM
13	I took this course in order to expand and clarify my understanding of project management that I might better myself professionally.	Jul 31, 2010 1:03 AM
14	Been taking enough of this classes that I wanted to continue the process.	Jul 31, 2010 4:06 PM
15	to perform my current job as a construction project manager more effectively.	Jul 31, 2010 7:37 PM
16	To better understand the construction project process.	Aug 12, 2010 6:45 PM
17	Sounded interesting	Aug 17, 2010 12:12 AM
18	To earn continuing education credits for my professional registration and for training for my job as a project manager.	Aug 17, 2010 3:53 PM


How relevant was the course content to your job? -- PM Boot Camp -- 18 responses
5.6%
38.9%
55.6%
Very relevant
Relevant
Not relevant

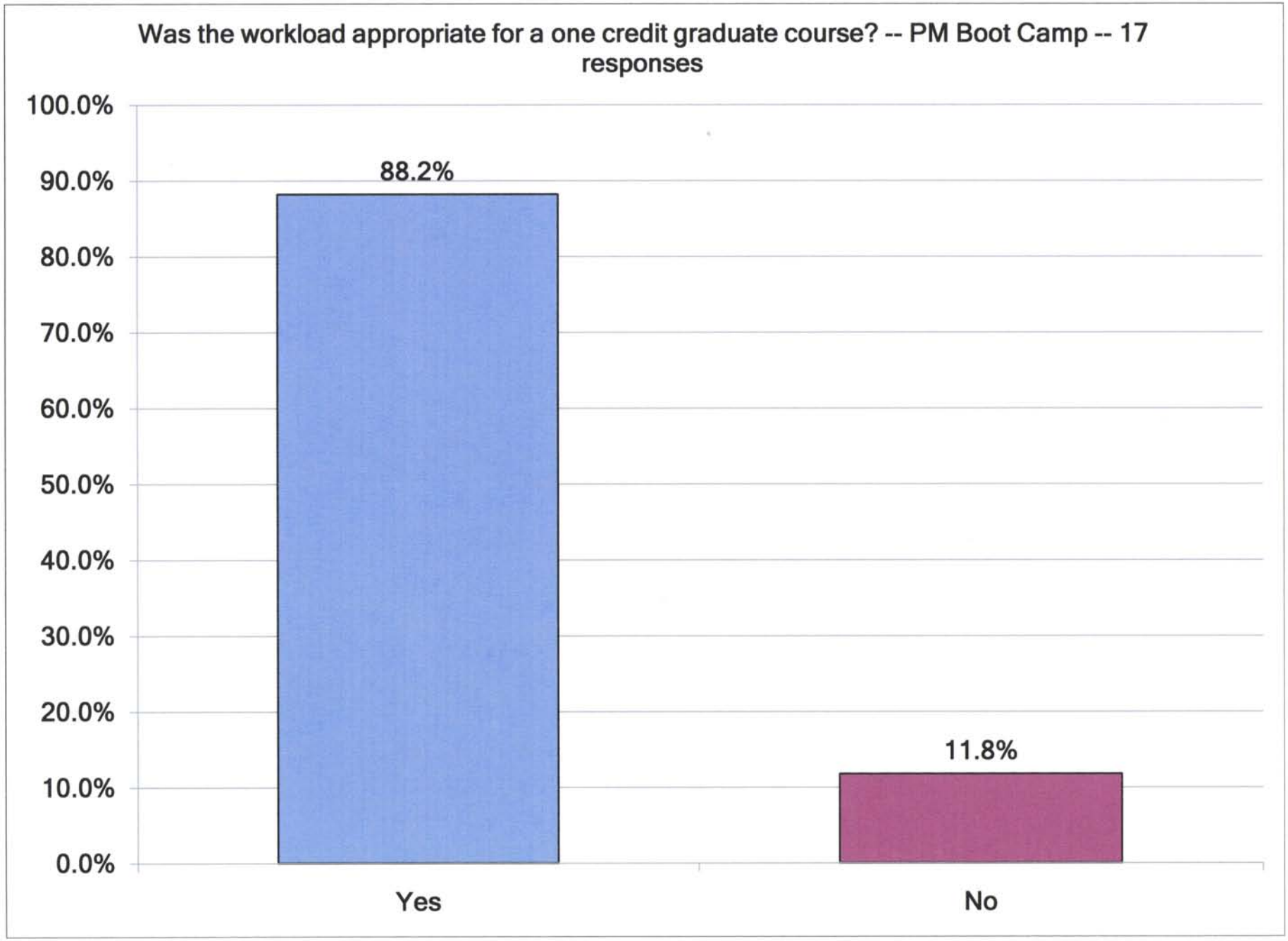

How relevant was the course content to your personal professional growth? -- PM Boot Camp -- 18 responses
5.6%
50.0%
44.4%
Very relevant
Relevant
Not relevant

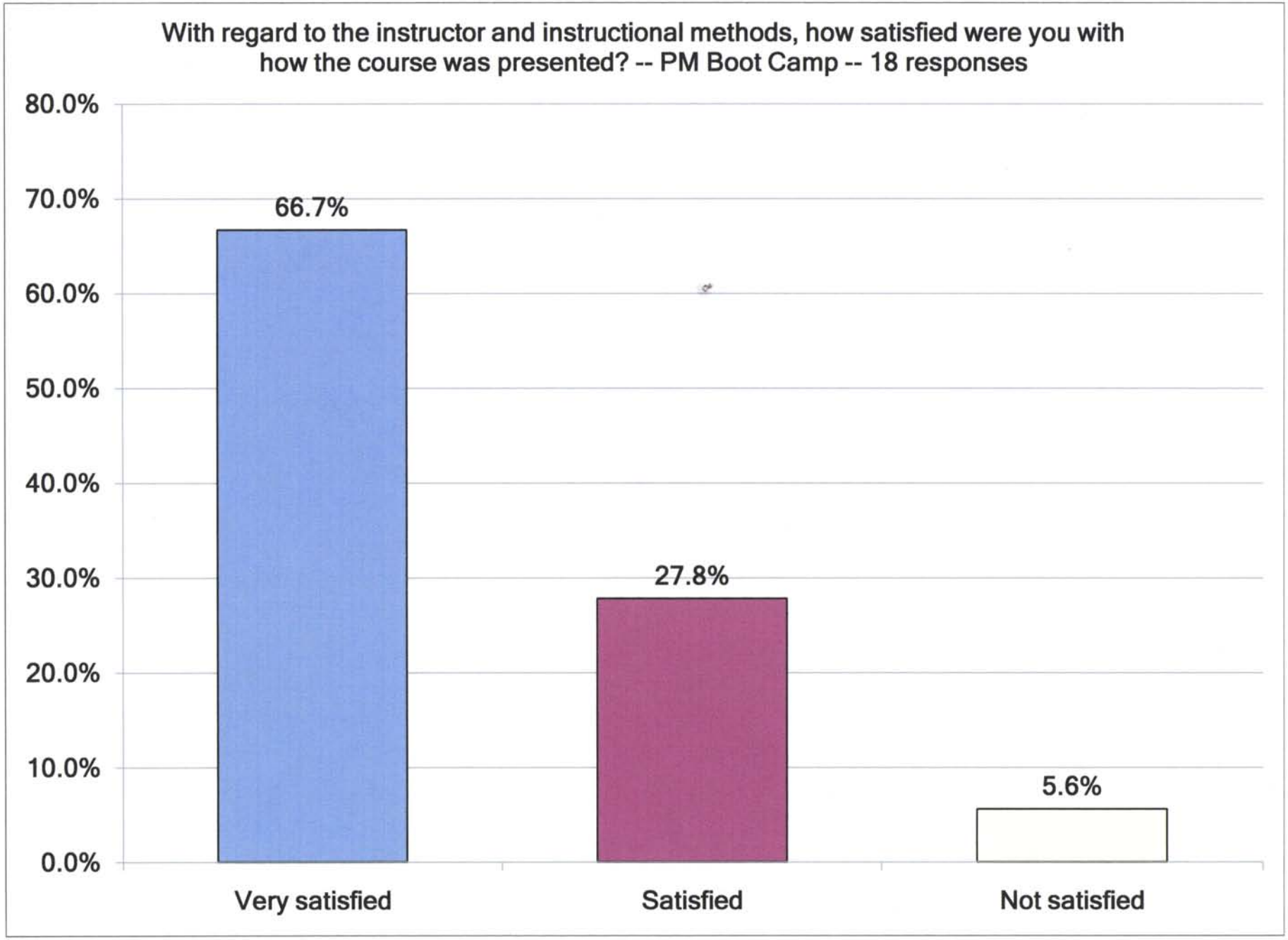
CM Program Course Survey

Please add comments about the course content, with suggestions for changes. PM Boot Camp

	Response Count
	9
answered question	**9**
skipped question	**47**

	Response Text	
1	A very qick overview of project management with some detail of particular subjects. The CPM portion was good.	Jul 23, 2010 5:04 PM
2	Course content was interesting. No suggests for changes at this time.	Jul 23, 2010 5:55 PM
3	An excellent course.	Jul 23, 2010 6:52 PM
4	Very technically based.	Jul 23, 2010 7:48 PM
5	the other participants were very enlightening with their experience. More indepth content would be nice, but it was understood that it was an introductory level course	Jul 24, 2010 5:30 PM
6	I thought the course was surprisingly smooth for the amount of information we covered. Unfortunately the course topics can be complicated and may take some students (me) more than a week to fully grasp. Overall I was glad to be exposed to all this information. If I could change one thing it would be the addition of a textbook to the class where we as the students could dig deeper and find the answers when there simply wasn't enough time in class.	Jul 29, 2010 10:18 PM
7	Very well organized course with good examples and discussions.	Jul 29, 2010 10:31 PM
8	I do not feel that the content was appropriate for a graduate level course and I do not feel that I was adequately or even moderately challenged.	Jul 31, 2010 1:03 AM
9	The course was very good and went over all of the basics.	Aug 17, 2010 3:53 PM


Was the workload appropriate for a one credit graduate course? -- PM Boot Camp -- 17 responses
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
88.2%
11.8%
Yes
No


With regard to the instructor and instructional methods, how satisfied were you with how the course was presented? -- PM Boot Camp -- 18 responses
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
66.7%
27.8%
5.6%
Very satisfied
Satisfied
Not satisfied

CM Program Course Survey

Please add comments about how the material was presented, including suggestions for improvements PM Boot Camp

	Response Count
	11
answered question	**11**
skipped question	**45**

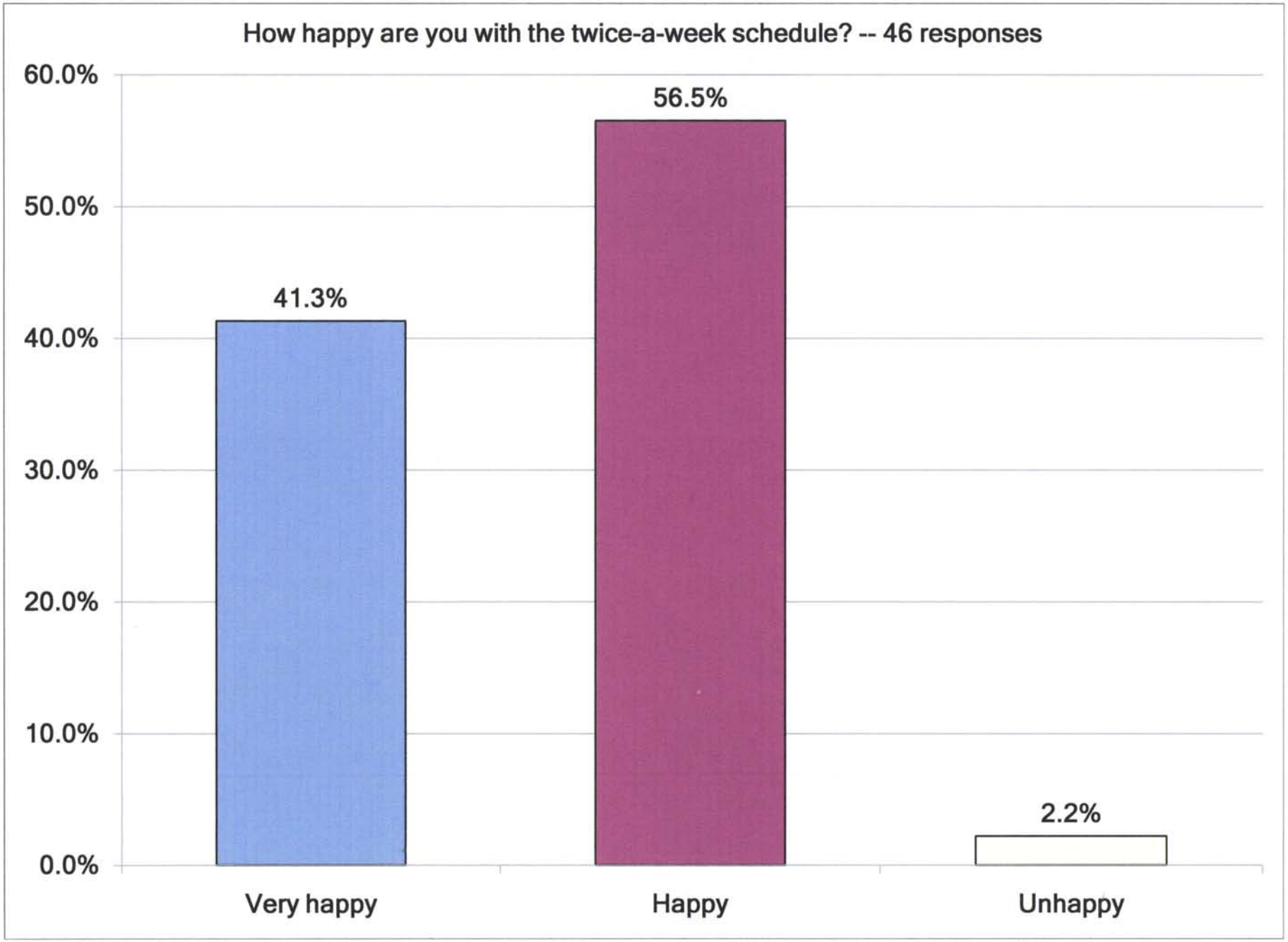
	Response Text	
1	Good material that presented the topics well.	Jul 23, 2010 5:04 PM
2	Material was presented in an organized, methodical manner. Some topics were glanced over due to time constraints; time management in terms of topic relevance could be improved.	Jul 23, 2010 5:55 PM
3	The material content, examples, and participant interactions were very interesting and applicable.	Jul 23, 2010 6:52 PM
4	The flow chart work was very revealing.	Jul 23, 2010 7:48 PM
5	Instructor was excellent. Material presented well. More depth would be nice.	Jul 24, 2010 5:30 PM
6	Because I took the course over video conference there were some technichal difculties. However, I was thought that the distance learning was good considering I didn't have to travel.	Jul 27, 2010 11:03 PM
7	I did it by video from Juneau. I thought it was well done.	Jul 29, 2010 10:08 PM
8	The Powerpoints were good but having a textbook that we could read with examples and more in depth information would be better.	Jul 29, 2010 10:18 PM
9	Good job	Jul 29, 2010 10:31 PM
10	While the material was well presented, I believe that the class size created issues with covering all the course material, and in its proper depth.	Jul 30, 2010 4:52 PM
11	sometimes the powerpoint slides were hard to read due to size of television when only part of the screen was devoted to the slide and the rest devoted to views of the various rooms. Maybe 2 screens would be better, one for the people and one for powerponts or the dryerase board.	Jul 31, 2010 7:37 PM

CM Program Course Survey

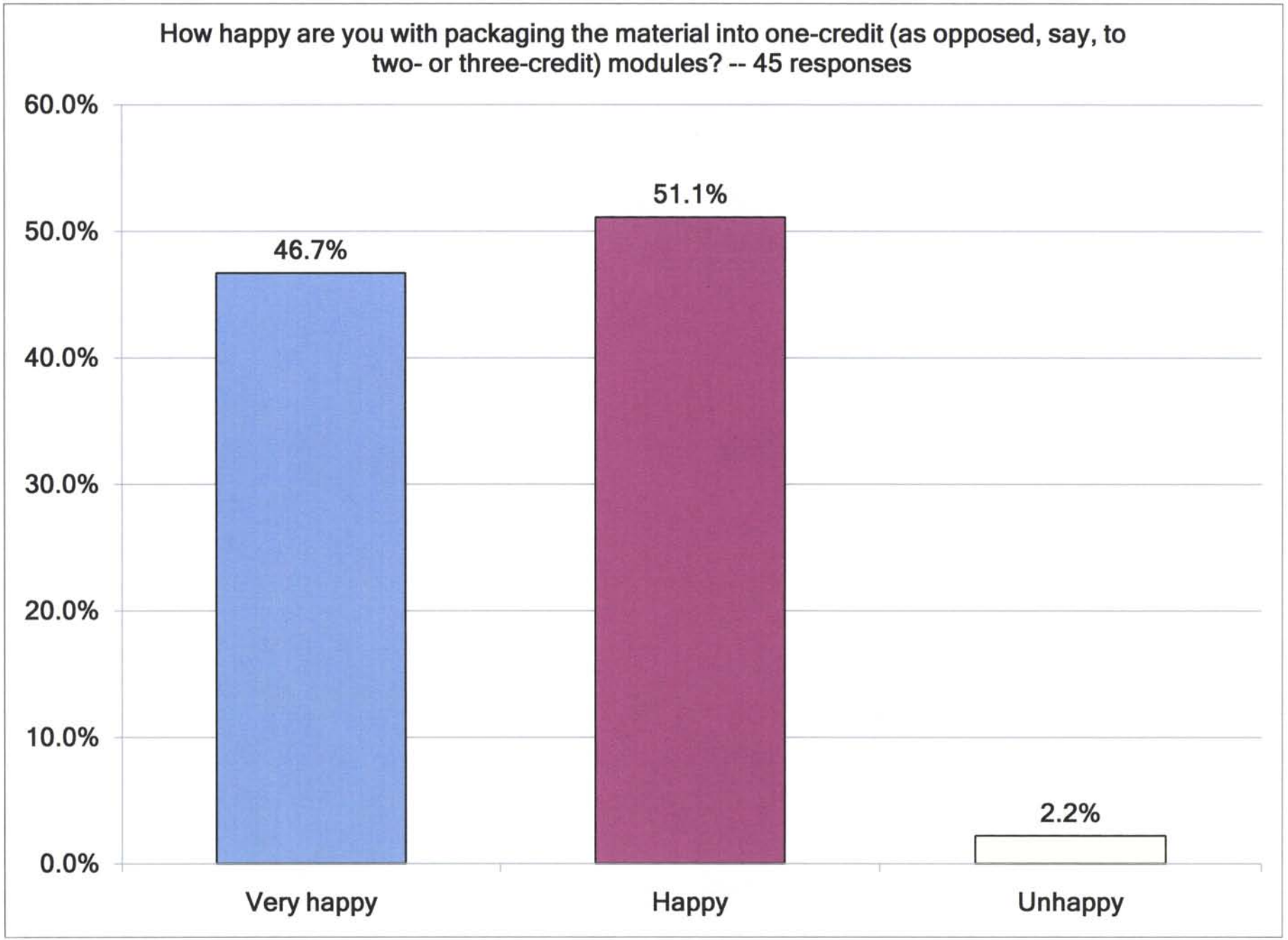
Please offer other comments, reflections, suggestions, and the like about this course. PM Boot Camp

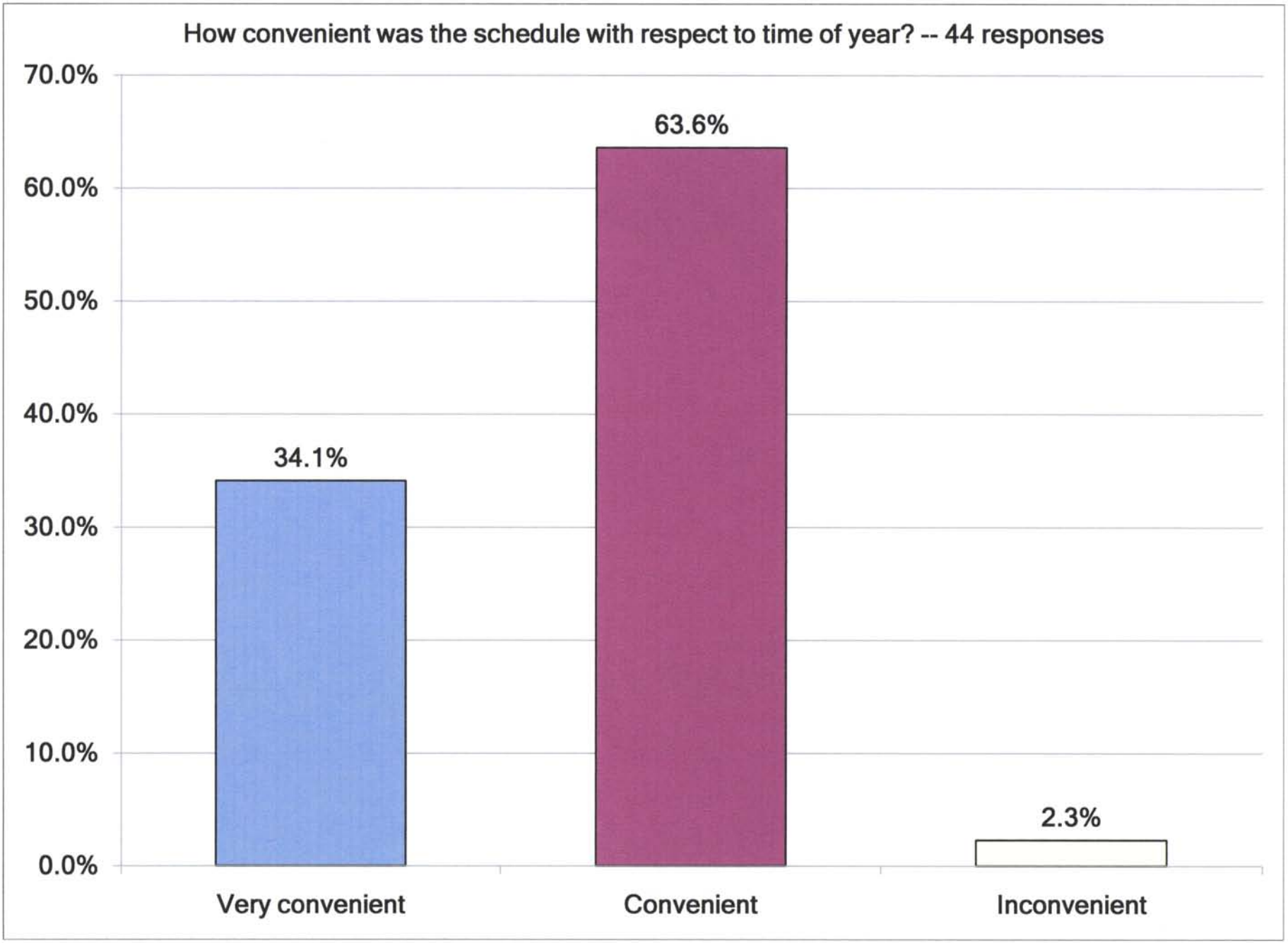
	Response Count
	9
answered question	**9**
skipped question	**47**

	Response Text	
1	The professior was great and presented the information well. The class being in several locatons worked great. The class room and support was great once the figure out how to contol the lights which would turn off after a few minutes without some one moving in the room.	Jul 23, 2010 5:04 PM
2	Enjoyed the class discussions.	Jul 23, 2010 5:55 PM
3	The course was accelerated which made spending time doing research on problems/homework a bit difficult while still working full time. Possibly stretching the course out over a few more weeks to allow time for research and study. Regardless, the accelerated schedule worked fine, delivered the material and learning opportunity very effectively.	Jul 23, 2010 6:52 PM
4	I enjoyed having perspectives from other organizational structures other than DOT.	Jul 23, 2010 7:48 PM
5	Tip to students is finish all the last weeks homework the weekend before - it takes a long time to do the final assignments.	Jul 29, 2010 10:08 PM
6	Overall the course was great. I'm planning on applying for and going after the Graduate Certificate here in the winter.	Jul 29, 2010 10:18 PM
7	Include long-distance groups with different experience level & backgrounds. Group from city of Ketchikan was interesting.	Jul 29, 2010 10:31 PM
8	When I enrolled in a course that contained "Boot Camp" in the name, I anticipated a challenging class that would pack a large amount of intense training into a small period of time. What I received was a broad overview of the most fundamental aspects of Project Management that. I would recommend reconsidering the name of the course and/or reviewing the materials in order to provide a class that is challenging while accessible.	Jul 31, 2010 1:03 AM
9	I found the method of presentation via the video teleconferencing extremely satisfactory. It was nice that all students and the professor could be seen and heard in the classroom despite the fact that we were all 1000's of miles apart. I also appreciated that the professor rotated his onsite presentations amongst all the classroom locations. the timeframe was good, short and intense, but doable. I would be interested in taking more of these courses, but they definitely need to be during the off season from construction.	Jul 31, 2010 7:37 PM


How happy are you with the twice-a-week schedule? -- 46 responses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
41.3%
56.5%
2.2%
Very happy
Happy
Unhappy


How happy are you with the 3:00 to 5:15 PM timeframe? -- 46 responses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
41.3%
47.8%
10.9%
Very happy
Happy
Unhappy


How happy are you with packaging the material into one-credit (as opposed, say, to two- or three-credit) modules? -- 45 responses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
46.7%
51.1%
2.2%
Very happy
Happy
Unhappy


How convenient was the schedule with respect to time of year? -- 44 responses
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
34.1%
63.6%
2.3%
Very convenient
Convenient
Inconvenient

CM Program Course Survey

What time of year is best for you?

	Response Count
	42
answered question	**42**
skipped question	**15**

	Response Text	
1	Late fall. Early spring.	Jul 23, 2010 5:00 AM
2	Winter Nov thru March	Jul 23, 2010 2:37 PM
3	fall or spring	Jul 23, 2010 5:00 PM
4	Fall through Spring	Jul 23, 2010 5:22 PM
5	Winter	Jul 23, 2010 5:56 PM
6	Spring	Jul 23, 2010 5:59 PM
7	Feb - Mar and Oct to Nov will be good for me.	Jul 23, 2010 6:09 PM
8	spring and fall	Jul 23, 2010 6:54 PM
9	Winter	Jul 23, 2010 7:00 PM
10	Early Jan. thru mid-March or October/November.	Jul 23, 2010 8:01 PM
11	early winter	Jul 23, 2010 8:08 PM
12	November thru March, going into April get to be too late in the year.	Jul 24, 2010 5:32 PM
13	Winter	Jul 25, 2010 6:37 PM
14	Winter	Jul 26, 2010 2:52 PM
15	October, March, April	Jul 27, 2010 5:25 AM
16	Late fall through early spring	Jul 27, 2010 5:38 PM
17	We are very busy during the summer months with project and inspection related work. Thus, fall, winter, and early spring are best for courses.	Jul 27, 2010 6:00 PM
18	Winter	Jul 27, 2010 11:05 PM
19	Anytime but summer	Jul 28, 2010 12:45 AM
20	Probably the fall and winter.	Jul 29, 2010 10:09 PM
21	Late September through mid November and mid January though late March.	Jul 29, 2010 10:11 PM
22	Winter	Jul 29, 2010 10:14 PM
23	Current schedule works	Jul 29, 2010 10:21 PM
24	January-March	Jul 29, 2010 10:32 PM
25	Fall and Winter	Jul 29, 2010 11:03 PM
26	Fall-Winter-spring	Jul 29, 2010 11:28 PM
27	Winter	Jul 30, 2010 1:54 AM
28	fall and winter	Jul 30, 2010 3:35 PM

	Response Text	
29	Obviously the winter season is the time of year when most people's work schedules allow for them to attend these classes. However, similarly if I am going to be out-of-state for personal reasons, this same season will be the time when I do that. This conflict has caused me to miss a couple of classes which I was very interested in, and which I hope are cycled through again in the future (Technology, Materials Estimating).	Jul 30, 2010 5:05 PM
30	Winter, but not around holidays.	Jul 30, 2010 7:36 PM
31	Fall and winter are the slowest seasons for construction and thus the best times to participate in a course.	Jul 31, 2010 1:06 AM
32	winter (i.e. not construction season)	Jul 31, 2010 7:39 PM
33	dead winter	Aug 2, 2010 4:21 PM
34	October through December	Aug 3, 2010 12:04 AM
35	January-March	Aug 10, 2010 3:20 PM
36	Winter.	Aug 16, 2010 11:23 PM
37	November - April	Aug 17, 2010 12:13 AM
38	November through February	Aug 17, 2010 12:42 AM
39	January to April	Aug 17, 2010 3:56 PM
40	wintertime (after/before construction season)	Aug 17, 2010 7:48 PM
41	Winter, generally.	Aug 17, 2010 8:11 PM
42	Jan. thru April.	Aug 18, 2010 5:03 PM

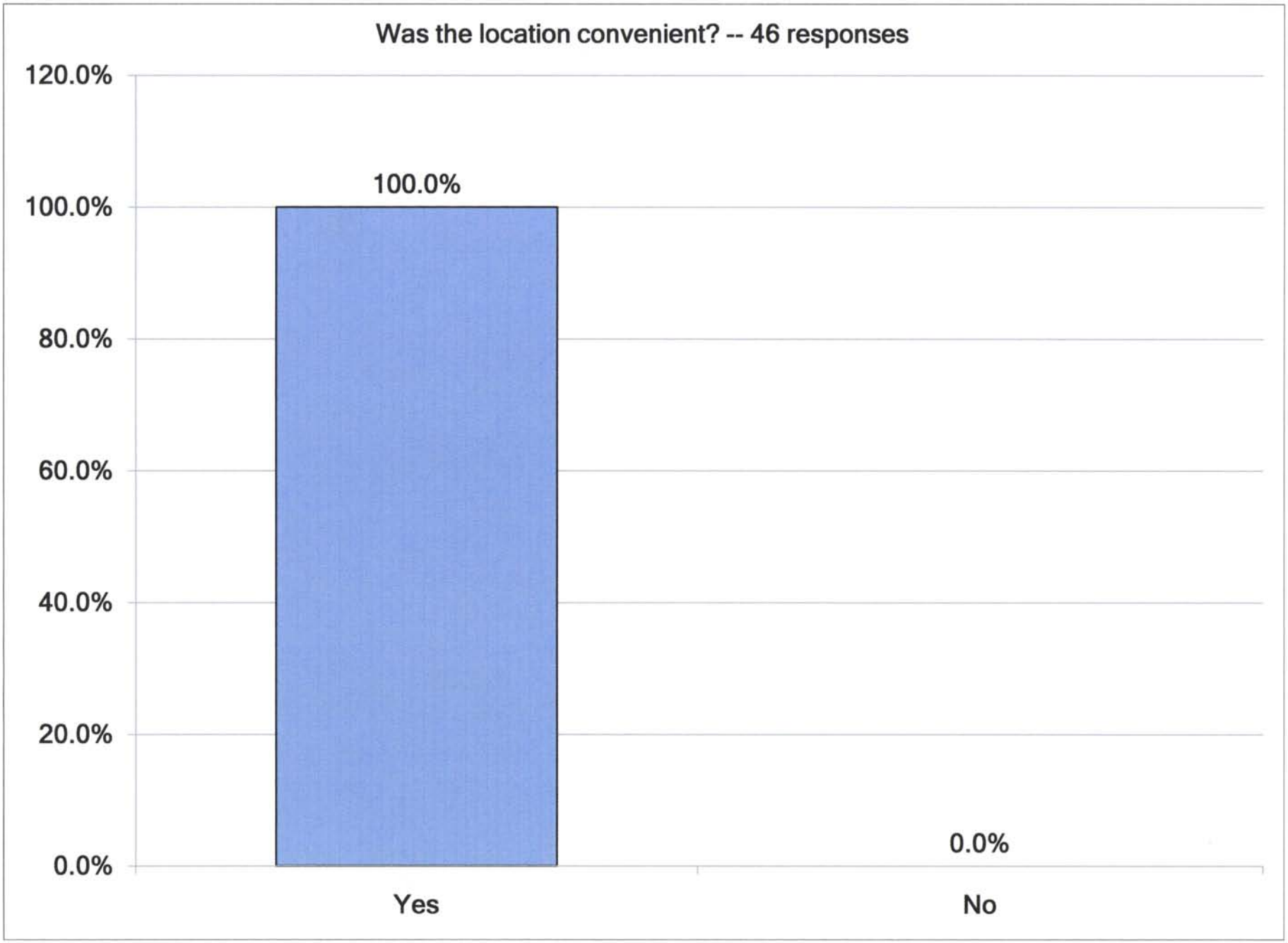
CM Program Course Survey

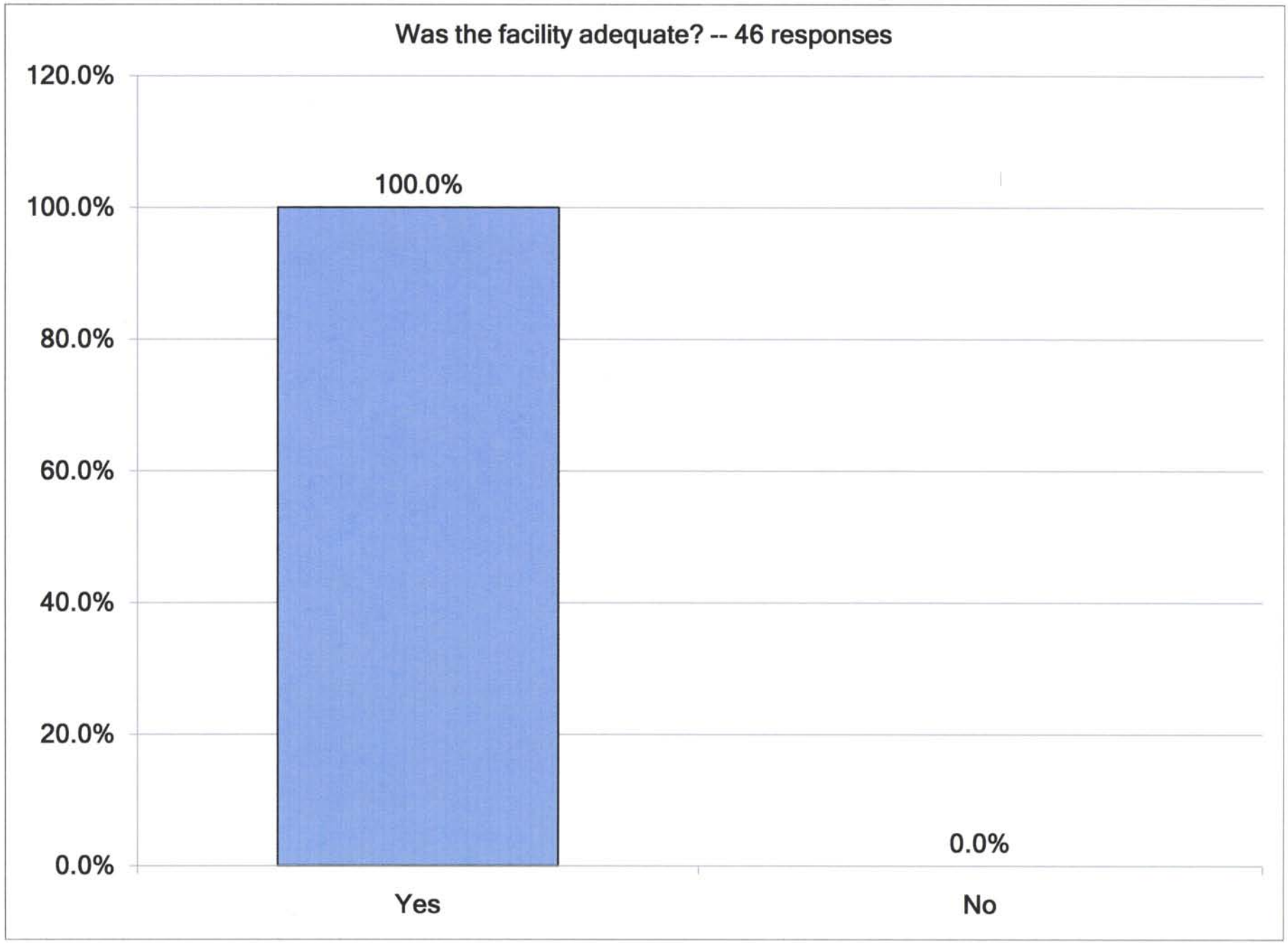
What times of the year should we avoid?

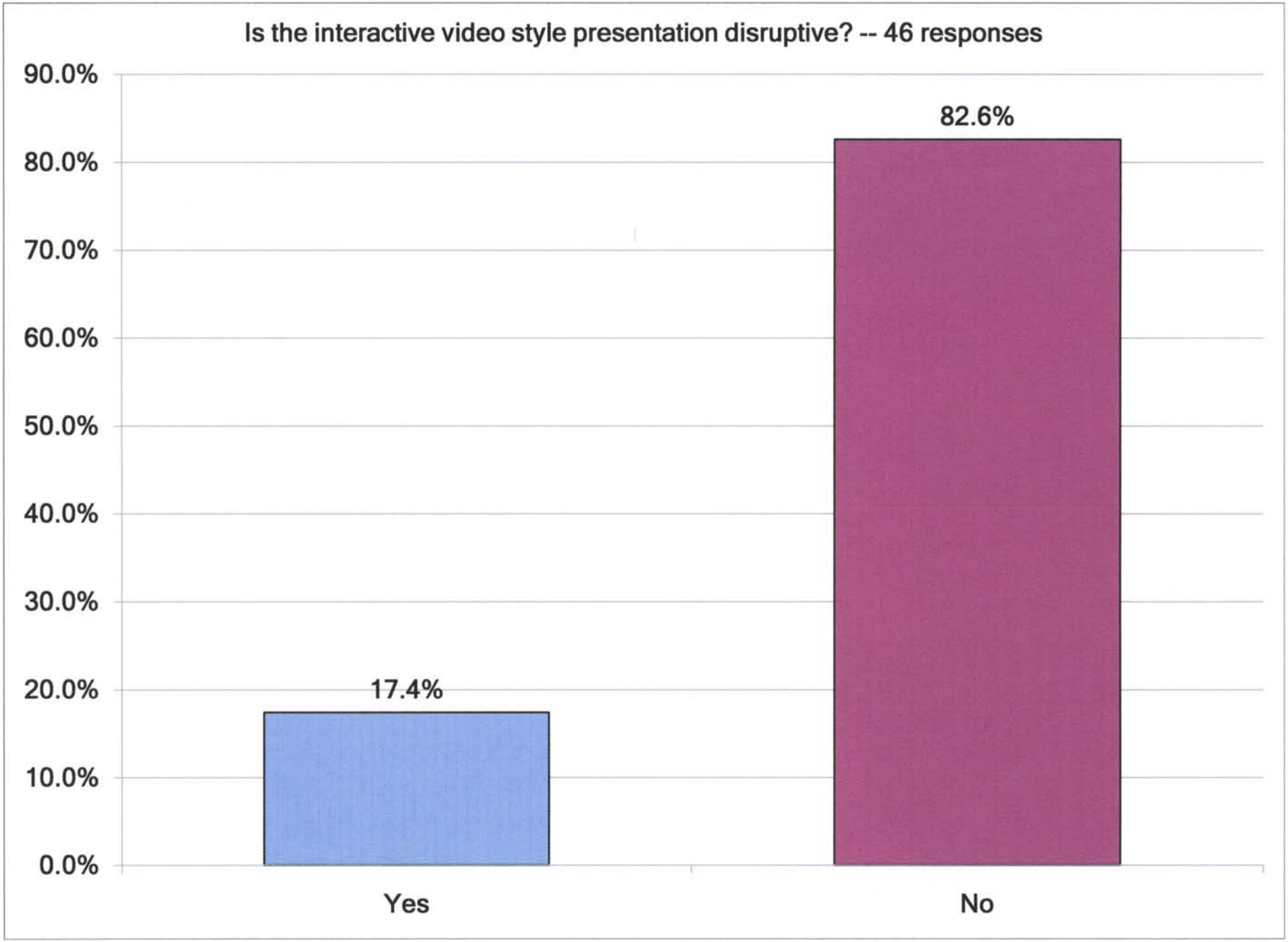
	Response Count
	41
answered question	41
skipped question	16

	Response Text	
1	All others.	Jul 23, 2010 5:00 AM
2	April thru Oct	Jul 23, 2010 2:37 PM
3	summer	Jul 23, 2010 5:00 PM
4	Summer	Jul 23, 2010 5:22 PM
5	Summer constuction season	Jul 23, 2010 5:56 PM
6	Summer	Jul 23, 2010 5:59 PM
7	Summary construction season and end of year holiday season.	Jul 23, 2010 6:09 PM
8	summer construction season	Jul 23, 2010 6:54 PM
9	Summer/Construction season.	Jul 23, 2010 7:00 PM
10	May, September, December Fairbanks is the most season-dependent place I have ever lived. When it's hunting season, everyone is gone. In May, everyone wants to get outside or is already out on their Construction sites.	Jul 23, 2010 8:01 PM
11	summer	Jul 23, 2010 8:08 PM
12	Thankgiving and Christmas weeks. would be nice to start mid November, so more courses could be taken in a given year.	Jul 24, 2010 5:32 PM
13	May, June, July, Aug	Jul 25, 2010 6:37 PM
14	construction season	Jul 26, 2010 2:52 PM
15	Summer, obviously	Jul 27, 2010 5:25 AM
16	Summer Construction - late spring through early fall.	Jul 27, 2010 5:38 PM
17	Summer	Jul 27, 2010 6:00 PM
18	Summer construction season	Jul 27, 2010 11:05 PM
19	Summer	Jul 28, 2010 12:45 AM
20	Spring and summer, construction season.	Jul 29, 2010 10:09 PM
21	December, April thoug August	Jul 29, 2010 10:11 PM
22	Summer	Jul 29, 2010 10:14 PM
23	Fall, when the trout are obese and animals can be killed.	Jul 29, 2010 10:21 PM
24	April and December	Jul 29, 2010 10:32 PM
25	spring and summer	Jul 29, 2010 11:03 PM
26	Summer	Jul 29, 2010 11:28 PM
27	Summer	Jul 30, 2010 1:54 AM
28	construction and summer	Jul 30, 2010 3:35 PM
29	Summer season.	Jul 30, 2010 5:05 PM
30	Summer, holidays.	Jul 30, 2010 7:36 PM

	Response Text	
31	Spring and summer.	Jul 31, 2010 1:06 AM
32	May-September for sure.	Jul 31, 2010 7:39 PM
33	summer and fall	Aug 2, 2010 4:21 PM
34	May through September	Aug 3, 2010 12:04 AM
35	May-October	Aug 10, 2010 3:20 PM
36	Summer.	Aug 16, 2010 11:23 PM
37	April - November	Aug 17, 2010 12:13 AM
38	All other times	Aug 17, 2010 12:42 AM
39	Summer; December	Aug 17, 2010 3:56 PM
40	construction season (may to late september)	Aug 17, 2010 7:48 PM
41	Summer, especially August/September.	Aug 17, 2010 8:11 PM


Was the location convenient? -- 46 responses
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
100.0%
0.0%
Yes
No


Was the facility adequate? -- 46 responses
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
100.0%
0.0%
Yes
No


Is the interactive video style presentation disruptive? -- 46 responses
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
17.4%
82.6%
Yes
No

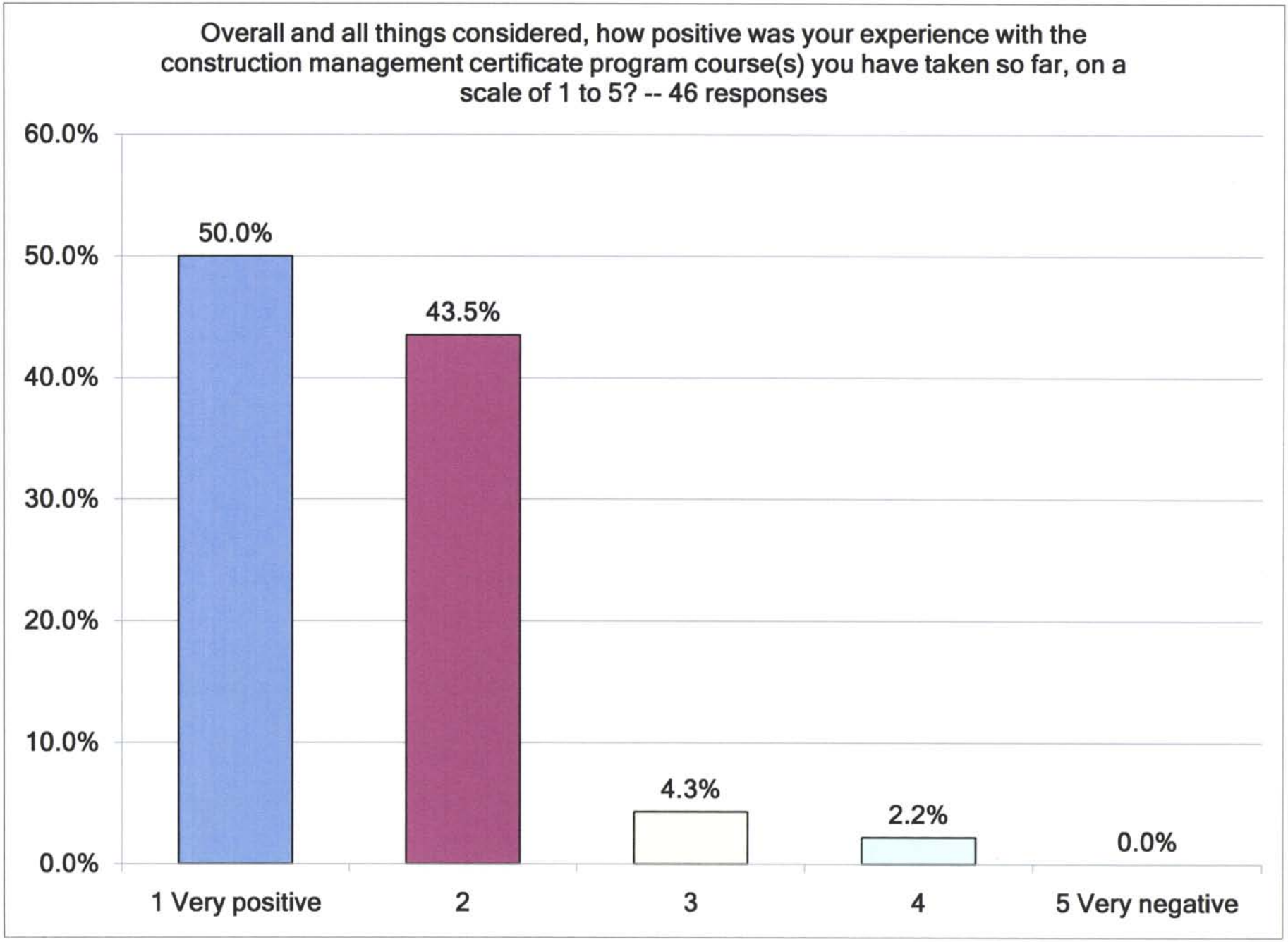
CM Program Course Survey

Please add comments on schedule, location, facility, and the like.

	Response Count
	19
answered question	**19**
skipped question	**38**

	Response Text	
1	I appreciate the segmented class topics. The ability to pick and choose a one credit course allows me to manage what class I feel is the most time/commitment effective.	Jul 23, 2010 5:00 AM
2	Overall, interactive video style presentation was good but mildly disruptive due to technical issues (I think the issues had more to do with the facilities capabilities). Location of facility was convenient and the facility itself with the exception of the video conferencing issues was convenient as well. Timeframe was slightly disruptive to work scheule, but it was managable.	Jul 23, 2010 5:59 PM
3	None.	Jul 23, 2010 6:09 PM
4	See prior section concerning stretching the schedule a little to provide time for study and problem research.	Jul 23, 2010 6:54 PM
5	Caution with video presentation. Instructors must be more familiar with equipment to avoid disruptions.	Jul 23, 2010 7:00 PM
6	As all the participants are full time employees and many have families, please do not overlap the courses as this means the participant has class M T W & Th plus homework. Also, having a small gap between the classes, even if it's just means starting the next class on a Wednesday .vs. a Monday, would be helpful. This gives the student time to close-out and process the material from the previous class and mentally prepare for the next. Also, if we could get the reading material for the class ahead of time, this would be wonderful! Some classes have a lot of reading and it would be helpful to begin at least skimming this before the class. Repetition and practical application of the knowledge learned are the best ways to retain what has been taught.	Jul 23, 2010 8:01 PM
7	Please start earlier in the winter.	Jul 24, 2010 5:32 PM
8	In regard to question 9. The interactive video was occasionally disruptive when a microphone wasn't set up properly or the like.	Jul 26, 2010 8:08 AM
9	All things considered, this is an excellent system for delivering meaningful educational opportunities around the state. I suspect it could be effectively spread to other states if there is a need.	Jul 27, 2010 6:00 PM
10	I would like to see the start time moved to 4:30 or 5:00 pm because I get off work at 5:00pm.	Jul 27, 2010 11:05 PM
11	worked well for me, looking forward to starting the next class.	Jul 29, 2010 10:21 PM
12	all was good	Jul 29, 2010 10:32 PM
13	Video teleconferenced course is not very effective. I'm embarrassed that UAF would offer graduate courses this way. Reputable colleges wouldn't offer graduate level courses this way.	Jul 30, 2010 1:54 AM

	Response Text	
14	I believe that in the DOT offices, *most* people are usually available as early as November for these classes. Many people don't seem to start the personal traveling season until around the Christmas holiday. I am not sure if the Thanksgiving/Christmas holidays would negatively impact classes scheduled during the November/early-December time of year.	Jul 30, 2010 5:05 PM
15	The 2:15 long classes were a bit much (and yes I understand the required rigor, but I think 1:30 per class is about ideal for paying rapt attention).	Jul 30, 2010 7:36 PM
16	The class schedule worked well with my work schedule. The location and facility were effective for the intended use.	Jul 31, 2010 1:06 AM
17	interactive video has very positive benefits but still some challenges	Aug 2, 2010 4:21 PM
18	The homework seemed just a little heavy on the claims class. The Negotiations class	Aug 17, 2010 12:42 AM
19	The instructor was able to hold the same class at multiple locations.	Aug 17, 2010 3:56 PM


Overall and all things considered, how positive was your experience with the construction management certificate program course(s) you have taken so far, on a scale of 1 to 5? -- 46 responses
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
50.0%
43.5%
4.3%
2.2%
0.0%
1 Very positive
2
3
4
5 Very negative

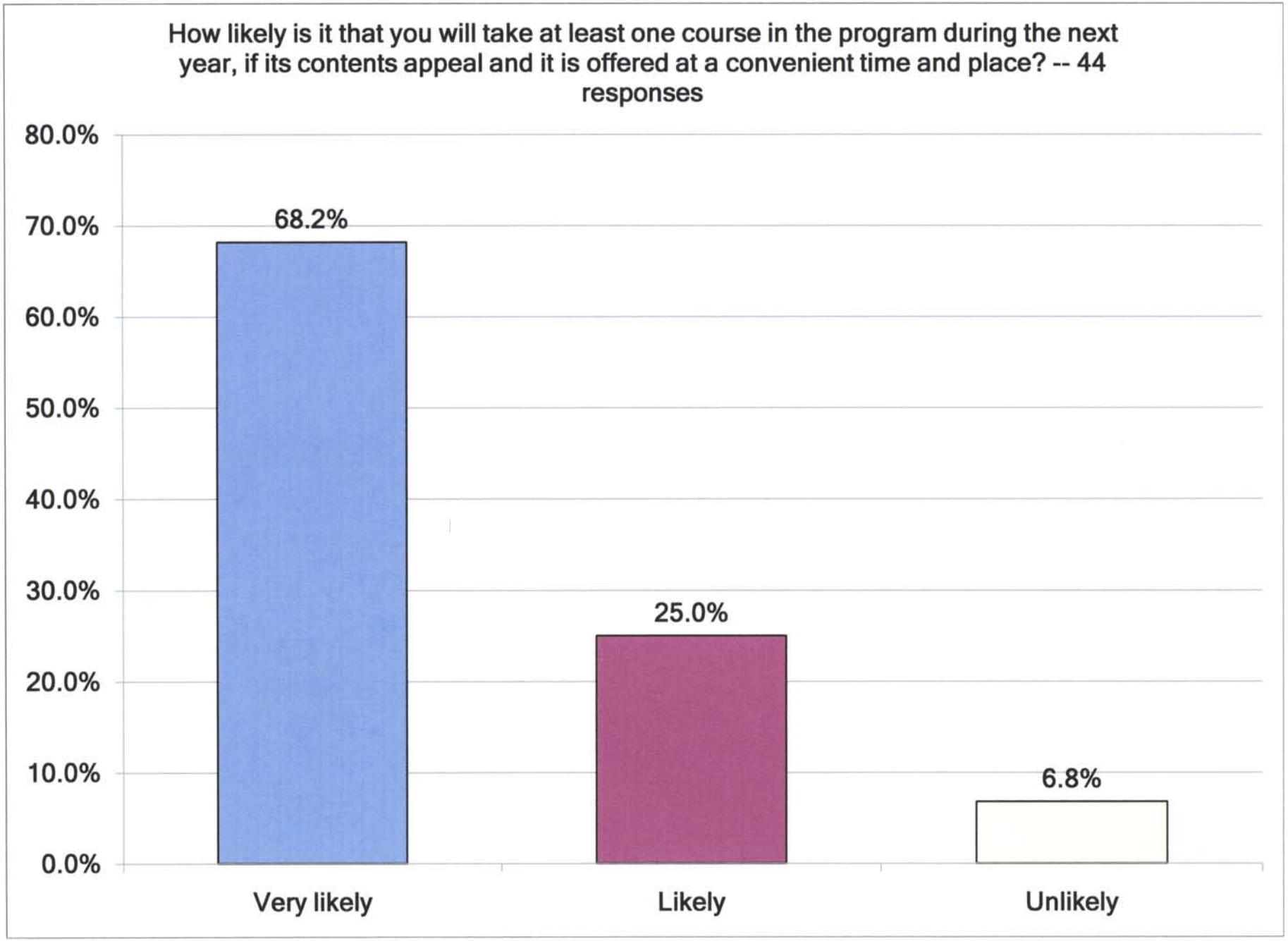
CM Program Course Survey

What course topics should we plan to give over the next few years?

	Response Count
	22
answered question	22
skipped question	35

	Response Text	
1	Managing Change. I was unable to take that course last spring due to a scheduling conference.	Jul 23, 2010 5:02 AM
2	Managing Multiple Projects Professional Communication Methods	Jul 23, 2010 2:38 PM
3	Claims, public interaction, contracts	Jul 23, 2010 5:02 PM
4	Alternate Procurement Methods, Arctic Engineering	Jul 23, 2010 5:22 PM
5	More in depth GPS surveying. How to use CPM in contract delay disputes.	Jul 23, 2010 6:49 PM
6	Actually, the list of various topics presented so far looks great. My problem is that they are not offered in S.E. AK as often as Anchorage or Fairbanks.	Jul 23, 2010 6:59 PM
7	- Collaborative Leadership for Engineering and Technical Projects and Programs	Jul 23, 2010 7:02 PM
8	same	Jul 23, 2010 8:08 PM
9	I will have to think about this and get back with you. This spring I had some ideas, but they have faded from memory right now.	Jul 23, 2010 8:25 PM
10	How to deal with personalities (they make the project succeed or fail). how to survive in a political world. Writing/analyzing change orders How to write a successful request for proposal. Advanced scheduling Advanced boot camp	Jul 24, 2010 5:35 PM
11	Faults and failures in construction. The gray area of changing/not changing PE's stamped drawing.	Jul 27, 2010 5:26 AM
12	Construction Claim Case Studies - may change over a few years. Construction Negotiation - any course in negotiation is good.	Jul 27, 2010 5:40 PM
13	Project Scheduling, Cost estimating for change orders	Jul 28, 2010 12:45 AM
14	scheduling, construction management, arctic engineering, civil and structural engineering	Jul 29, 2010 10:31 PM
15	Human relations-resolution of disagreements in field during construction Technical issues are relatively easy, so conflict resolution and teamwork subjects!	Jul 29, 2010 10:35 PM
16	Cost Estimating	Jul 29, 2010 11:04 PM
17	Technology advances (not just GPS issues, but also new/proven materials, structural insulation in roads, etc.) design & contract language- to improve the quality of plans/contracts which are issued and improve the use/language of change orders, etc used by project administrators/engineers.	Jul 30, 2010 5:11 PM
18	The more soft skills the better.	Jul 30, 2010 7:36 PM

	Response Text	
19	I think that this last round of classes was heading in the right direction. Emphasis on the "soft skills" for a portion of the curriculum is important. Environmental issues are an increasing concern. Possibly add another environmental class with guest lecturers from from various agencies.	Aug 3, 2010 12:12 AM
20	Construction Scheduling, management	Aug 16, 2010 11:26 PM
21	I have not seen the entire construction management program, but I think that there are some of these classes that I would like to take.	Aug 17, 2010 3:59 PM
22	some repeats - i missed many of them, otherwise keep on with what is there, also a review economics class would be nice	Aug 17, 2010 7:50 PM


How likely is it that you will take at least one course in the program during the next year, if its contents appeal and it is offered at a convenient time and place? -- 44 responses
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
68.2%
25.0%
6.8%
Very likely
Likely
Unlikely

CM Program Course Survey

Please leave any other comments and suggestions in the box below.

	Response Count
	12
answered question	**12**
skipped question	**45**

	Response Text	
1	Thanks for offering the courses.	Jul 23, 2010 5:02 AM
2	Keep up the good work!	Jul 23, 2010 2:38 PM
3	None	Jul 23, 2010 6:49 PM
4	The more statewide engineering education opportunities you can offer the better.	Jul 23, 2010 6:59 PM
5	Definitely need to work on improving outreach, marketing of this program. I couldn't find in catelog or online.	Jul 23, 2010 7:02 PM
6	This is a wonderful program! I hope it can be marketed to other sections of DOT, other government offices and consultants/contractors. I only found out about the program from a friend as I wasn't looking to take classes, therefore had not read a UAF catalogue lately.	Jul 23, 2010 8:25 PM
7	Keep it up. Would like the courses to meld with the graduate program in engineering management.	Jul 24, 2010 5:35 PM
8	Keep up the good work!	Jul 27, 2010 6:03 PM
9	Larry Bennett did a great job!	Jul 29, 2010 10:31 PM
10	Address parking issues, sometime was hard to find spot and caused tardiness.	Jul 29, 2010 10:35 PM
11	give a pat on the back to whoever thought the program up	Aug 17, 2010 7:50 PM
12	I just want to say, "Thank you for your care and concern, for your endurance, and for sharing your expertise & research"!	Aug 18, 2010 5:06 PM

4

ALASKAN GRADUATE ENGINEERING EDUCATION IN THE BS PLUS 30 ERA:

Needs of the Professional Workforce and Suggested Responses

Report from a Roundtable

June 22, 2010

Coast International Inn
Anchorage, Alaska

Robert A. Perkins, P.E.
F. Lawrence Bennett, P.E.
University of Alaska Fairbanks
College of Engineering and Mines
July 20 2010

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Roundtable on Alaskan Graduate Engineering Education in the BS plus 30 Era: Needs of the Professional Workforce and Suggested Responses

Executive Summary

A June 22 2010 roundtable of Alaskan engineering managers and training professionals considered the training needs of the engineering workforce and how those needs might be met. Among a large list of identified needs, mentoring, leadership, mastering the business of engineering, written communication, collaborative critical thinking, information technology, and ethics were cited as of highest importance. Observations and conclusions included the importance of non-classroom learning, the need to utilize a variety of training methods, the emerging emphasis on mentoring and mentored internships, the multi-faceted nature of project management, the early success of the new graduate certificate program in Construction Management, and the need to develop other similar programs. Among the recommendations are to establish a working group to coordinate and publicize engineering workforce training statewide, develop a selected set of new courses to meet identified high priority needs, look seriously at the Arizona Leadership in Engineering Administration Program (LEAP) as an effective way to train younger engineers in the business of engineering, publicize the findings from this roundtable widely, and reconvene a similar roundtable about two years hence.

Introduction

Thirty-one persons gathered at the Coast International Inn in Anchorage on June 22, 2010, to consider the training needs of Alaska's engineering workforce and how the profession, the industry, and academia might respond to those needs. From 8:00 AM until 1:30 PM, including a working lunch, they heard short status reports, gathered in discussion groups, shared findings, and formulated preliminary recommendations to guide Alaska's employers, trainers, educational institutions and individuals in expanding and improving training opportunities for working engineers.

A list of the attendees is included as Appendix A. They included representatives from Alaska's engineering design, construction and petroleum private sector, public engineering agencies, and educational institutions. Each was invited because of his or her responsibilities as an engineering employer and manager.

As stated in the roundtable's invitation letter, the purposes and questions to be addressed were as follows:

1) Background and current status information on the new "BS plus 30" standard approved by the National Council of Examiners for Engineering and Surveying (NCEES). This standard will require engineers seeking professional registration to have completed a baccalaureate degree in engineering plus 30 post-graduate credit hours of relevant breadth and depth courses in their areas of specialty. How might this affect your staff and the types of courses you want your employees to have?

2) Efforts to date in Alaska to provide graduate education that supports that standard, including the newly approved Graduate Certificate in Construction Management. Might other similar programs help your operations and the professional development of your employees?

3) The latest findings from our on-going effort to identify Alaska-specific needs related to fulfilling these requirements, based on meetings and interviews held in May and June 2010 with employers and individual engineers. Can you add to these findings from your experiences?

4) Further discussion to seek information from you and other key persons from the Alaska engineering profession regarding their engineering workforce needs, especially education and training needs.

A copy of the agenda is included in Appendix B. The roundtable's format was designed to provide opportunity for each attendee to contribute ideas, suggestions and comments, as well as to hear somewhat more formal presentations. Most of the time was spent on two agenda topics, as stated in the roundtable's title – 1) graduate engineering education needs, and 2) potential responses to those needs. The body of this report is organized in this manner. It summarizes presentations and discussions and refers to an extensive set of appendices containing speaker materials and raw "flip chart" transcriptions from the small group discussions.

This roundtable follows, and builds upon, a similar undertaking held in June 2008. In that case, the topic was training needs of Alaska's professionals in construction. The June 2010 event reported here took on a wider scope, seeking to include all engineering organizations, personnel and activities rather than only construction. One of the conclusions from the previous roundtable was that training providers

must continually assess training needs in light of changing employee backgrounds and industry conditions. This report responds to that conclusion by attempting to provide such an updated assessment.

Support for this roundtable was provided by University of Alaska through Workforce Development Funding (Alaska Training and Vocational Education Program).

Needs

Three briefings on training needs by F. Lawrence Bennett began the presentations. In the first, a summary of the June 2008 roundtable was given. That meeting concluded that primary training needs for professionals in construction included the entire realm of the business aspects of construction, an understanding of the interrelationships and interdependencies of construction management, various cost and finance issues, and presentation skills. It then provided more specific recommendations for courses in communications, other "soft" skills, and technical topics, and it noted several Alaska-specific training needs. A summary is included as Appendix C.

The second briefing, whose summary is given in graphical form in Appendices D and E, reported on a series of luncheon meetings held in Anchorage, Juneau and Fairbanks in earlier in June 2010, at which a small number of engineering managers suggested current high priority unmet training needs for younger and older engineers in their employ. Results showed that, among younger engineers, communication skills of all types are especially needed, as is knowledge about environmental law, permitting and regulations; various technical specialties; and project management training. For older engineers, the most mentioned need was for mentoring skills, followed by leadership and supervision; project management; and environmental law, regulations and processes.

The third briefing gave an overview of the proposed change in the law regulating the registration of professional engineers. If implemented, the law would increase the educational requirement for eligibility to sit for the second, or professional, part of the licensure examination by requiring thirty credits beyond the bachelor degree, whereas the current law requires only an accredited bachelor degree in engineering. This so-called "BS plus 30" requirement has been developed and approved by the National Council of Examiners for Engineering and Surveying (NCEES). As such, this 'model law" is recommended to the various states for implementation, no

earlier than 2020. If implemented in Alaska, the new requirements would place new responsibilities upon trainers and educational institutions and would likely lead to substantial reformation of the undergraduate-graduate study package. Appendix F includes Power Point slides from the BS plus 30 briefing.

Three engineering managers then offered suggestions of training needs for working engineers within their areas of responsibility. Roger Healy, Chief Engineer and Assistant Commissioner, Alaska Department of Transportation and Public Facilities, discussed the department's challenges in recruiting and retaining qualified personnel. He noted that DOT&PF's turnover rate has decreased from 12% to 9% during the past years. Employees need more knowledge about how government works and courses on environmental issues, arctic engineering and seismic engineering. An example of the department's current engineering challenges is the major attention that must be given to the Alaska Marine Highway System fleet, whose average age exceeds 40 years, over the next several years. A summary of Mr. Healy's remarked is attached as Appendix G.

Gregory Schmidt is Deputy Chief of the Engineering Division, Alaska District, U.S. Army Corps of Engineers. As shown in Appendix H, the Corps' wide-ranging mission and activities require considerable engineering expertise and the related need to maintain technical currency. Required expertise includes cold regions engineering, environmental issues, energy, BIM and GIS technology and such civil works as coastal and river bank protection and infrastructure upgrades. Employees of the future will need to think creatively; understand policy, laws and regulations; be skilled communicators, both oral and written; possess skill in using technological tools; and be able to understand and perform such economic studies as cost to return analyses.

Anne Brooks is owner and principal of Brooks & Associates. Summarized in Appendix I, her remarks related to the training needs of Alaska's private sector engineers. She suggested that training must be timely, affordable and relevant. The need for soft skills was highlighted, since engineers must connect their technical work with the public. Also, mentoring of recent graduates by more senior engineers and managers is a skill that is often lacking.

Following the prepared remarks reported above, the group was divided into three smaller breakout groups for further discussion of training needs of working engineers. Participants were asked to suggest needs within their organizations, for both younger and more senior employees, and to try to come to some consensus on the most important needs. Facilitators were Keli Hite McGee, Hilari Weinstein

and Bill McMullen; all three are experienced trainers whose particular benefit to the groups' discussions was that they are not currently involved in Alaskan engineering. The intent was to generate fresh listings of needs representing all organizations present, using the earlier presentations as idea-starters

Appendix J captures the raw, unedited responses from each group. Those needs identified as having high importance are listed below. Several were identified by more than one group. Although they emerged at varying levels of specificity, the topics seem to give a good general idea of important training needs as viewed by a representative sample of Alaska's engineering managers. These topics can provide a basis for developing appropriate responses.

- Integrated/cross-functional/interdisciplinary teams, collaboration within such groups, the engineer's role and responsibility therein
- Mentoring processes and skills
- Visioning, seeing the bigger picture, and the engineer's role in vision development
- Business overview; organizational systems and management
- Communication (many types ...)
- Codes and standards
- Information technology
- Ethics and professionalism
- Critical thinking
- People skills
- Dealing with stakeholders
- Program management
- Project definition
- Leadership
- Recruiting and retention

Responses

Having identified high priority training needs for Alaska's working engineers, the roundtable then moved to what was probably its more challenging endeavor: suggesting ways by which the profession might meet those needs. The format was similar to the earlier "needs" section – a series of prepared presentations on various existing training approaches, followed by meetings of breakout groups to assemble preliminary (very preliminary!) designs for courses or other means to resolve currently unmet training needs.

Bill McMullen described the Leadership in Engineering Administration Program (LEAP) that he administers for the American Council of Engineering Companies of Arizona. See Appendices K and L. Introduced in 2000, this career development program is designed for upwardly mobile young professionals working in Arizona's consulting engineering industry. It launches that state's most promising young professionals on a development track leading to successful project management, general management and principal positions. More than 200 young engineers have completed the program.

Next the deans of Alaska's two engineering schools described graduate programs at their respective institutions. Rob Lang noted several types of offerings at the University of Alaska Anchorage, in addition to the B.S. degree: Master of Science, Master of Engineering, graduate certificates and short courses. Examples include arctic engineering and project management masters degrees, both of which are available through regular classes as well as on the Internet; a certificate program in port and coastal engineering; and short courses in earthquake engineering and geomatics. Dean Lang's handout is found in Appendix M.

Doug Goering described graduate engineering education at the University of Alaska Fairbanks, where the College of Engineering and Mines offers fourteen graduate degrees plus a certificate in construction management. At least three programs have some connection to professional level continuing education: the long-standing course in arctic engineering (CE 603), the mechanical engineering fast track BS/MS program, and the construction management certificate (to be described in more detail in the next presentation). Dean Goering also noted that graduate research projects can be undertaken by working professionals pursuing graduate degrees part-time. Please see Appendix N for more details.

A presentation by Bob Perkins described the new UAF graduate certificate program in construction management. Shaped and supported by the roundtable held in June 2008, the program was approved by the University of Alaska Board of Regents in September 2009. The program leads to a post-graduate certificate after successful completion of 15 credits of graduate study. To date, courses have been offered in one-credit-hour modules, with 135 minute classes twice a week for three weeks. Eleven different classes have been offered, some more than once. Classes have been offered in Fairbanks, Anchorage, Juneau, Ketchikan and Sitka. Most offerings have featured live, interactive video instruction to permit concurrent participation by students in more than one location. A total of approximately 60

students have taken classes, and many are well on their way toward fulfilling the 15 credit hour requirement. Appendices O and P contain further information.

The final presentation in this series was by Billy Connor. As shown in Appendix Q, he gave an overview of several different training approaches being used by various transportation agencies for their working professionals and others. He compared and contrasted traditional masters programs, graduate certificate programs, conferences and workshops, short courses and informal training, noting the advantages and limitations of each. He called attention to a new transportation leadership graduate certificate program currently being launched as a cooperative venture among several US universities. Finally, he observed that, to be effective, training must be flexible enough to use several approaches depending upon topic, participant and circumstance.

We then asked Keli Hite McGee and Hilari Weinstein, both highly skilled and experienced trainers, to share insights into training of engineers and other technical professionals in soft skills. We include Keli's handouts in Appendices R and S, and Hilari's in Appendix T. Keli suggested that a practical approach involves research; logical, pragmatic summaries; examples and stories; and discussion activities about applications. Her examples, using the topics of communication and confirmation bias, communication and trust, and change management, are shown in Appendix R.

Hilari Weinstein demonstrated some techniques she uses to train engineers and other professionals in the arts of communication, including the non-verbal component of oral communications. Her demonstration was clear in the limitations of book learning and the importance of hands on practice in training good communicators. Appendix T is a flyer about Hilari's High Impact Communication.

The approach to the breakout group sessions was to select seven high priority training needs that emerged from the roundtable's earlier discussions and assign those needs to the groups, with the charge to 1) develop a preliminary list of topics to be included, and 2) suggest what type of format (credit course, seminar, short course, etc) might be most appropriate. The seven subject areas were as follows:

- Information technology
- Mastering the business of engineering
- Mentoring

- Collaborative critical thinking
- Ethics
- Leadership
- Written communication

One group worked on the first three, another group worked on the next three, and a third group concentrated on the written communication subject area. Transcripts of the resulting suggestions are given in Appendices U1 through U7.

Afterthoughts

As noted in the agenda, an invitation was extended to any who cared to contribute relevant comments after or outside the roundtable. We include four such contributions, as Appendices V through Y.

Conclusions and Recommendations

A final plenary session during lunch sought to summarize the morning's sessions and give direction to future planning and development of training programs for Alaska's engineering workforce. To start the discussion, each participant was asked to contribute one idea, suggestion, recommendation, or other reflection that seemed important after the morning's intense, multitudinous, wide-ranging presentations and discussions. The result was yet another flip chart, transcribed as Appendix Z. The items on this list range from the importance of mentoring to the need for collaboration among Alaska's universities, agencies, professional organizations and other groups; from mastering the business of engineering to teaching alternative project delivery systems; and from a recommendation that forums on training needs such as this one be held frequently to the suggestion that younger engineers, not just their supervisors and employers, should be surveyed about their needs.

The group was asked to express preferences among the seven courses whose preliminary designs had been developed by breakout groups. Such a sorting would guide training planners to develop offerings considered of greatest value. The intent was to identify offerings satisfying at least two criteria: "How important?" and "If we gave it, would they come?" The result was the following ranking, where the numbers in parentheses show the number of votes, each voter having been restricted to two votes:

1. Mentoring (12)
2. Leadership (11)
3. Mastering the business of engineering (9)
4. Written communication (7)
5. Collaborative critical thinking (6)
6. / 7. Information technology (1) Ethics (1)

What can one conclude from all of the above? A review of the text written above and the attached appendices, plus the privilege of attending the sessions themselves, may leave one with a headache, but they also leave some general impressions. Among these are the following:

One size does not fit all.
Different training modalities are available, such as classroom, video, on-line, different academic models, MS, and graduate certificate. Furthermore, different instructional methods are also available – solo numerical problem solving, team collaborations and problem solving, personal training in speaking and so on. Once training programs are developed that work for some student/employees in some situations, we must be alert for other types of students and situations and explore other methods, perhaps, of meeting their needs.

Ivory Tower or Leaning Tower of Pisa (which is still standing)
Many needed skills cannot be taught or learned in the classroom or on the computer. They must be learned by doing and by close interaction with those who do know how. The role of the academic course in these areas is to facilitate or accelerate those learning processes – if that is practical. Some skills are really personal growth, again academics can help, but professional academics (certainly in engineering) do not normally think in terms of such growth. "Critical Thinking" is a great example. A student can memorize the steps that process, but that may have no relation to their ability to actually think, especially under pressure.

Black and Blueberries
There is a need for integrating all the new communications and data storage and retrieval into the business process. There is wide agreement of the need for such training, but no agreement about what it may require.

How to Mentor the Mentors?

Good mentoring seems critical to all steps in the advanced training of engineers and professionals, as well as retention and succession planning steps of organizations. But there are no definitive ideas about how to train the mentors, some of whom are the busiest people in the organization. The tendency is to leave mentoring to the HR Department.

More specific conclusions from the roundtable seem to fall into two categories: 1) identified high priority needs, both general and more specific, and how those needs might be met, and 2) conclusions about the on-going need to organize for, investigate, coordinate and follow-up on efforts to provide training opportunities.

Category 1) Needs and how to meet them

The highest priority training needs are in the following subjects:

- Communications (of all types)
- Environmental permitting, regulations, processes; NEPA
- People skills
- Project management
- Leadership and supervision
- Ethics, professionalism and liability
- Codes and standards
- Scheduling
- The business of engineering, including organizational systems and management
- Information technology
- Various technical specialties
- Mentoring

The area of project management is very multi-faceted, embracing

- The need to move from task orientation (which is the emphasis in undergraduate training) to project orientation
- Cross- disciplinary teams; team building
- Defining project objectives; clarifying scope
- Role of the engineer in projects
- The notion that many non-engineering disciplines are usually involved

Alaska-specific needs must be part of the training needs milieu

- Cold regions

- Energy
- Environmental
- Project management issues, such as cultural, workforce availability and training, supply train, cost, and logistics

A recently identified emerging training need for more senior engineers is mentoring, as discussed above. We must train both mentors and "mentees."

There is a need for mentored internships for engineers early in their careers. AIA Intern Development Program has elements that can apply to the professional development of engineers

Acquisition of the requisite "book of knowledge," whether or not in preparation for taking the professional engineering exam, can only be achieved through a combination of education (undergraduate and graduate) and experience.

Training of working engineers can be achieved only through a combination of approaches, depending on the type of learning need and subject matter, the students' and employers' situations, and the available time.

While some needed training subjects are common to all age groups, some needs depend on age and experience.

Arizona's very successful Leadership in Engineering Administration Program (LEAP) could be a valid approach to teaching the business of engineering to younger employed engineers.

The fledgling UAF Construction Management Graduate Certificate program is proving useful for those in the construction area. Similar certificates are likely to follow the same pattern.

<u>Category 2) Organizing to assure needs continue to be identified and met</u>

It is important to conduct meetings such as this one regularly, with participants from a wide spectrum of Alaskan engineering organizations.

It is also essential to publicize widely the outcomes from meetings such as this.

Maintenance of communications with employers, employees and students with regard to training needs is important. Don't neglect surveying younger engineers.

Statewide coordination of 1) training opportunities for working engineers and 2) publicity for any such offerings is currently lacking.

Many training opportunities already exist in the University of Alaska system. Any future planning should build on these in-state strengths.

While not dealt with at this meeting, the provision of sufficient of resources to support training is an on-going concern and must be a topic of discussion at future such forums.

Several recommendations follow from the conclusions, as follows:

1. Establish a mechanism to develop, coordinate and publicize, statewide, training opportunities for working engineers. A small working group representing the several constituencies is suggested.

2. Develop a selected set of new training opportunities, focusing on those needs identified in this roundtable. Among the highest priority are

    - Mentoring
    - Written communication
    - The business of engineering
    - Leadership and supervision

3. Continue to offer existing courses identified as high priority needs, including

    - Environmental regulations and permitting
    - Project management, revised to respond to conclusions from the roundtable
    - Cross-disciplinary team-building
    - Scheduling

4. Consider seriously the Arizona LEAP model as an appropriate means for training young engineers in the business of engineering

5. Attract a wider audience to the existing Graduate Certificate Program in Construction Management

6. Develop a second graduate certificate program with a format similar to that used for the Graduate Certificate Program in Construction Management

7. Publicize the results of this roundtable widely, through

   - This report to all attendees
   - This report to University of Alaska leadership; all Alaska professional engineering organizations; the Board of Registration for Architects, Engineers and Land Surveyors; and other appropriate engineering leaders and organizations in Alaska.
   - Public meetings of professional engineering organizations, faculty groups, and others
   - Papers published by the Alaska Professional Design Council, American Society for Engineering Education, and other organizations with similar interests and missions

8. Keep the profession informed about developments in the proposal that would require additional education beyond the bachelor degree as a prerequisite to sitting for the professional engineer examination

9. Hold a similar roundtable in mid-2012 to review progress to date and identify contemporary needs and appropriate responses

Acknowledgements

We are indebted to the 31 persons who contributed over half a day of their valuable time to participate in the roundtable, and to their employers. We acknowledge with special thanks the contributions of all those who prepared and gave presentations and who led breakout groups as facilitators – Roger Healy, Greg Schmidt, Anne Brooks, Bill McMullen, Rob Lang, Greg Goering, Billy Connor, Keli Hite McGee and Hilari Weinstein.

The continuing financial and personal interest of the University of Alaska Workforce Programs Office and its Associate Vice President Frederick Villa made possible the work reported herein.

For further information

Further information about the roundtable and related workforce development topics at the University of Alaska Fairbanks may be obtained from the authors at

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Fairbanks AK 99709
907-479-5118
benco@alasla.net

Appendix A -- Attendee List -- June 22, 2010 Roundtable on Graduate Engineering Education

Name	Affiliation	e-mail address
Bennett, Larry	Bennett Engineering	benco@alaska.net
Brooks, Anne	Brooks & Associates	a.brooks@brooks-alaska.com
Brown, Janet	Alaska Department of Transportation & Public Facilities	janet.brown1@alaska.gov
Bunch, Brittany	UAF College of Engineering and Mines	bjbunch@alaska.edu
Cattanach, Dick	Construction Education Foundation	dick@alaskacef.org
Connor, Billy	Alaska University Transportation Center	bgconnor@alaska.edu
Duffy, Larry	UAF Graduate School	lkduffy@alaska.edu
Goering, Doug	UAF College of Engineering and Mines	djgoering@alaska.edu
Goettler, Brian	US Coast Guard Juneau	Brian.J.Goettler@uscg.mil
Harder, Arnold	Kinney Engineering	arnoldharder@kinneyeng.com
Healy, Roger	Alaska Department of Transportation & Public Facilities	roger.healy@alaska.gov
Hite McGee, Keli	Hites Consulting	khmcgee@me.com
Johansen, John	Alaska Department of Transportation & Public Facilities	john.johansen@alaska.gov
Johnson, Galen	UAF Community and Technical College	gjohns55@alaska.edu
Kinney, Greg	Alyeska Pipeline Service Company	KinneyDG@alyeska-pipeline.com
Krol, Lon	Alaska Department of Transportation & Public Facilities	lon.krol@alaska.gov
Lang, Rob	UAA School of Engineering	afrjl@uaa.alaska.edu
Latreille, Greg	BBFM Engineers	glatreille@bbfm.com
McMullen, Bill	Consultant, LEAP Director	willybbb@cox.net
Mearig, Lance	USKH	lmearig@uskh.com
Miller, Patty	Alyeska Pipeline Service Company	patricia.miller@alyeska-pipeline.com
Nelson, Dale	NANA Pacific	danelsonpe@gmail.com
Perkins, Bob	UAF College of Engineering and Mines	raperkins@alaska.edu
Rice, Kim	Alaska Department of Transportation & Public Facilities	kkim.rice@alaska.gov
Schmidt, Greg	US Army Corps of Engineers	Gregory.J.Schmidt@usace.army.mil
Shrader, Steve	Municipality of Anchorage	ShraderSD@ci.anchorage.ak.us
Smith, Doug	Haskell Corporation	dsmith@haskellcorp.com
Wang, Steve	UAA School of Engineering	afhsw1@uaa.alaska.edu
Weinstein, Hilari	High Impact Communications	hilari@highimpactcommunication.com
Winters, Victor	Alaska Department of Transportation & Public Facilities	vic.winters@alaska.gov
Wynns, Kim	BP Exploration	wynnk1@BP.com

Appendix B

Roundtable on Alaskan Graduate Engineering Education in the BS plus 30 Era: Needs of the Professional Workforce and Suggested Responses

June 22, 2010 8:00 AM to 1:30 PM
Coast International Inn, Anchorage

Agenda

8:00 Welcome by Professor Bob Perkins

8:05 Introduction of participants

8:15 Purposes and plan for today – Larry Bennett

Part I. – What are the needs of Alaska's engineers for post-baccalaureate training, education, development, professional growth?

- 8:20 Three brief presentations by Bennett
    - Needs identified at 2008 roundtable on Alaskan construction professionals
    - Needs identified in 2010 by several Alaskan engineering managers
    - The coming BS + 30 requirement for professional registration
- 8:35 Alaska Department of Transportation and Public Facilities Needs – Roger Healy
- 8:45 US Army Corps of Engineers Alaska Needs – Greg Schmidt
- 8:55 Private Sector Engineers' Needs – Anne Brooks
- 9:05 Breakout groups to
    - Identify additional needs
    - Prioritize identified needs
    - Facilitators –Hilari Weinstein, Keli Hite McGee, Bill McMullen

- 9:40 Reports from groups

9:50 Refreshment break

Part II. – How should universities and other entities respond to those identified needs?

- 10:05 Panel discussion on a selection of current training programs
    - 10:05 Arizona Leadership in Engineering Administration Program (LEAP) – Bill McMullen
    - 10:15 UAA Graduate Programs – Dean Rob Lang
    - 10:25 UAF Graduate Programs – Dean Doug Goering
    - 10:35 UAF Construction Management Certificate Program – Bob Perkins
    - 10:45 Some Transportation Agency Training Approaches – Billy Connor
- 11:00 Challenges in teaching soft skills to engineers – Hilari Weinstein and Keli Hite McGee
- 11:15 Breakout groups to
    - Identify and prioritize appropriate Alaskan responses
    - Facilitators –Hilari Weinstein, Keli Hite McGee, Bill McMullen
- 11:50 Reports from groups

Part III. – 12:00 Working lunch

- Recommendations
- Action plan

Adjournment – 1:30 PM

After-thoughts are always welcome. Please e-mail to Larry Bennett at benco@alaska.net by June 28, 2010.

Appendix C

Training needs for professionals in Alaskan **construction**
identified at May 29, 2008 Roundtable

Summary listing

- The entire realm of the business aspects of construction
- An understanding of the interrelationships and interdependencies of construction management
- Cost and finance issues
    - Estimating
    - Cost control
    - Forecasting
- Presentation skills

Communication skills

- Written communications
    - Formal
    - Informal
- Proposal preparation
- Claims documentation
- Web-based communication
- Reading written materials for understanding
- Public communications
- Meeting management
- Negotiating
- "Toastmasters"-type training
- Crew motivation
- Listening skills
- Power Point preparation and use

"Soft" skills

- Organizational dynamics and interpersonal skills
    - Supervision,

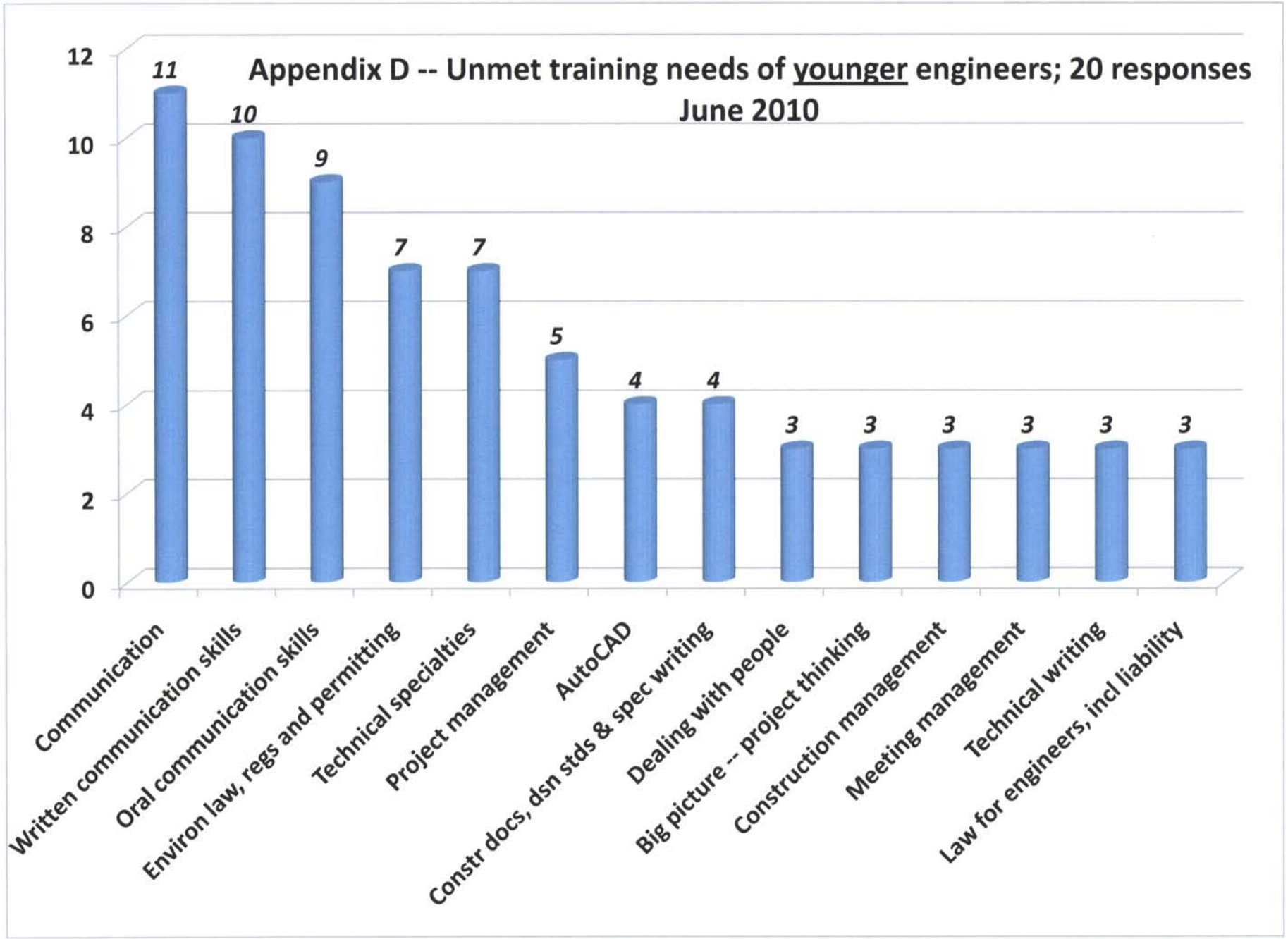
    - Communications
    - Leadership v. management
- Partnering concept
- Importance and challenges of teams in the workplace
    - Therefore, team approaches to some technical courses

Technical skills

- Construction schedule and cost management
- Legal matters
    - Contracts
    - Claims
    - Dispute resolution
    - Environmental
    - Labor
- Other environmental concerns
- Tradeoffs among cost, schedule and quality
- Alaska-specific
    - Regional differences
    - Cultural understanding
    - Tribal matters
    - Arctic construction techniques
    - Local labor training

One conclusion … training providers must **continually assess such needs** in light of changing employee backgrounds and industry conditions.

-- from Perkins and Bennett, "Training Needs of Alaska's Professionals in Construction," Report from a Roundtable, May 29, 2008


Appendix D -- Unmet training needs of younger engineers; 20 responses
June 2010
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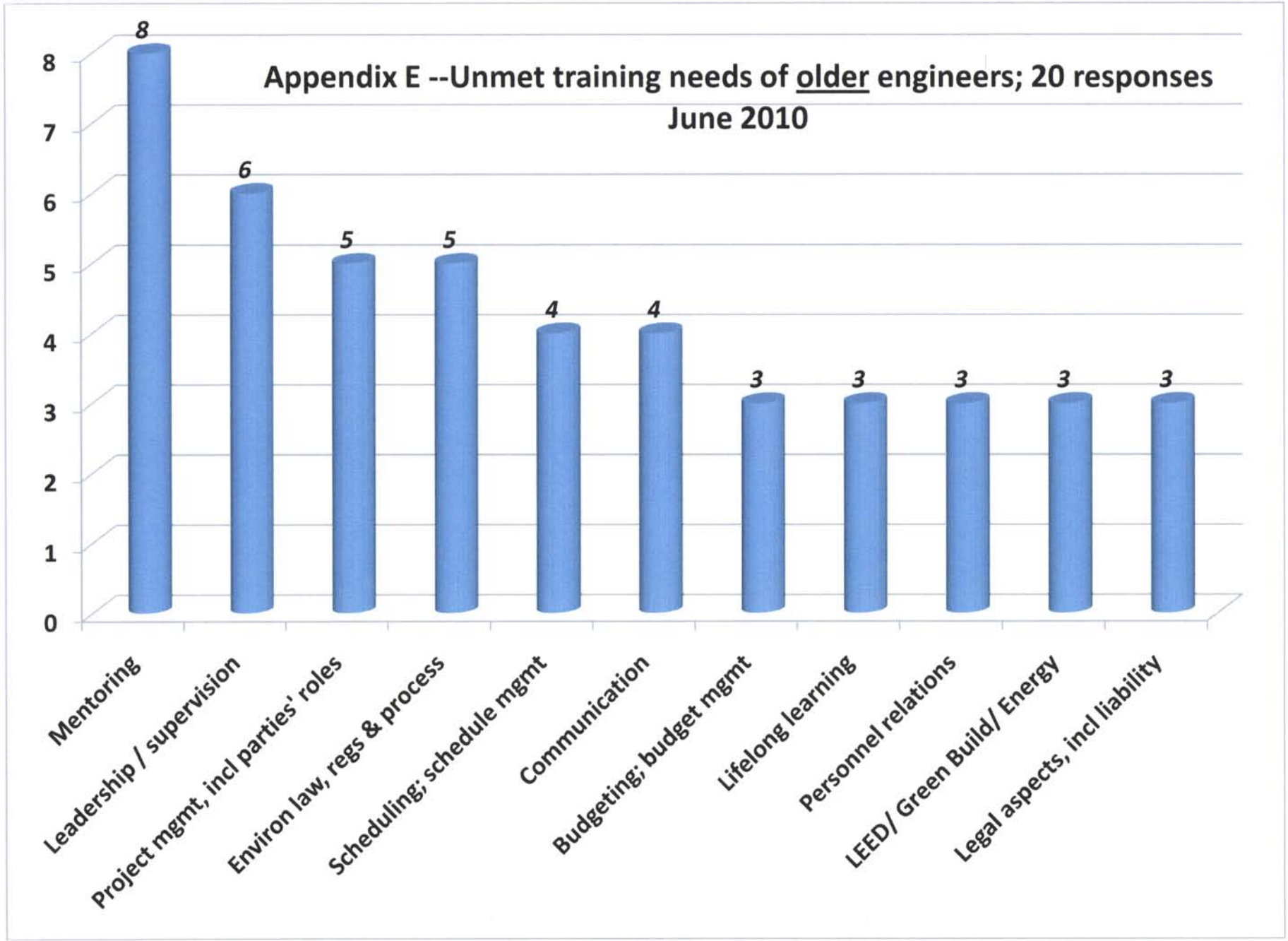
3
Communication
Written communication skills
Oral communication skills
Environ law, regs and permitting
Technical specialties
Project management
AutoCAD
Constr docs, dsn stds & spec writing
Dealing with people
Big picture -- project thinking
Construction management
Meeting management
Technical writing
Law for engineers, incl liability


Appendix E --Unmet training needs of older engineers; 20 responses
June 2010
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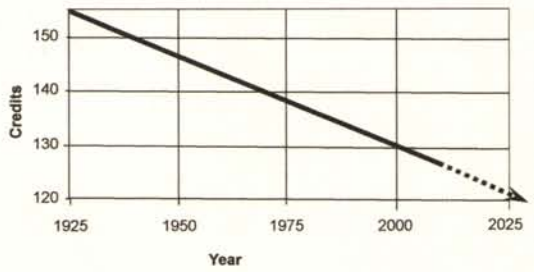
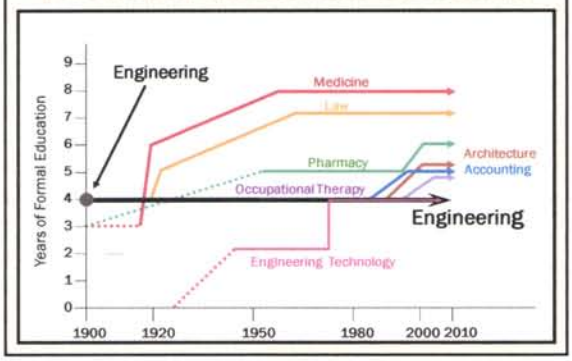
Mentoring
Leadership / supervision
Project mgmt, incl parties' roles
Environ law, regs & process
Scheduling; schedule mgmt
Communication
Budgeting; budget mgmt
Lifelong learning
Personnel relations
LEED/ Green Build/ Energy
Legal aspects, incl liability

THE BS PLUS 30 CHALLENGE

A Concern?



A CENTURY OF PROFESSIONAL PREPARATION



TRENDS AND PRESSURES

- Expanding knowledge base
- An increasingly complex world resulting in the need for greater specialized technical competence
- Addition of non-technical courses to the curriculum (ABET, core curriculum, etc)
- Decrease in BS credit hours

NCEES RECENT HISTORY

- 2001 Engineering Licensure Qualifications Task Force Established
- 2005 Begins process of changing *Model Law*
- 2006 Adds language to *Model Law*

  [educational requirement to qualify to take PE exam] Graduation with a bachelor of science degree from an engineering program of four years or more accredited by EAC/ABET, or equivalent, **plus 30 additional credits from an approved course provider(s) in upper-level undergraduate or graduate-level coursework in professional practice and/or technical topic areas.** The additional education requirements would be implemented no sooner than 2010.

NCEES, CON'D

- 2008 – Bachelors Plus 30 Task Force Established
- 2009 – Reaffirms basic position; changes some words
- 2010 – Begins exploring alternatives

National Council of Examiners for Engineering and Surveying

To Be an Engineer Intern (EI) --

B[ABET] + FE Exam

or

B + M[ABET] + FE Exam

Model Law Section 130.10 (2020)

7

National Council of Examiners for Engineering and Surveying

To Take Professional Engineer (PE) Exam, you must be Engineer Intern (EI) and

M[ENRG] + Experience

or

"+30" + Experience

8

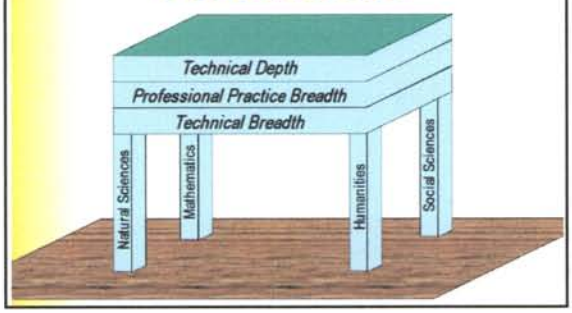
National Council of Examiners for Engineering and Surveying

And what is the +30 ?

- 30 credits of courses equivalent in rigor to upper-level undergraduate or graduate courses.
- At least 15 credits in engineering (ALL 30 credits can be in engineering!).
- Remainder of credits can include science, math, and/or professional practice topics (such as business, communications, contract law, management, ethics, public policy, & quality control)
- From "approved course providers."

9

BOK FOR LEARNED PROFESSIONS



BODY OF KNOWLEDGE

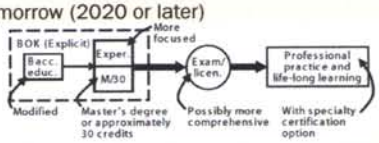
- SWEBOK
- EnvE BOK
- CE BOK

Knowledge, skills,* & *attitudes **necessary to ENTER into the practice of civil engineering at the professional level.**

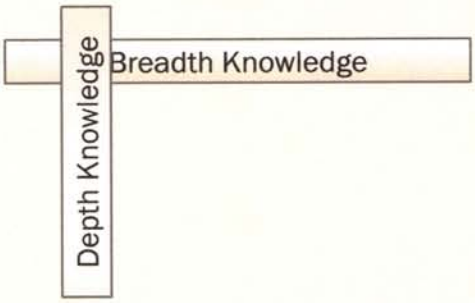
NOW AND LATER ...

Today

Tomorrow (2020 or later)



DEPTH AND BREADTH



EXAMPLE

Business Law Leadership Project Budgeting Risk Management Managing Change

Advanced Digital Signal Processing
Digital Processing of Continuous-Time Signals
Discrete Fourier Transforms
& Fast Fourier Transforms
Digital Filters
Multi-rate Digital Signal Processing
Spectral Estimation

ANOTHER EXAMPLE

Public Finance Public Speaking Team Building Quality Control Project Management

Transportation Planning
Traffic Flow Network Modeling
Traffic Demand Analysis & Management
IT Applications in Signalization & Control
Safety Issues in Transportation Planning & Management
Transportation & Sustainable Development

Appendix G

Alaska DOT&PF Needs

Department Overview:

Approximately **3,800** positions – full, part, seasonal, and non-permanent positions

For purposes of analysis, Workforce Development has segmented ADOT positions into 19 separate occupational groups: Admin Support, AMHS Shoreside, Engineering, Leasing, Labor/Trades/Crafts, Financial, Environ mental, etc.

All support Department's mission – Providing for the safe movement of people and goods and delivery of state services.

ADOT's **turnover rate for 2009 was ~9%**, down slightly from 12% in four year average.

ADOT's retirement eligibility is about 30% over the last four years, with **~24% (918 employees) eligible for retirement in the next five years.** About 360 of those 918 can retire today.

Engineering positions trend close to the norm for retirement eligibility. Department is concerned about losing engineering skillsets, but also broader issues of knowledge transfer.

Providing this Department overview:

- Project Delivery functions cut across many disciplines, not just engineering. Successful delivery of projects is multi-disciplinary. Increasingly, engineering management must have variety of skills outside of technical engineering to guide project successfully. "Own the project" throughout its delivery.
- Department's mission is tied to other occupational groups that have been difficult to have a large pool of qualified applicants.
    - Transportation Planners
    - Right-of-Way Agents
    - Fleet Managers
    - Environmental Analysts
    - Land Surveyors
    - Port Captains
    - AMHS Masters, Pilots, and Mates
    - Engineering (of all above Engineering profession is not the worst)

Specific engineering disciplines needing support:

- Arctic Engineering.
- Project Management
- Seismic Engineering (within Bridge Section we have limited positions versed in seismic)
- Electrical is waning (Big influx of Airport Projects over)
- Naval Architecture (ferry fleet is on average 40 years old and way past their design life)
    - Most of these specialties can be, or are being contracted out to consultants.

Other subject areas that the +30 concept should address:

Public Policy; Public Administration; Contracting, Environmental Process (federal and state); Technical Writing; Business (ability to 'sell' the project); (If unable to promote and sell the project, others will be substituted and Engineers may lose project lead role); Public Involvement Process.

30+ Concept is not universally supported throughout Department's engineers. More knowledgeable and more versant engineers are encouraged, but additional educational requirements lead to greater difficulty in recruitment, and skills are more easily defined and refined in the workplace.

Appendix H

US Army Corps of Engineers – Alaska Needs

Key Points:

- Our needs will be customer driver

Cold Regions Directory of Expertise

- Expand the partnership from CRREL and POA to Cold Climate Housing Research Center
- Promote scientific and engineering knowledge about constructing facilities and infrastructure in cold climates
- Already provided symposiums
    - In Conjunction with AIA (Sept 2009) and Procurement Fair (Mar 2010, Fairbanks)
- Future applications: Foundations, Building Thermal Envelopes, Buiding Matl's / techniques
- Ability of Mechanical Engineers, Architects to do energy audits and analysis
- DoD Infrastructure

Energy related growth

- More efficient production, more green production of power
- Alternate energy sources
    - Consider initial cost, Life-cycle cost

Increased use of BIM technology

Increased use of GIS technology

Civil Works funding may decline somewhat in the intermediate term, however, potential areas for growth include:

Coastal Protection / River Bank Protection

Infrastructure Upgrades to move good and energy to the Bush communities

Vehicle could include Denali Commission

Providing services and infrastructure while minimizing Environmental Impact

Energy will grow as an issue – provision of energy (sub- 10 MW generators) with low Env Impact

Ie, small hydroelectric detention facilities which do not impede fish passage;

Small wind or tidal generation that does not impact environment or wildlife; economically viable

USACE will need employees who:

Think creatively

Understand policy, laws, regulations

Are skilled communicators (both verbal and in writing)

Possess skill in using the technological tools

Economists (Cost to return ratio)

Enviromental Restoration

- Restoration: FUDS program is growing
  - Advanced technology
- Ability to assess risk quickly – many sites on military installations are contaminated)
  - Statistics
  - Response
- Air Quality: Greenhouse Gases measurement
- Consideration of methane trapped in permafrost

Overall needs:

- Agility (Humanitarian Assistance, US AID) -- EWB
- Expeditionary Mindset and Capability (Disaster Relief, Deployment to support military ops)
- Technological excellence

Appendix I

Private Sector Engineering Needs

- Training must be
  - Affordable
  - Timely
  - Northern relevant

- Possible modalities, in addition to university courses
  - In-house
  - Webinars
  - Conferences
  - Short Courses

- Importance of the soft skills necessary to translate design to the public and vice versa

- Importance of mentoring in providing an holistic view of engineering
  - Understanding the obligation of senior professionals to mentor junior professionals

- Importance of clear scope when soliciting work with public sector funding

Appendix J – Training needs identified in small group discussions

Needs – Group A (Keli Hite McGee)

Allocating time effectively (Younger and older)

Mentoring and transition – Training both mentor and mentee (Younger and older)

Issue: How much can the University take care of the needs? Where or when are they picked up by the industry?

*Codes and standards – what do they mean and how do you apply them?

Contract law and land law (Younger engineers)

Linking the training content needs: business + engineering + social/interpersonal

*IT – Smart Plan – 3D modeling – How do we get the most out of it for the business?

Resource issues: Funding limitations, where we can only focus on "hard skills"

*NHI training; short courses

Alaska-relevant training

*Ethics and professionalism

Government impact & process; understanding the public sector

Learning from successful projects

Integrating university theoretical basis and applications

*Integrated/cross-functional/interdisciplinary teams

*Critical thinking

*= high importance

Needs – Group B (Bill McMullen)

Younger

*People skills

*Role in vision development; see bigger picture

Learn to formulate the problem

What IS the problem?

Time management

Mentoring

Change management

*Collaboration within group (bring in knowledge)
- Engineers' role and responsibility
- Multidiscipline approaches

Human resources (labor law)

*Dealing with stakeholders

Construction experience
- Mentored
- Stay current with practice

Older

Policies and procedures

Organization management

Project management

*Program management

Information management – IT; codes and standards

*Vision; engineers' role; org mgmt

Human resources
Labor law
Personal management

Professor needs to understand

*Mentoring skills

*= high importance

Needs – Group C (Hilari Weinstein)

Younger

*Project definition
- Writing good scopes
- PDRI (Project Definition Rating Index)
- Engaging client to get clear answers

Time management

Green issues
- LEED
- Life cycle costs
- Alternative energy

Understanding the construction business

Case studies – lessons learned

*Business overview –organizational systems

*Communication
- Written (formal)
- Targeted
- Oral
- Presentations
- Business development
- Cultural
- On-line
- Cross-generational
- Technical writing
- Outlining
- Coaching

Older

*Project definition

Time management

Current technology

Communication skills

- Mentoring

*Leadership

*Recruiting and retention

*Mentoring

Community service

*= high importance

Appendix K

American Council of Engineering Companies of Arizona

LEADERSHIP IN ENGINEERING ADMINISTRATION PROGRAM (LEAP)
Class of 2011

A career development program designed for upwardly mobile young professionals working in Arizona's consulting engineering industry. A program to help us develop successful business leaders who consistently please our clients and create value in our firms.

The Arizona Consulting Engineers Association continues to offer the leadership training program it introduced in 2000. LEAP's goal is to boost the career development of future leaders in Arizona consulting engineering. It is designed to launch our most promising young professionals on a development track leading to successful project management, general management and principal positions. Students will learn effective and practical business applications they can put to immediate use in their firms.

Training is focused on consulting practice and helping students understand the "business of consulting engineering". Emphasis is placed on the "people skills" so important in our business – effective communication, teamwork and leadership. The importance of client service, having a client/marketing focus, and creating value for all the firm's stakeholders is woven throughout the lessons. Several opportunities are provided for students to develop and practice their presentation skills.

Specific instruction directed to the selling of professional services helps students develop and sharpen their marketing skills. Interactive teaching methods and homework assignments help them learn the fundamentals of project management and how to apply the "tools" used by successful managers. They learn about professional service contracts, risk management, liability, indemnification and insurance.

The program covers the importance of "external factors" affecting practice in Arizona – legislative affairs, Board of Registration, professional and business associations. It introduces our young professionals to a broad spectrum of the engineering consulting industry in Arizona and helps them develop networks to serve their careers and our businesses for years to come.

The LEAP faculty is a mix of recognized professionals serving the A/E industry, with highly experienced and credible leaders from our own member firms. Training sessions will be held at the Desert Willow Conference Center, 4340 East Cotton Center Boulevard, Phoenix. Tuition for the Class of 2011 will be based on faculty, materials, facility and equipment costs. Our goal is to keep tuition at the $3000 per student charged in 2010.

Scheduled to start in mid-January, classes will continue with one-day sessions on three-week intervals thereafter. We plan 11 sessions totaling 72 professional development hours. The target class size is 25, to afford each student ample opportunity for active participation in class activities, and to allow individual attention by trainers. Sessions will alternate from Fridays to Saturdays, sharing the time commitment between firms and attendees. Homework, outside reading and small group exercises will be assigned between classes to broaden the learning opportunity and provide continuity.

Employees of ACEA member firms having 5-10 years experience will be considered for attendance. Applicants should be at the point in their careers where they are about to make, or are in, the transition from purely technical responsibilities to supervisory and management responsibilities.

Attachment: Example Class Schedule *(2011 schedule to be similar to 2010)*

LEAP 2010 Class Schedule
(as example for 2011)

Day One, Friday, January 8
Introduction & Administration (1:00), Understanding Ourselves & Others (6:00)
Introduction – ***Jim Dowell, ACEC/AZ Board President***
Trainers – ***Jeff Koenig (NCTI), Bill McMullen (LEAP Director)***

Day Two, Saturday, January 30
Leadership Skills for the 21st Century (7:00)
Trainers – ***Pete Walsh (Peak Performance Coaching), Jeff Koenig (NCTI)***

Day Three, Friday, February 19
Communication Skills for Business Success (6:00), Value Creation Assignment (1:00)
Trainers – ***Hilari Weinstein (High Impact Communication), Bill McMullen***

Day Four, Saturday, March 13
Perspectives on the Business (3:15), Student Presentations on Value Creation (2:15), Project Scope of Services (1:30)
Trainers – ***Mike Ellegood (PSMJ Resources), CG Gnanasambanthan (Premier Engineering), Hilari Weinstein, Bill McMullen, Bruce Toro***

Day Five, Friday, April 2
Project Scoping, Planning & Control (7:00)
Trainer - ***Bruce Toro***

Day Six, Saturday, April 24
Managing Business Risk (3:15), Negotiating Project Terms (1:30), Strategic Planning (2:00)
Trainers – ***Doug Folk (Folk & Associates), Jeff Gerrick (Professional Underwriters of Arizona), Bruce Toro, Bill McMullen, Darrell Wood, Albert Romano***

Day Seven, Friday, May 14
Human Resources (3:00), Board of Technical Registration (1:30), Professional Ethics (2:00)
Trainers – ***Alan Rhea (Stanley Consultants), Chet Pearson (BTR), Carolyn Mattick (ASU)***

Day Eight, Saturday, June 5
Contracts that Manage Risk (3:00), Selling Consulting Engineering Services (4:00)
Trainers – ***Doug Folk, Jeff Gerrick, Steve Wilson (Michael Baker Jr., Inc.), Andrea Norman (Mind_ the_Gap)***

Day Nine, Friday, June 25
Winning Proposals (4:00) & Persuasive Presentations (3:00)
Trainers – ***Andrea Norman, Hilari Weinstein***

Day Ten, Saturday, July 17
Managing Construction Phase Risk (3:00), Marketing Team Winning Presentations (4:00)
Trainers – ***Doug Folk, Jeff Gerrick, Hilari Weinstein***

Day Eleven, Friday, August 6
Wrap-up & Graduation
Guest Speakers – To be determined
LEAP Director – ***Bill McMullen***

LEAP Alumni Impact Arizona Consulting Engineering

LEAP has graduated 241 students and has another 23 in the Class of 2010. LEAP alumni are making their mark in Arizona consulting engineering. Many have achieved senior management or principal positions in their firms. They are prominent on ACEC/AZ liaisons and committees, and in Arizona business and professional associations. Three are ACEC/AZ Board Members.

Selected Quotes from Previous Graduates

"LEAP is the best class I have ever attended. It can and should be a national class available everywhere."

"LEAP was a great, logically structured program. I looked forward to every class."

"This was probably the best course I've taken since college."

"The program is excellent. Everything is outstanding."

"FANTASTIC! All of the classes were great."

"LEAP 2009 exceeded my expectations."

"I have already noticed an increased confidence in myself at work."

"Every trainer was very impressive and very good at what they do. They are the best of the best.

"LEAP was a great place to meet so many people and the networking was wonderful."

"I have 25 more friends in the consulting industry now."

"I know this is focused on engineers, but consulting geologists and other scientists could receive great value."

"LEAP made me realize I am not and will not be, a 'commodity'."

Leadership in Engineering Administration Program (LEAP)

A career development program for upwardly mobile young professionals working in Arizona's consulting engineering industry. A program to help us develop successful business leaders who consistently please our clients and create value for our firms.

How Did LEAP Happen?

- ACEC principals' desire to improve business savvy of staff professionals
- Principals' committee formed to define training needs and develop a program
- Program planned in 1999, launched January 2000 with 22 students
- Class filled every year since then

LEAP Training Objectives

- Boost the career development of our most promising young professionals
- Help them learn the "business" of consulting engineering
- Enhance their ability to effectively network in the marketplace
- Improve their critical business skills

Curriculum Highlights – it's all about the "business of consulting engineering"

- Individual preferences & values
- Leadership & teamwork
- Coaching skills
- Oral communication skills
- Consulting business basics
- Value creation for stakeholders
- Project scope development
- Managing business risk
- Professional service contracts
- Project planning & control
- Negotiating contract terms
- Strategic business planning
- Human resources
- Marketing & sales
- Group presentations
- Professional ethics

LEAP Faculty

- Recognized professional trainers in the industry
- Experienced leaders in ACEC member firms
- Visiting academic educators
- Outstanding LEAP alumni

LEAP Success Factors

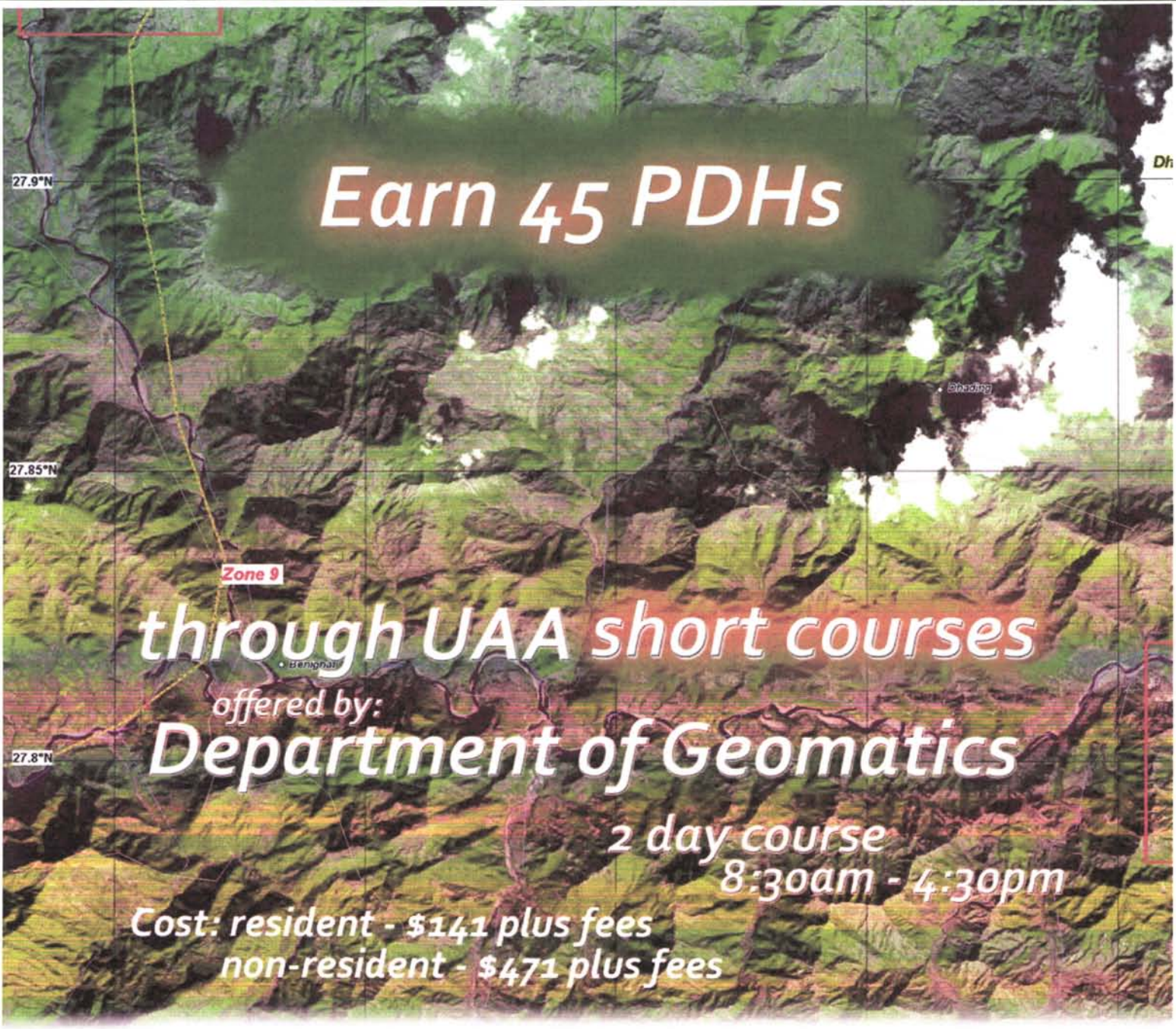
- 241 graduates in first 10-years
- 23 more will graduate August 2010
- LEAP alums prominent in AZ market
- Many are now principals in AZ firms
- Three are ACEC Board Members

QUESTIONS...?
COMMENTS...?

Appendix M

Graduate Programs and Post-graduate Training at UAA

Area	B.S.	M.S.	M.E.	Certificate	Short Courses
Applied Environmental Science and Technology		x			
Arctic Engineering		x (web)			x
Civil Engineering	x	x	x		
Earthquake Engineering				Graduate	x
Geographic Information Systems (GIS)				Undergrad.	x
Geomatics (Surveying and Mapping)	x				
Engineering Management		x			
Port & Coastal Engineering				Graduate	
Project Management		x (web) (cohort)			x
Science Management		x			
Miscellaneous					



Spring 2010 - 1 GIS courses available now
Watch for more GIS courses available Fall 2010

Course	Registration Number	Class Dates	Registration Deadline
GEO A490 - Spatial Reference Systems in GIS	CRN # 39803	March 20, 27	Wed., Mar. 17

Register on-line. For more information, please contact Susan Dickerson at 907-786-1972 or anskd@uaa.alaska.edu

Appendix N

UAF College of Engineering and Mines
Workshop on Graduate and Professional Education

June 22, 2010

Douglas J. Goering, Dean

UAF Graduate Engineering Programs

The College of Engineering and Mines at UAF offers fourteen graduate degrees as well as the newly-approved graduate certificate in Construction Management. These degree programs include the Engineering Ph.D. with concentrations in nine different areas, as well as traditional master's programs in Arctic, Civil, Electrical, ESM, Environmental, Geological, Mechanical, Mining, Mineral Preparation, and Petroleum Engineering. Many of the students enrolled in these UAF degree programs are traditional full-time graduate students that are supported on college teaching or research assistantships. However, depending on the program, there is also a large fraction of students that are working on a graduate degree/certificate part time as they work full time in the engineering profession. In the past the college has tried to accommodate work schedules by offering classes late in the day or one evening a week from 7-10 pm.

Programs with an emphasis on Professional Education

At least three of the graduate programs currently offered in CEM have some connection with professional level continuing education or with the potential BS + 30 requirement. The first of these is the Construction Management certificate program. This program is designed specifically with working professional engineers in mind and operates using a flexible curriculum model which can be tailored somewhat to the needs of specific groups. The courses are offered in 1-credit increments to allow expedited completion, and 15 credits are required to receive the graduate certificate. Another area of professional emphasis includes the continued offering of CE 603, Arctic Engineering, both on the UAF campus and on-line via a web-based course. CE 603 is required for professional engineering registration in Alaska and is, therefore, very popular with students intending to go into professional practice or those wanting to become registered in the State of Alaska. Finally, the third program that may potentially intersect with the BS+30 requirement is the Mechanical Engineering fast track BS/MS program. This program was set up to allow UAF undergraduate students in mechanical engineering to complete their MS degree with only one additional year of study beyond the BS. The total requirement for both degrees is 150 semester credit hours. This program allows completion of the BS + 30 requirement in a much more structured way, and awards an MS degree in a shorter time frame than is typically possible in a more traditional MS program. If the BS + 30 requirement becomes the norm for professional engineering registration, such fast track programs may increase in popularity.

Research and Graduate Student Support

The level of overall research expenditures in the college has increased dramatically over the past 10 years from around $4M annually in 2000 to about $18M during the 2010 fiscal year. The level of research activity has an important impact on graduate programs in two areas. First, grant funds help provide support for graduate students through research assistantships. While this is a

more important funding mechanism for traditional full-time graduate students, there are also benefits to working professionals who complete their degrees part-time as they are exposed to active research projects that are of interest to governmental and private funding agencies. In some cases, working professionals are able to combine the research requirements of the degree program with their own professional endeavors by completing research in the same area as that of their professional work. This has the dual benefit of providing research that is of direct value to the students firm or business and at the same time satisfying the research requirements of the degree. While such projects have to be carefully vetted by faculty advisors, there are substantial advantages if appropriate projects can be arrived at. This may be one way of furthering for-credit work at the professional level, even on a credit by credit basis whether the student is enrolled in a specific graduate program or not. All existing graduate degree programs do offer flexible credit for research, so part of the required system is already in place.

Appendix O

University of Alaska Fairbanks Department of Civil and Environmental Engineering

Graduate Certificate in Construction Management

The objective of the Graduate Certificate in Construction Management is to increase the skills of graduate engineers and other construction professionals in order to accelerate their advancement into more responsible management positions. The program was designed with strong input from construction industry employers and will continue to regard the employer as a partner in the program. Career opportunities are integral to the program along with its devotion to lifelong learning of key professionals in the Alaskan construction industry.

Program Requirements

To earn a certificate, you must complete a total of 15 credits of courses from the three main construction management categories and two main associated categories as approved by your advisory committee, as follows:

1. Human relations and communications, 4 to 6 credits
2. Construction project management and scheduling, 4 to 6 credits
3. Technical management of construction and costs, 4 to 6 credits
4. Financial aspects of construction, 0 to 3 credits
5. Other technical areas, 0 – 3 credits

Credits obtained toward the certificate may be applied toward another master's degree.

Classes

Classes are given in one-credit modules via live, interactive video at times convenient to employed construction professionals and are available at Anchorage, Fairbanks, Juneau, Ketchikan, Sitka, and Nome. A sampling of classes in the program includes

- **Big picture, systems thinking and organizational dynamics**
- **Construction claims case studies**
- **Scheduling for construction administration**
- **Managing risk**
- **Overview of environmental laws, regulations, and permitting**
- **Managing environmental permits on construction projects**
- **New technology for construction**
- **Negotiation basics for construction management**

A one credit course is equivalent to 45 Professional Development Hours (PDH's) for meeting Alaska engineering registration continuing education requirements of 12 PDH's per year.

In fall 2009, at least two courses will be given: Managing Environmental Permits on Construction Projects and Scheduling for Construction Administration; in spring 2010, four more courses are planned.

Admission

Qualifications for admission to the program are

- A four-year ABET college degree in engineering and at least two years construction experience, or
- A four-year non-ABET degree in engineering, science or math-field and four years construction experience, or
- A four-year college degree and six years construction experience, or
- At least ten years of management-level construction experience, plus
- Three letters of recommendation, including one from the line supervisor of the applicant.

Program Approval

This program was approved by the University of Alaska Board of Regents at their September 2009 meeting. Applicable courses taken prior to program approval can be counted toward the certificate program requirements.

For further information, you may contact

Dr. Robert A. Perkins, PE
UAF Civil and Environmental Engineering
ffrap@uaf.edu
907-474-7694

or visit our website at http://www.alaska.edu/uaf/cem/cee/cm/

June 20, 2010

Graduate Certificate Program in Construction Management

Engineering Workforce Roundtable

22 June 2010

Education for Workforce Development

- Dr. Robert A Perkins, PE
- 474 7694
- raperkins@alaska.edu

Students' Needs

- Increased Opportunities
- Promotion
- Confidence
- Sheepskin

Construction Management Skills

- Engineering (nuts and bolts)
  - concrete code, inspection tools, safety rules, reports and forms
- Managerial technical
  - planning, cost, scheduling, contract and environmental law
- Managerial "soft skills"
  - communications, human resources, teamwork, public

Skills vs. Career Stage

Job	% Nuts and Bolts	% Technical	%Soft
New	80	15	5
4 yrs – incipient mgr	40	45	20
8 yrs – lower middle mgr	10	45	45
12-yr plus upper middle mgr	Trace	40	60

Typical Civil Graduate

- Nuts and bolts = 0 credits
- Managerial Technical = 1 to 3 credits at most
- Managerial soft = 3 to 6 with non-technical venue, 1 to 2 in technical venue

Skills vs. Career Stage

	% Nuts and Bolts	% Technical	%Soft
New	80	15	5
4 yrs – incipient mgr	40	45	20
8 yrs – lower middle mgr	10	45	45
12-yr plus upper middle mgr	Trace	40	60

Demographics

- Age 25-35
- Family, often with young children
- Already have a good job
- Relocation issues
  - Move stress
  - Spousal employment

Graduate Certificates

- Typically 12 to 15 graduate credits
  - Can count towards MS
- Focused on narrow area
  - Design of Pharmaceutical Facilities
  - Value Chain Enterprise Systems
  - Pharmaceutical Process Engineering
- Often distance delivered

Construction Management Certificate Mission Statement

This program will advance the managerial skill level – the ability to make wise management decisions - of graduate engineers and other professionals in the construction industry to help prepare them for more responsible jobs.

Construction Management Certificate Program

- 15 Credits
- Divided in three rubrics
- Cafeteria style within the rubrics
- Will not need engineering degree
  - Sliding scale
  - With supervisor's approval

Outline of Certificate Program

Four Discipline Areas

1. Human interactions and communications (4-6 credits)
2. Construction project management (4-6 credits)
3. Construction contract administration (4-6 credits)
4. Other Areas (3-4 credits total)

Some may already have some credits toward this certificate, because the following existing UAF 3-credit courses can be counted:

Human Relations and Communications
- BA 607, Human Resource Management
- ESM 601, Managing and Leading Engineering Organizations

Construction Project Management
- ESM 609, Project Management
- CE 620, Civil Engineering Construction
- ESM 608, Legal Principles for Engineering Management

Construction Technical
- CE 451, Construction Cost Estimating and Bid Preparation
- CE 603, Arctic Engineering
- ESM 622, Engineering Decisions

2008 CM Classes

(One credit)

- Big picture, systems thinking and organizational dynamics, Fairbanks, (15)
- Construction claims case studies, Fairbanks and Anchorage, (5)
- Scheduling for construction administration , Fairbanks and Juneau, (17)
- Managing risk, Fairbanks and Juneau, (13)
- Overview of environmental laws, regulations, and permitting, Fairbanks and Anchorage, (2)

2009 CM Classes (Spring)

(One credit)

- Construction claims case studies, bridge emphasis, Juneau and Fairbanks (22)
- Construction claims case studies, non-bridge emphasis, Sitka and Fairbanks (9)
- New technology for construction, Anchorage and Fairbanks (15)
- Negotiation basics for construction management, Anchorage and Fairbanks (15)

Course format and schedule

- A one-credit course in this program typically meets 6 times: twice per week for 2 ¼ hours each time. These contact hours meet the university requirement for in-class minutes.
- To date, classes have met either Monday and Wednesday or Tuesday and Thursday from 3:00 to 5:15 PM. Thus, there is a sharing of employer and employee time.

To qualify as a credit course

- Academic requirement
  - Plan of study approved by college
    - Syllabus
  - Must have "assessment"
  - Substantial out-of-class work
- Thus, expect to spend 2-3 hours outside of class for every hour in class.

Live Interactive Video Instruction

- How can we teach in more than one place at the same time?
- Through the use of live interactive video

Future

- Extend Certificate Program?
- Pre-Construction Management
- Other technical areas
  - -- Transportation
  - -- Environmental Design
  - -- Environmental Management
  - -- Arctic

Transportation Agency Training Approaches

Those who depend on experience for knowledge are destined to fail.

Roman General

Existing Graduate Engineering Education Models

- Traditional Masters Programs
- Graduate Certificate Programs
- Conferences and Workshops
- Short Courses
- Informal Training

Master's Program

- Generally considered highest quality education
- Typically take 1.5 to 2 years
- Can remove employee from workforce
- Cost Concerns
- Most don't want a Master's degree

Graduate Certificates

- Typically 12 – 15 credit hours
- Still high quality education
- No research component
- Provides a compromise with Masters Programs
- Can be more user friendly

TLGC

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TRANSLEADER Universities

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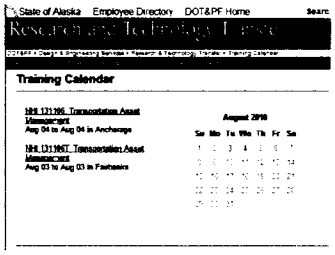
- City Univ of New York
- Penn State
- Univ. of Tennessee
- Univ of Wisconsin
- Purdue
- Texas A&M
- North Dakota State
- Univ. Of Washington

Conferences and Workshops

- High concentration of information within time frame
- Usually focused on narrow subject matter
- Usually one way communication
- Retention of technical information considerably lower than formal education
- Development of Resources

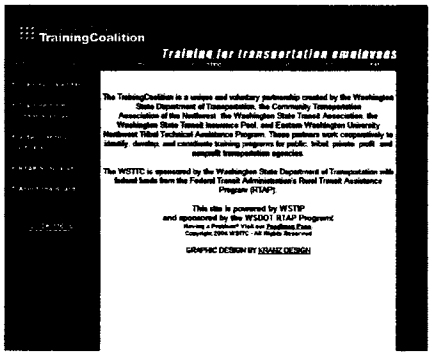
Short Courses

- Focused on agency needs
- High information density
- May be classroom or online
- Little or no learning assessment
- Long Term Retention low



National Highway Institute

- The NHI is authorized to award International Association of Continuing Education and Training (IACET) continuing education units



Informal Training

- Don't overlook
- Based on immediate need
- Hands on and applied
- High retention

In Summary: Training must use several models to be effective.

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Appendix R

I think the most effective methods for teaching soft skills are with research, concepts in pragmatic terms, and discussion questions about application. The research appeals to the logical mind. The pragmatic summary of the terms and

Topic	Research	Pragmatic Summary	Example/ Story	Application Activities
Communication and Confirmation Bias	• Lewicka, Maria (1998), "Confirmation Bias: Cognitive Error or Adaptive Strategy of Action Control?", in Kofta, Mirosław; Weary, Gifford; Sedek, Grzegorz, *Personal control in action: cognitive and motivational mechanisms*, Springer, pp. 233–255, ISBN 9780306457203, OCLC 39002877 • Oswald, Margit E.; Grosjean, Stefan (2004), "Confirmation Bias", in Pohl, Rüdiger F., *Cognitive Illusions: A Handbook on Fallacies and Biases in Thinking, Judgement and Memory*, Hove, UK: Psychology Press, pp. 79–96, ISBN 9781841693514, OCLC 55124398 • Nickerson, Raymond S. (1998), "Confirmation Bias; A Ubiquitous Phenomenon in Many Guises", *Review of General Psychology* (Educational Publishing Foundation) **2** (2): 175–220, doi:10.1037/1089-2680.2.2.175, ISSN 1089-2680	Confirmation bias impacts our interpersonal effectiveness by impacting our ability to listen genuinely listen to others. We develop a confirmation bias based on a collective of experiences, we develop a perspective. Our viewpoint becomes a bias. We confirm the bias again and again with proof, thus becoming a confirmation bias. We even relish in our "rightness" by sharing it with our co-workers. It's as if we carry a bag specifically for the biases we hold. Regrettably, there will always be evidence to support any bias we believe. We actually develop confirmation biases for good reasons. We collect information and group experiences to	Let's say, for example, that based on a few experiences you have come to the conclusion that all Subaru drivers are painfully slow drivers. From there you will collect evidence that supports this bias. When you're late for work and you find yourself behind an extremely slow Subaru driver, what do you do with that information? Exactly. You deposit that evidence in your "bias bag." So, what happens when a speeding Subaru goes by on another day? Sometimes our biases are so powerful that you won't even see the unsupportive evidence. If you do, you might exclaim something like, "Well it's about time!" You might even chalk it as an exception by justifying it as a rental car or a teenager who	Think about a time when you been misperceived. What was the power of their perspective?

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Topic	Research	Pragmatic Summary	Example/ Story	Application Activities
		keep us safe from harm. It's absolutely human nature. As children we learn that the round, red, brightly lit, thing on top of the stove is hot and will hurt us. We retain that information so we are cautious in the future around all stoves. Unfortunately, we sometimes apply this natural instinct to people and situations to a negative degree. As a consequence, we develop a damaging bias. I can usually detect when someone has a bias and has spent some time confirming the bias. It is so compelling that they will state, "No Keli, this isn't my perspective. This is the way it IS." The trouble is that we usually see what we seek. It becomes a self-fulfilling prophecy—psychology 101.	borrowed the car. As a great employee who has had some negative interactions with an unequipped supervisor, you may find yourself in a personal struggle. You want to be motivated, but it is difficult. Consequently, you could lose your good quality work ethic. If you can find a new supervisor or organization that will better value your work ethic and outlook, then I encourage you to embrace the opportunity. If however, you love your job but feel a quite beaten down, then consider this strategy.	
Communication and Trust	▪ Trust in the Workplace, A Monograph by Robert W. Rogers President, DDI Sheryl	Trust = Character + Competence	Your child just turned 16 and got their driver's license. It is completely	Group discussion: Think about a specific person at work you don't trust. No names. Is it an

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Topic	Research	Pragmatic Summary	Example/ Story	Application Activities
	Riddle Sr. Vice President, Consulting Services, DDI ▪ The 7 Habits of Highly Effective People, Stephen R. Covey ▪ The Speed of Trust by Stephen M. R. Covey	Character is our integrity. It is' our ability to keep and make promises. It means when we say we are going to do something, we can be depended upon to do it. We are honest and fair. This is usually the one people are talking about when they say, "I just don't trust them." Competence is our ability to do what we are responsible for at work. This is usually when people say, "They are the nicest person in the world, but I can't rely on them."	snowy and icy out. They ask you if they can drive across town and see their friend. What is your answer? Mine is no. The typical teenager response will be, "What?! Don't you trust me?" My answer is, "No, but not for the reason you think." I say, "I trust that when you tell me you are going somewhere that you are a person of your word. You have showed me this in the past. "(Character) Next, "However, you have only been driving a limited amount on these types of roads and you don't have the experience needed to maneuver these roads." (Competence)	issue of character? Or is it an issue of competence? Sometimes, sadly, it is both. Then ask them if they came to you and told you they heard something about someone. What would you do with that information? Fine tuning your gauge to know if you need to build or re-build trust. What are the signs of low-trust? What are the signs of high-trust? Self-assessment activity: How credible are you? www.Speedoftrust.com
Change Management	"Why Do Employees Resist Change?" by Paul Strebel (Harvard Business Review,May–June 1996, Product no. 4142) Strebel looks at antipathy to change from a different angle: the relationship between employees and their organization. This relationship has three dimensions: 1) the formal aspect, manifested in job	Taken from Managing Change and Transition, a Harvard Business Essentials guide, 2003 Leaders must be respected and effective. Bad or mediocre leaders that are not respected kill organizational performance. Usually they can't retain good	In my profession I have witnessed many unsuccessful change efforts. Many times management is so focused on what needs to be done that they don't get the necessary feedback from the people who will make or break it. In the absence of information and	Group discussion on a scenario. There is rumor that the company is downsizing. List actions that are reactive responses to change. Discuss the impact on people and the organization. List actions that are proactive responses to change. Discuss the impact on people and the organization.

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Topic	Research	Pragmatic Summary	Example/ Story	Application Activities
	descriptions and performance agreements, 2) the psychological aspect, where trust, dependence, and respect affect employees' behavior, and 3) the social dimension, which emerges from the organization's culture. Employees sometimes resist change because it alters the terms of their commitments with the organization. To break through resistance to change, executives must define—and persuade people to accept—the new terms as they relate to all three dimensions.	employees and cannot motivate employees. If this is the case an organization cannot expect to get very far with change. People can choose whether or not to passionately help the organization through the rough patches of change and it will fail. If the top leaders of the organization can replace bad and mediocre leaders at all levels, and replace them with people that are effective at managing people and can be respected then it is one step closer to being capable of change.	listening, employees will fill in the unknown with worst-case scenario discussions. Being respected as a leader of change is done most effectively through genuine communication and listening.	

Appendix S

print

Are emotions a better gauge of corporate success than intelligence?

by Keli Hite McGee / Inside Business
06.20.10 - 03:10 am
FAIRBANKS — *In a study of skills that distinguish star performers in every field from entry-level jobs to executive positions, the single most important factor was not IQ, advanced degrees or technical experience, it was EQ. Of the competencies required for excellence in performance in the job studies, 67 percent were emotional competencies.*

— Daniel Goleman, "Working with Emotional Intelligence"

Today's organizations consist of cross-functional teams, constant organizational change, team problem solving and decision making, and a variety of personalities and generations.

Our effectiveness takes more than industry intelligence and technical expertise. We need to possess what often are referred to as soft skills. They include a multitude of intrapersonal and interpersonal skills such as self-awareness, flexibility and adaptability to change, skills in confronting and resolving conflict, and many more.

Soft skills refer to our emotional intelligence quotient, or EQ. Our EQ is our ability to recognize and understand our emotions and the emotions of others in order to respond effectively. People at the mercy of their emotions or oblivious to the emotions of others are more stressed and consequently less productive.

Companies can continue to give top priority to financial performance — but many now also realize that technical and intellectual skills are only part of the equation for success. A growing number of organizations are now convinced that people's ability to understand and to manage their emotions improves their performance, their collaboration with colleagues and their interaction with customers. After decades of businesses seeing "hard stuff" and "soft stuff" as separate domains, emotional competence may now be a way to close that breach and to produce a unified view of workplace performance.

— Fast Company

Daniel Goleman, one of the key contributors to EQ research and literature, defines the four aspects of emotional intelligence:

1. Self-awareness is our ability to read our emotions and recognize their impact.

2. Self-management is our ability to control our emotions and impulses and adapt to circumstances.

3. Social awareness is our ability to sense and react to the emotions of others.

4. Relationship management is our ability to inspire and influence others while managing conflict.

Emotional intelligence (EQ) is emerging as a critical factor in high performance at work, at school and at home. World leading organizations are adopting EQ practices into organizational development and human resources. Likewise, leading educators, hospitals, psychologists and coaches are using EQ tools to create positive results and meet pressing educational, family, health and social needs.

— NexusEQ

How can we increase emotional intelligence?

First, we must increase our self-awareness. Be cognizant of your emotional responses. Determine what triggers the emotional response. In my experience facilitating group problem solving, people with low emotional intelligence often don't recognize or acknowledge their emotions.

Second, we need to improve our self-management by recognizing our ability to choose our response.

When someone says something like, "They made me mad," the reality is nobody "made" the person mad. He or she chose to get mad. Our ability to own our emotions and respond effectively improves our EQ. Pausing to breathe ensures oxygen goes to our brain and gives us the space to respond appropriately.

Third, we must increase our social awareness by purposefully watching the body language of others and actively listening. The best form of active listening is through empathy. Listen to understand a person's message and the emotions he or she is feeling.

Finally, we must improve our relationship management. This calls for openness and asking questions. Make a point of asking for someone's perspective. No matter how high your emotional intelligence, there always is room for

improvement.

The Wall Street Journal wrote about the importance of developing your emotional intelligence to succeed. It stated, "Interpersonal communication and other so-called soft skills are what corporate recruiters crave most but find most elusive in M.B.A. graduates. The major business schools produce graduates with analytical horsepower and solid command of the basics — finance, marketing and strategy. But soft skills such as communication, leadership and a team mentality sometimes receive cursory treatment."

Keli Hite McGee is an executive coaching and strategic planning consultant for Hites Consulting Inc. and an instructor for the UAF/TVC Professional Development and Corporate Training Program. She can be reached at hites@mac.com.

Appendix T

HIGH IMPACT COMMUNICATION

"People will forget what you said,

People will forget what you did,

But people will never forget how you made them feel."

~Maya Angelou

Every client interaction is a presentation and hitting your target requires the message and the messenger BOTH must be effective and engaging

There are three ways to influence your audience, through:

What is Seen What is Heard What is Felt

Exhibit the 6 C's for Powerful Presentations:

Competence
Confidence
Credibility
Care
Conversational
Connection

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Appendix U1

Responses to High Priority Training Needs – Suggested Courses

Course Subject Matter: Information Technology

Course Content:

- Information management
- What is information?
- Data management
- Care and feeding
- Optimize
- Transforming data into information
- What information is relevant? – Optimize
- State of practice / Best practices
- Information security
- Intelligent systems

Course Format:

- University courses
- Organize special seminars / workshops

Appendix U2

Responses to High Priority Training Needs – Suggested Courses

Course Subject Matter: Mastering the Business of Engineering

Course Content:

- Manage client expectations
- Engineering job descriptions and expectations
- Understand competitive advantage
- How do you define business?
- Risk management
- LEAP curriculum

Course Format:

- Tailored faculty
- University courses (seminars)
- Industry expert
- Case studies – current
- Internalize through application / mentoring

Appendix U3

Responses to High Priority Training Needs – Suggested Courses

Course Subject Matter: Mentoring Skills

Course Content:

- How to mentor (skills)
- Applied mentoring
- Internship (mentored)
- Young engineers / find mentors

Course Format:

- Incorporate into organization
- Credit awarded
- Activity-based training
- Series of short courses
- Metrics

Appendix U4

Responses to High Priority Training Needs – Suggested Courses

Course Subject Matter: Collaborative Critical Thinking

Course Content:

Multi-discipline/cross functional
Project-based assignments
Examples & inspiration
Start with the end in mind
Assumptions/confirmation bias
Roles clarified: owner, designer, each team member
Respect among your peers
Problem solving/ decision making
Constructive conflict/communication

Course Format: Seminar over time; include case studies

Appendix U5

Responses to High Priority Training Needs – Suggested Courses

Course Subject Matter: Ethics

Course Content:

- Case studies of ethical dilemmas
- Organizational and societal/ethnic/cultural expectations
- Balancing fair and reasonable profit with ethics
- Personal/career implications of ethics and decision making
- Matching personal values with organizational values
- Professional liability
- Managing ethical perceptions
- Transition figure

Course Format: 1 day or ½ day; or spiral into other courses
Attorney as instructor or at least present

Appendix U6

Responses to High Priority Training Needs – Suggested Courses

Course Subject Matter: Leadership

Course Content:

- Expectations
- How to handle criticism
- Effective decision-making
- Willingness to take the leadership role
- Delegation
- Time management
- Reading others
- EQ (Emotional intelligence quotient)
- Trust/Integrity
- Congruent leadership
- Direction/vision
- Mentoring
- Empathy/empathetic listening
- Motivational leadership (involves some communication)

Course Format: Boot camp or semester; must be space between classes

Appendix U7

Responses to High Priority Training Needs – Suggested Courses

Course Subject Matter: Written Communications

Course Content:

- Business letter (v. memo v. e mail) – define need
  - Different forms of outline depending on type of correspondence
  - Deductive v. inductive
  - Examples
  - Template creation
- Project report
  - Elements of virtuous reports, including clear purpose statements
  - Deductive progression
- Proposals
  - Technical writing
  - Persuasive written communication
  - Marketer's collateral
- Targeted communication
  - Headline
- Technical writing
- E mail etiquette
  - Rules of appropriateness
  - Complete thoughts
- Communication strategy flowchart
  - "When to …"

Course Format:

- Principles
- Case study
- Do
- Advocacy

Appendix V

Commentary by Lance Wilber, Assistant Commissioner, Alaska DOT&PF Central Region

Management... I think these are relevant any profession, but not always in the forefront of consideration of engineering actions

- Perspective, perspective, perspective... in any profession, there is more going on then the project/problem in front of them. Be aware of them and respect them.
- Public verse Private... there is a different working environment in the sectors and resource allocation of people & money is different in the ability/timely to change
- Appreciate the politics in decision making, by the working engineer should not play politics
- Recognizing the Generations (traditionalist, BB, Gen X and Gen Y) in team. "That older generation just does not get it!'
- Looking to hire the "right" talent... I look for initiative in the younger talent. I look for a mentor in experienced talented engineer.

Communications

- Not so much a skill learned... as art gained...
- Being a salesman... the stereotypical engineer "can I use the square root", "V over C ratio", or because "the model shows" in my public meeting or agency leadership presentation ....is not the right answer. The ability to sell / pitch / explain your project is important; know who your audience is?
- Knowing when you're out of your element!
- You're rarely the smartest one in the room; don't act like it!
- The only person that cares or appreciates that you're an engineer in a public meeting, is maybe another engineer, your mother or father.
- Setting expectations...What is it that the existing university professor tells the young student engineer to expect their first job out of school to be for technical, decision making and the likely player/professions in the room when they are working? Is probably wrong?

Technical

- Knowledge appreciation of NPDES / Storm Water requirements and permitting for everything from environmental to construction.
- What is NEPA...? Many young working engineers have no or limited sense of NEPA, its intent, process or permitting necessary to complete a public works / civil engineering project
- Grading... I hear from my working engineers and peers in the private sector that the young engineer does not understand or how to develop simple grading plans.

Appendix W

Commentary by Dick Cattanach
Chief Executive Officer, Construction Education Foundation

1. Faculty involvement. As you know, the construction industry in Alaska is small by most standards. Even so, most in the industry have little interaction with engineering faculty members. This lack of interaction hurts both parties and the students.
2. Relevance of training. Steps should be taken to assure that the education provided to the students is relevant today and provides a good foundation for future growth. This can only be accomplished through communications with current employers and on-going communications with students.
3. Life-long learning. Unfortunately many students believe that their education ends when they receive their degree. They need to understand that it is essential that they continue to be exposed to new ideas and techniques as they become more senior.
4. Soft skills. Most students probably have a good understanding of the basic engineering underpinnings of the industry. However, many lack the skills needed to be successful in the industry. The ability to write and speak, to listen, to communicate clearly, and to make sacrifices is necessary to be successful in the industry. How do we prepare students to understand the demands of their chosen field?

Appendix X

Commentary by Chris Gianotti, Principal and Senior Structural Engineer, **P|N|D** Engineers, Inc., Juneau

I would like to provide comments regarding what we have recently experienced and the noted deficiencies and strengths of new hires, several have come from the University of Alaska system.

Strengths from new hires we have seen include:

1. The more valuable hires have been those with solid education and backgrounds in fundamentals. They have strong math and physics backgrounds and are capable, if necessary, of solving problems from the basics and are not dependent upon rote formulas. Structural engineers need to be well versed in calculus, physics, chemistry, materials sciences, strength of materials, dynamics and statics.
2. The more valuable hires have strong knowledge of material codes: AISC manual, ACI 318, etc. Some have strong knowledge of timber and the NDS standards. In Alaska we use steel concrete and wood and it is essential for structural engineers to have several classes in each of these materials. If a student has had advanced coursework in steel concrete and timber, they are more productive.
3. The more valuable hires have a good grasp on the Building Code and ASCE 7. We use these daily and the engineers need to understand what is in these and where to find the pertinent provisions that affect their work.
4. The more valuable hires are competent in AutoCAD. It is essential that new engineers have good drafting skills: they need to know how to lay out plans, reference and create sections and details. The industry standard is changing from AutoCAD 2d drafting to REVIT and BIM systems. We do not have available a sufficient number of CAD drafters, so we rely on our engineers to supplement the drafters we have. Some hires have done internships with construction firms, fabrication drawing detailers, or design firms. This is valuable experience and students should be encouraged to obtain summer jobs doing drafting.
5. The more valuable hires have some knowledge of construction contract documents. General provisions of a contract and specifications.
6. The more valuable hires have construction experience. Those who have served as laborers or specialized tradesmen have gained experience on how plans are read and interpreted, the level of detail necessary to communicate the design

intent, how work is done, and the difficulties of construction. Students should be encouraged to obtain summer jobs doing construction work.

7. Engineers need to be good communicators. They need to have good speaking and listening skills. They need to be able to write well, in plain terms.

8. Structural engineers need to know how to do more than design structures. They need to have a good background in other fields so they understand points of view of the other professionals with whom they work. Hydraulics and hydrology, fluid mechanics, the basics of thermodynamics, and basics of electricity are necessary.

9. Valuable hires have strong skills in using spreadsheets and structural calculation programs, including frame analysis programs. Skills in programming languages are not necessary. We often develop design programs in spreadsheet programs.

10. Valuable hires can assemble a well-packaged, clear and concise calculation package. It is essential that we can track the basis of a design when doing reviews and often times several years after the design is complete. The calculations need to be in sufficient detail and with enough comments to show what was considered, the methods used, the design criteria followed, critical user specifications, etc.

Deficiencies we have seen include

1. Minimal drafting skills. Some new hires do not know what a section cut is or how to designate it on a plan sheet. Some do not know how to use CADD programs.

2. Very poor writing skills and poor verbal skills. Some cannot write a paragraph with coherent sentences. These should not have graduated, but were somehow allowed to.

3. The inability to prepare clear and concise calculations. It is hard to believe this was not emphasized in college engineering classes.

4. Many structural engineers have never taken a timber of masonry design class. Those classes should be offered on a regular basis. It would also be beneficial to occasionally offer an aluminum design class. There are welding shops in SE Alaska that fabricate welded aluminum structures. Our engineers have to learn this material design on their own.

Lastly, there are very limited opportunities for continued technical education in SE Alaska. The University of Alaska Southeast does not offer much or any classes in arctic engineering, civil engineering, construction management, etc. It would be

beneficial to have some course offerings for our younger engineers to gain additional knowledge.

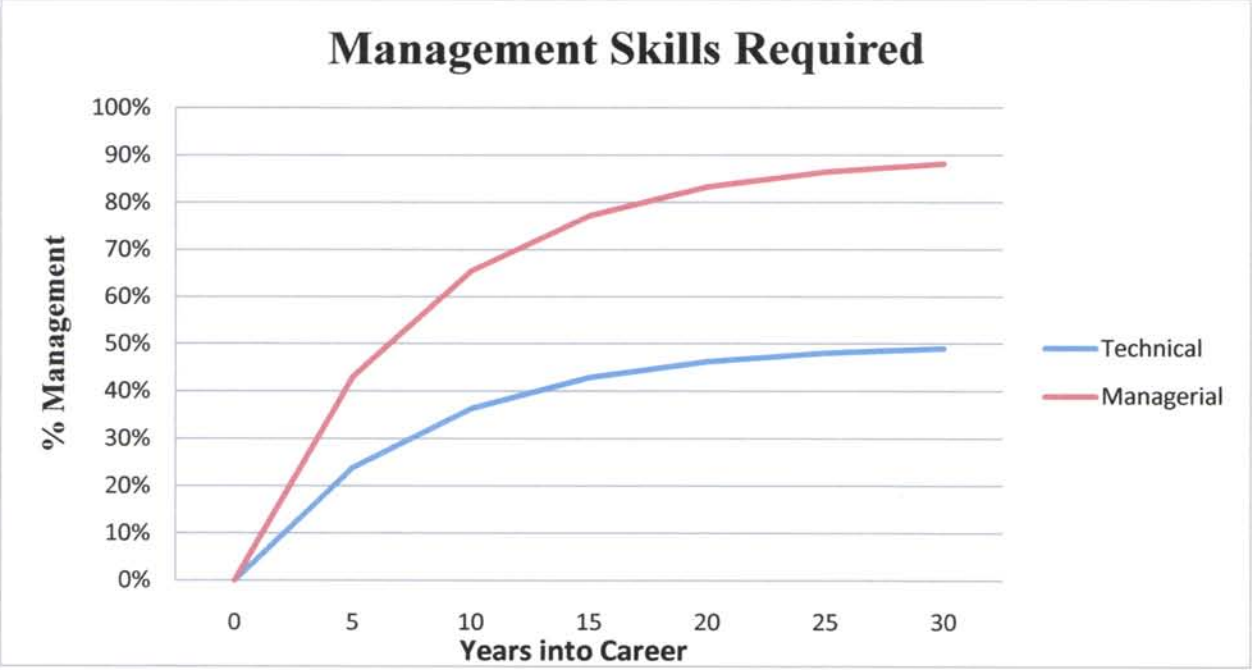
Appendix Y

Commentary following roundtable by Bob Perkins
UAF Civil and Environmental Engineering

What to teach and how to teach it must consider the three main players: Engineer/student; employer; and education provider, although we shouldn't forget other stakeholders: public, clients, non-engineer/professional staff, union leaders, legislature, HR rules, FHWA, Internal education apparatus and rules, etc., since these may impact the solutions.

Career

Graph of management skills career,



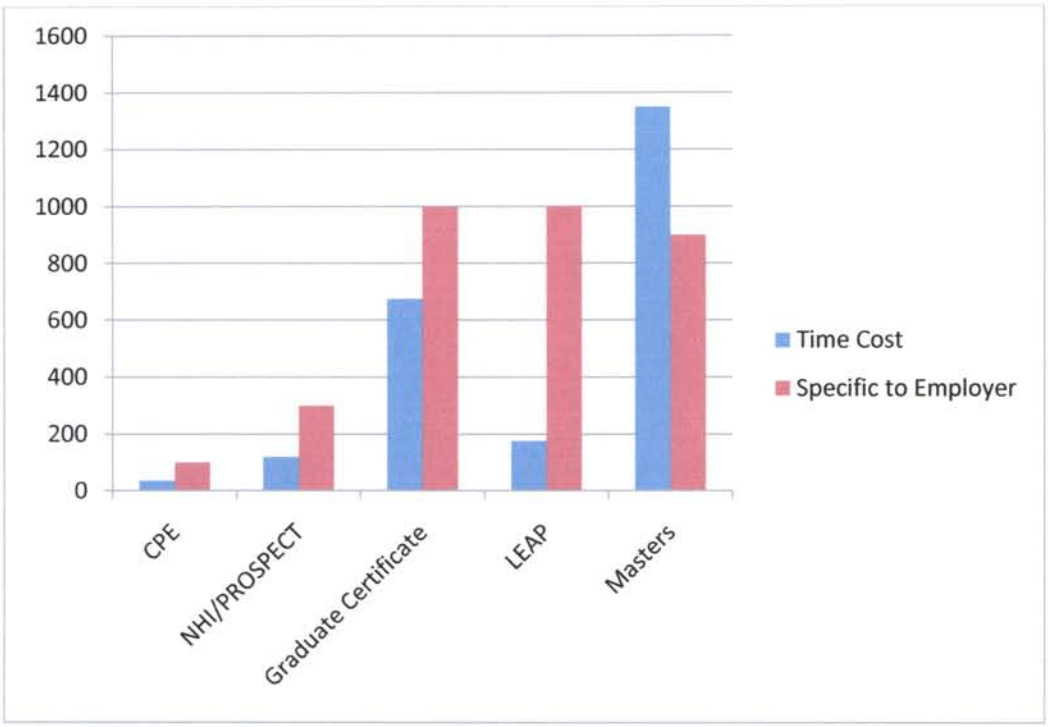
We see that while the "manager" need more management skills sooner, the "technical engineer" needs many of these skills, but perhaps less of them and they are needed later in the career.

Modalities

There are many teaching modalities available today: face to face (or traditional), web-based pedagogy, webinars and similar, eliminate and other computer-based, video and audio conferencing, and many variations of smart classrooms.

Programs

Here is a graph of the "time cost of program completion" versus "specificity to employee's career.



Time Cost is in approximate hours over three years of the degree, see below. Specificity is in arbitrary units. Note this assumes the employee is technically competent and education is to advance management. However this could be applied to a purely technical advancement, in some situations. We see that that the more demanding are generally more specific to a career.

Calculations

Type of Program	Time Cost	Notes
CPE	12 hr/year in AK	May not be specific to employer (or even student's needs)
NHI/PROSPECT	Varies, 40 hr/year	Say 120 in three years
Graduate Certificate	15 cr * 15 class hr * 3 hr could use 3.5 or 4 but assume relevant to work and more efficient	675 over three years, based on 3 hours total per classroom hour – that is, one hour outside class for each in class.
LEAP like	8 hr * 11 classes *2	176 based on one hour in class and one hour out of class.
MS	30 cr * 15 * 3 (might use 3.5 to account for parking and so on.	1350 based on one hour in

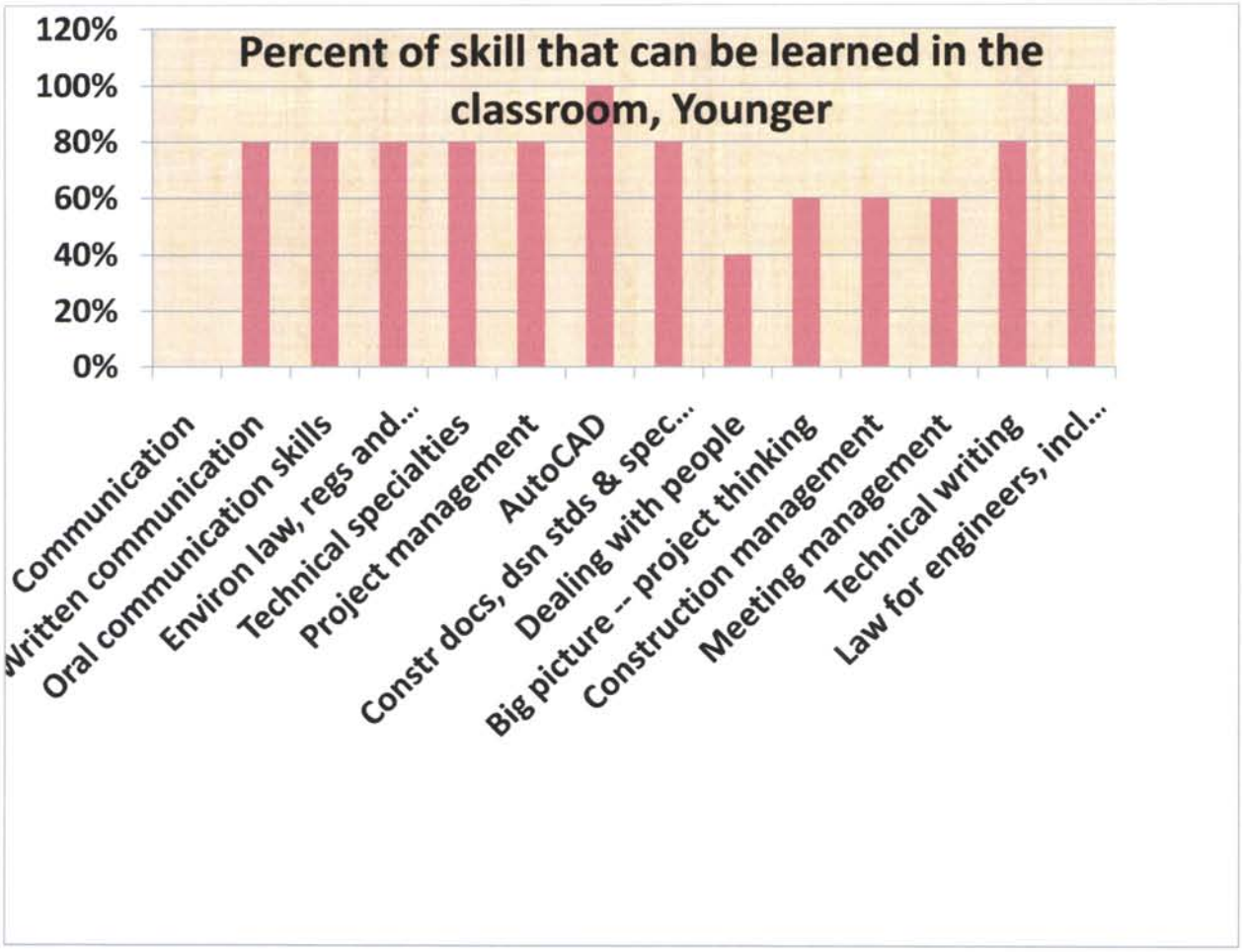
Courses

Can "soft" skill be taught. Proliferation of providers proves it can be taught, but can it be learned? It may be useful to digress a moment about the nature of tacit versus implicit knowledge

> With **tacit** knowledge, people are not often aware of the knowledge they possess or how it can be valuable to others. Effective transfer of tacit knowledge generally requires extensive personal contact and trust. Another example of tacit knowledge is the ability to ride a bicycle.
>
> Tacit knowledge is not easily shared. Tacit knowledge consists often of habits and culture that we do not recognize in ourselves. In the field of knowledge management, the concept of tacit knowledge refers to a knowledge which is only known by an individual and that is difficult to communicate to the rest of an organization. Knowledge that is easy to communicate is called explicit knowledge. The process of transforming tacit knowledge into explicit knowledge is known as codification or articulation.
>
> The tacit aspects of knowledge are those that cannot be codified, but can only be transmitted via training or gained through personal experience. Tacit knowledge has been described as "know-how" -- as opposed to "know-what" (facts), "know-why" (science), or "know-who" (networking). It involves learning and skill but not in a way that can be written down. (From Wikipedia, http://en.wikipedia.org/wiki/Tacit_knowledge)

Many skills, of course, are a mix, can be learned to some extent, but then must be practiced in order to be useful. By nature, what we teach in the classroom are explicit skills, although a student may pick up some tacit skills by contact with the instructor or other students.

So below I follow the tasks in Larry's compilation of responses and rate according to my perceptions of the relative mix of classroom learning versus OJL (on the job learning) that will be required in order for the skill to develop to be useful. Keep in mind that for those that score toward the OJL, there is often a classroom component that might help.


Percent of skill that can be learned in the classroom, Younger
120%
100%
80%
60%
40%
20%
0%
Communication
Written communication
Oral communication skills
Environ law, regs and...
Technical specialties
Project management
AutoCAD
Constr docs, dsn stds & spec...
Dealing with people
Big picture -- project thinking
Construction management
Meeting management
Technical writing
Law for engineers, incl...

The highest scored need for older is "mentoring" which I did not score, since the mentor is, in a sense, the provider of training (more on that later). For the younger and older, I did not score "communications," since that is overarches all the soft skills, especially the next two, written and oral communication skills.

Note that most of these skills can be taught in the classroom, but most have a component of OJL in order to be useful.

Programs

Mentoring

Mentoring would involve a transfer of both tacit and explicit knowledge. By definition, it would be difficult to train a mentor to transmit tacit knowledge.

NCARB has the IDP (Intern Development Program) for architectural registration. (http://www.ncarb.org/en/~/media/Files/PDF/Guidelines/idp_guidelines.ashx) Which lays out topics and competencies that the new architect must experience for registration. This is highly organized but most architects need to know the same things – while engineers are quite varied in what they need to know. However within an organization, such a checklist could be developed. Likewise, the concept of mentoring during "on-boarding" is often mentioned. Could mentoring

be outsourced? Contrast with mentoring by HR department. Mentoring for professionals should be by members of the profession. The concept of a "mentored internship" is interesting.

Communications

Communications is an overarching concern, noted for both newer and older engineers. From the standard, "What we have here is a failure to communicate," to American Sign Language 101, communications dominates most of our work, family life, and play. Relating this to "teaching topics" is more challenging. We make some headway by dividing it into media: oral, written, and visual communications, or audience: selection committee, curious pubic, angry public, media, and so on. Beyond that, the issues may be better handled as human relations, human resources, leadership, or similar topics, rather than "communications."

Appendix Z

Recommendations from flip charts for final session

1. Must identify and deal with constraints on (barriers to) resources (2 votes)
2. Importance of mastering the business of engineering
    a. Best practices
    b. Somewhat organization specific
3. Prepare for "+30" with experienced people
4. Mentoring
5. Adopt LEAP for Alaska
6. Need for regular forums on training needs, including technical (2)
7. Need for web-based forum for problem solving, including reading list (2)
8. Teamwork and trust – teams must work together effectively
9. Consider adding other requirements for PE, such as ethics
10. Make Alaska aware of its workforce development needs; distribute this report widely
11. Survey younger engineers (not just their supervisors/managers) about their needs
12. Alternative project delivery systems & the need for collaboration among the roles and parties
13. Develop guidelines for the UA role in training working engineers
14. Innovation/ creativity training for young people
15. Need collaboration among UA, DOTPF, COE, professional societies, etc with respect to professional development
16. Teach the importance of lifelong learning
17. Continuing education's main purpose is to maintain currency in order to protect the public and meet public expectations.
18. Consider the organizational costs of not training
19. Importance of exposure to construction for all engineers, whether or not they will ultimately work in construction. (internships and other …) (2)
20. There needs to be an organized training information source.
21. Training as an investment
22. The public is the ultimate beneficiary of our training programs
23. Importance of mentored internships