Curriculum Guidelines for Master's Level Programs in Information Systems for Emergency Management

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ABSTRACT

Curriculum guidelines are presented for Master's level programs that combine core topics from the disciplines of Emergency Management (EM) and Information Systems (IS). Based on responses to an online survey from 111 respondents from 19 countries who were mainly identified through ISCRAM (Information Systems for Crisis Response and Management), all ten courses described for all EM master's programs are considered important, as are all ten courses for an EM degree program with an IS focus. The two top-rated IS courses for such programs are Social Media for EM and Decision Support Systems for EM. Differences in opinions related to respondent characteristics such as nationality, educational level, and roles (academics vs. practitioners) are described, and suggestions for future expansion of this research suggested.

Keywords

Emergency Information Systems, Emergency Management, EMIS, Master's degree, curriculum.

INTRODUCTION

Curriculum guidelines for undergraduate programs are available for many computer-related disciplines, such as those provided by ACM as the basis for accredited programs (https://www.acm.org/education/curricula-recommendations). They include course descriptions for "core" (required) and some suggested elective courses. Both types of the courses should strictly follow the agreed curriculum. For example, Alexander (2003) stated that the curriculum of a basic, general course in emergency planning and management shall cover a significant proportion of certain elements such as basic knowledge of hazards, risks, emergencies and disasters; organizational structure and procedures; human impacts; planning and post-event work etc. A very common basis for developing such guidelines is first to have a committee to draft some recommendations, and then to conduct a survey of the members of the relevant professional association and/or representatives of stakeholder organizations (e.g., Bryce, Gould, Notz, and Peck, 2001). The survey which is described here is meant to help inform future curriculum guidelines for master's degrees that combine the disciplines of information systems and emergency management.

Emergency management is a rapidly growing and evolving discipline and profession. O'Connor (2005) stated that only two degree-level programs in this discipline existed prior to 1995, and additional 40 programs were developed by 2005. In the past, emergency managers have generally been trained in a variety of disciplines, and may or may not have had a college degree. For example, in the U.S., traditionally one could become an Emergency Manager (EM) after five years of related work experience. In 2010 the International Association of Emergency Managers (IAEM) upgraded this process to require a degree in Emergency Management for membership in the Association. The heavy investment in the Emergency Management area and the change of the requirements for new certifications has led to a proliferation of degrees under a variety of names and different educational institutions, from high school through doctoral programs, without any standard content (Turoff, 2014). Programs within and between degree-levels varied widely on their curriculums designated as appropriate for emergency management both bachelor and master levels. Therefore, it is difficult to assess the qualifications of graduates from these programs. It is necessary to develop a curricular framework out of lists of competencies, functions, and skills (Hosseini and Izadkhah, 2010) and to deliver updated knowledge and skills to emergency professionals on a continuous basis. Higher Education Institutions (HEIs) have attempted to integrate disaster management knowledge within their curriculum either by teaching it as a program or a module or by providing opportunities for students to research on the subject. The formal learning approach widely adopted by HEIs poses a challenge for HEIs in the incorporation of such knowledge within the higher education curriculum (Perdikou et al., 2014). This challenge is due to the complex and multidisciplinary nature of disaster management education and a lack of flexibility of formal learning approach in rapid responses to dynamic industry requirements. Thayaparan et al. (2015) suggested HEIs to accommodate both non-formal and informal learning approaches, in addition to their formal learning, named lifelong learning as an approach within disaster management education. Here in brief, formal learning is achieved through organized program and is recognized by a qualification, non-formal learning is achieved through an organized program but is not recognized by a qualification, and informal learning is achieved outside organized provision. The model curricula this research proposes to develop will focus heavily on the formal learning dimension of emergency management learning but will also be flexible enough to accommodate informal learning and will be broad enough to include the recommendations made by Alexander (2003).

Moreover, although information systems are playing an increasingly important role in emergency management, and there is a large professional association devoted to research and practice in this area that has had over ten years of annual conferences (ISCRAM, Information Systems for Crisis Response and Management), no current master's level programs combine requirements for inter-disciplinary expertise in both Information Systems (IS) and EM. As a result, an Education Committee was formed by ISCRAM with members from several different countries, to work on developing a set of courses that should be included in such a program, as either requirements or electives.

The committee worked to develop a set of course descriptions, and to then distribute a survey to elicit feedback on them from both academics and practitioners in EM in general and IS for EM. This paper presents results of the survey, based on 110 responses, and discusses resultant recommendations for guidelines for interdisciplinary master's level programs in either IS with a concentration in EM, or EM with a concentration in IS. This study is the first in a series of studies with an ultimate goal of preparing model curricula for Emergency Management programs.

CURRENT PROGRAMS IN EMERGENCY MANAGEMENT AND HOMELAND SECURITY

Many undergraduate and graduate programs have been developed and offered in the U.S. in the areas of Emergency Management (EM) and Homeland Security (HS) since 9-11. Lists of programs and details about each listed program can be found on FEMA's website at http://www.training.fema.gov/hiedu/collegelist/ (FEMA, 2015). There is a list of programs for several countries besides the U.S., including Australia, Canada, New Zealand Turkey, and the U.K. For the U.S. there are nine doctoral programs listed in EM and six in HS. Of most relevance to our inquiry are the master's level programs, of which 39 are listed for EM and 37 in HS. They are offered in a variety of disciplinary or inter-disciplinary areas and under various names. For instance, looking at just the entries for universities with names starting with an A or a B, we find, in the U.S.

- Adelphi University – Master of Science in Emergency Management

- Adler University – Master of Arts in Emergency Management Leadership (MAEML)
- Arkansas State University – Master of Science in Disaster Preparedness and Emergency Management
- Arkansas Tech University – Master of Science Degree in Emergency Management and Homeland Security
- American Public University – Masters Degree in Emergency and Disaster Management
- Anna Maria College – Master of Public Administration in Emergency Management (on-line)
- Bellevue University – Master of Science in Emergency Management
- Boston University School of Medicine - Master of Science in Healthcare Emergency Management

In Australia:

- Australian Emergency Management Institute – Advanced Diploma of Public Safety (Emergency Management)
- Charles Sturt University – Bachelor of Social Science degree with an Emphasis in Emergency Management and Master of Emergency Management degree

It is notable that none of the programs mention information systems in their titles. Also listed are 57 EM programs in the U.S. that are master's level certificates, specializations, or tracks; a comparable number for HS certificates; and even more undergraduate programs than graduate programs in both areas.

Many members of the ISCRAM Education Committee are familiar with some of these programs and the courses that they include, and this knowledge was drawn upon in developing a list of possible courses to include in a master's level program combining courses in EM and IS.

Through an analysis of the current degree programs, it was determined that interdisciplinary EM masters programs can be categorized into six concentrations or majors (Turoff, 2014) as follows:

1. Social and Management Sciences, Public Administration, and Journalism
2. Information Systems and Computing
3. Engineering, Construction, and Physical Sciences
4. Public Health, Biology, and Medical
5. Geology, Weather, Environment, and Maritime Studies
6. Criminal Justice and Security

These findings suggest that although important topics of emergency management appropriately are focused on in many educational programs, information systems for emergency management (EMIS) has not yet received the attention it deserves, especially in light of the advances in technology that are increasingly used in both emergency management practice and research. This project aims to provide guidance for developing such programs.

METHOD

Several members of the Education Committee of ISCRAM developed an initial set of course titles and descriptions for courses that might be considered for inclusion in an inter-disciplinary master's level program that spans both EM and IS. Courses in EMIS that could be included in EM programs not focused on IS were also evaluated because information systems are used ubiquitously in emergency management and so, we believe, some exposure to IS is important for all EM programs. This draft was distributed to all members of the committee for additions and comments. Next, the revised list was included in a survey administered to all members of the education committee and members of the Board of ISCRAM, for feedback and additions. The final survey that resulted from this iterative process was then distributed online to all members of ISCRAM, all attendees at the 2015 ISCRAM conference, and many professional EMs who belong to online discussion groups. This paper is based on the 110 usable responses out of a total of 167 responses received through September 2015. Of the 167 responses to the survey, 56 respondents did not answer any questions after they agreed to take the survey. Those responses were deleted from the analyzed data set.

The survey includes both fixed response, and comment boxes for every potential course to be offered in three

categories: general EM courses for all EM masters programs; EMIS courses to be offered for all EM programs; and EMIS courses to be required for an EM masters degree with focus on EMIS. Our research questions (RQs) are:

RQ1: Which courses in Information Systems and Emergency Management should be included in an interdisciplinary master's level degree that covers both disciplinary areas, either as required or as an elective?

RQ2: Do opinions on these issues vary according to characteristics of the participants, such as U.S. vs. other nationalities, role as an EM professional or educational level?

Quantitative questions in the survey were analyzed using SPSS 21. The quantitative questions were mostly 7 point semantic differential scale items to rate each course and also some nominal items to gather demographic information. Each proposed course is treated as a scale of one item as the courses are distinct and the goal is to present a model curriculum with specific courses. Therefore, it would be inappropriate to consider any possible overarching constructs that might include multiple courses. The courses, with their descriptions, are listed in Tables 1 – 3.

RESULTS

In presenting the results, we begin with a description of the characteristics of the participants in the survey. We then list all of the courses for which we solicited opinions, with the resultant ratings of importance to the respondents. Next we look at differences in opinions between various categorizations of respondents (highest academic degree earned, the country in which the respondent resides, and the EM role(s) the respondent has or currently has in the domain. Throughout the analyses the .05 level of significance is used.

Characteristics of the Respondents

Our respondents are well educated, diverse in experience, and active in the EM field. A large majority of the respondents (106 of 111 total) were well educated and hold at least a Bachelor's Degree. Over half (51.4%) belong to at least one professional organization (IAEM – 44; ISCRAM – 7; TIEMS – 6). Many of the respondents have held various roles in the EM domain (Practitioner – 90; Academic – 78; Researcher – 75) and have published at least one professional paper (N=98).

Ratings of Courses

Means were taken of the ratings of all of the proposed courses. Note that some respondents indicated they had no opinion for some courses and that response was not included in the analysis. Below, in Tables 1 through 3, the means, standard deviations, and measures of kurtosis (a measure of the skewness of data) are shown in descending order by the categories of courses. All proposed courses were highly rated by the respondents ($\mu > 4$ on a 7-point scale). For general EM courses, the most highly rated courses ($\mu > 6$) were Professional Characteristics and Organizational Practices for EM; Planning Foresight and Risk Analysis; Case Studies of Failures; Disaster Types and Characteristics; Legal, Ethical, and Policy Concerns; and Critical Infrastructures and Their Interactions.

While the ranking of the courses in EMIS for all masters programs and those with an IS focus are not the same, for both categories all of the courses are highly ranked and the top ranked courses for each type of program appear at the top in both lists. Decision Support Systems and Social Media top both lists. This is not a surprise and both are tools that are highly used, or have the potential to be extremely useful, in the domain. Note that although the EMIS courses in Table 2 (for IS focused programs) and Table 3 (for all EM master's programs) are nearly the same, there are differences. For example, a master's thesis is listed in Table 2 but not in Table 3; this is because an EMIS focused thesis would only be required for IS focused programs. Although any program may have a thesis requirement, if the program is not EMIS focused the thesis topics might be in different domains. Also of note is that for a program with IS focus a master's thesis requirement is very highly rated. The high ratings for all courses suggest that this seed list of courses proposed by the researchers is a valid and useful one from which a model curriculum can be built.

	N	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error
Professional Characteristics and Organizational Practices for EM	110	6.52	0.99	16.24	0.46
Planning, Foresight and Risk Analysis	110	6.40	0.99	6.08	0.46
Case Studies of Failures in Emergency Management	110	6.22	1.22	3.50	0.46
Disaster Types and Characteristics	110	6.19	1.33	3.31	0.46
Legal, Ethical, and Policy Concerns	110	6.16	1.22	5.20	0.46
Critical Infrastructures and Their Interactions	110	6.11	1.22	2.78	0.46
Security and Terrorism Characteristics and Situations	108	5.43	1.54	0.41	0.46
Public Health and Medical Services	108	5.31	1.63	-0.39	0.46
Emergencies in Developing Countries	107	4.86	1.67	-0.54	0.46
Fire Fighting Characteristics and Situations	108	4.35	1.70	-0.65	0.46

Table 1. Means of General Courses for All EM Master Degree Programs

	N	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error
Decision Support Systems for Emergency Management	102	5.97	1.43	3.10	0.47
Social Media for EMIS	104	5.93	1.39	3.22	0.47
A Masters Thesis	99	5.81	1.45	2.51	0.48
Requirements for EMIS	101	5.69	1.43	1.62	0.48
Collaborative Problem Solving Using EMIS	103	5.62	1.45	0.99	0.47
Advanced Topics in IS for EM	100	5.50	1.64	0.64	0.48
Information Systems Evaluation	101	5.43	1.51	0.02	0.48
Participatory Databases for EMIS	102	5.39	1.54	0.94	0.47
Sensor and Network Systems for EMIS	99	5.20	1.54	1.15	0.48
Human Computer Interface Design for EMIS	98	5.14	1.71	0.13	0.48

Table 2. Means of EMIS Courses for EM Master Degree Programs With an IS Focus

	N	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error
Social Media for EMIS	95	5.57	1.52	0.14	0.49
Decision Support Systems for Emergency Management	94	5.34	1.72	0.41	0.49
Collaborative Problem Solving Using EMIS	95	5.26	1.56	0.38	0.49
Requirements for EMIS	95	5.18	1.74	0.07	0.49
Information Systems Evaluation	94	4.93	1.64	0.03	0.49
Advanced Topics in IS for EM	93	4.92	1.85	-0.16	0.50
Participatory Databases for EMIS	94	4.82	1.84	-0.51	0.49
Digitizing a Paper World	94	4.69	1.88	-0.54	0.49
Sensor and Network Systems for EMIS	93	4.58	1.73	-0.41	0.50
Human Computer Interface Design for EMIS	93	4.48	1.73	-0.74	0.50

Table 3. Means of EMIS Courses for All EM Master Degree Programs

The above indicates that a solid EM master would require the first six courses in Table 1 and if it was also to be also have a concentration in EMIS, it would have the first six courses in Table 2. This would be a total of 12 three credit courses with four courses per semester for three semesters. As noted above, it is important for programs in the EM specialties discussed above to have some IS study requirement. We recommend that it be the first three courses in Table 3, leaving three electives. In general, we would only recommend doing a master's thesis is the person has some intention to go on later in their future for a Ph.D. program in some area of computing where they could do a thesis in the EMIS area. If the student has an undergraduate degree in computing, there might be more flexibility in choosing which graduate course in Table 2 they may take. This program does assume the student comes with a bachelor degree in some basic undergraduate major in one of the six areas listed earlier. With a minor in computing or accomplishing a set of undergraduate prerequisites, they could also choose the EMIS major. Hopefully, the whole program would be available online so those who are working can do this on a part time basis.

Correlations of the EMIS Courses for General EM Masters Programs and Those Programs Focused on EMIS

Most of the EMIS courses proposed appear in both the lists of courses for all EM masters programs and for those focused on EMIS. The exceptions are that the master's thesis is only listed for programs focused on EMIS and Digitizing a Paper World is only listed for general EM masters programs. The data were not normally distributed so non-parametric correlations (Spearman's rho) were taken for each pair of courses listed for both types of programs. All courses listed for programs focused on EMIS were highly correlated ($p<.001$) with the same course as listed as an EMIS course for all masters programs in EM. Thus, if a respondent rated a course as highly essential for one type of masters program, their rating was also high for the other type of program.

Differences in Response by Characteristics of the Respondents

The data were not normally distributed, as tested by Kolmogorov-Smirnov tests, and so non-parametric tests (Mann-Whitney U and Kruskal-Wallis tests) were used to address RQ 2. The characteristics of the respondents examined were country, highest degree earned, and role played in the EM domain.

Differences by the Country of the Respondent

Of the respondents who indicated which country they are from, 69 were from the United States and 27 were from other countries including American Samoa (1), Australia (1), Austria (1), Bangladesh (1), Brazil (2), Canada (4), Finland (1), Germany (2), Guyana (1), Italy (2), Kenya (1), Niger (2), Norway (1), South Asia (1), Spain (2), Sweden (1), Turkey (1), and the U.K. (2).

The only courses for which there was a significant difference in rating by the country of the respondent were the general EM courses: Professional Characteristics and Organizational Practices for EM ($z= -2.54$, $p=.011$), Emergencies in Developing Countries ($z = -2.66$, $p = .008$), and Legal, Ethical, and Policy Concerns ($z = -2.096$, $p=.036$) such that the U.S. group ranked the Professional Characteristics and Legal, Ethical, and Policy Concerns courses higher and the Other group ranked the Emergencies in Developing Countries higher.

There were no significant differences between the U.S. group and the "Other" group for any of the EMIS courses for general EM master programs or for EM master courses with an EMIS focus.

Differences by the Highest Degree Earned by the Respondent

The respondents indicated the highest level of academic degree earned: High School (3), Associates Degree (2), Bachelor Degree (29), Master (42), or Doctoral (21). Kruskal-Wallis tests were performed for each proposed course to determine if the course ratings differed significantly by the grouping of each degree. Kruskal-Wallis, a nonparametric test, can detect such significant differences but does not indicate where the differences lie. So, for those courses whose ratings were significantly different by degree ANOVA with Tukey's post-hoc tests were run to attempt to uncover where the differences were. Because ANOVA, a parametric test, is less robust for nonparametric data, the differences the results of using the parametric tests did not, in all cases, determine where the differences were. For each of the categories of courses (general, EMIS for all programs, EMIS for programs focused on EMIS) at least one course was found to differ by degree earned.

For general EM courses, significant differences were found by Kruskal-Wallis tests for: Public Health and Medical Services ($X2 = 21.67$, $p <.001$); Fire Fighting Characteristics and Situations ($X2 = 10.53$, $p = 032$),

Security and Terrorism Characteristics and Situations (X2 = 14.07, p = .007), and for Critical Infrastructures and their Interactions (X2 = 16.84, p = .002). Public Health and Medical Services was rated significantly higher by those with a Bachelors degree than those with either a Masters or Doctoral degree; both Security and Terrorism Characteristics and Situations and Critical Infrastructures and Their Interactions were rated significantly higher by those with a Bachelors degree than those with a Doctorate; and the post-hoc tests were unable to detect where the differences lie for Fire Fighting Characteristics and Situations.

For EMIS courses in a master EM program with a focus on EMIS, only the rating for the course Sensor and Network Systems for EMIS (X2 = 11.3, p = .023) differed significantly by grouping by degree such that those with Associates degrees rated the course as significantly more essential than those who achieved other degrees as their highest degree.

For EMIS courses in all master level EM programs, only the course Decision Support Systems for Emergency Management differed by group (X2 = 11.36, p = .023) such that those with a Bachelor degree rated the course significantly higher than those with a Doctoral degree and those with a Master degree also rated it significantly higher than Doctoral respondents. It should be noted that there was not a significant difference between the Bachelor degree group and the Master degree group.

Differences in Course Ratings by the Role(s) in EM of the Respondent

The respondents were asked to indicate the number of years spent as a practitioner, academician, and as a researcher. As many of the respondents have worked in more than one role during their careers, we grouped the responses to course rating questions by the following groups: practitioner only; academician only; researcher only; practitioner and academician but not researcher; practitioner and researcher but not academician; academician and researcher; and practitioner, academician, and researcher.

Two general EM courses differed significantly by the roles of the respondent: Public Health and Medical Services (X2 = 15.91, p = .007) and Security and Terrorism Characteristics and Situations (X2 = 20.12, p = .011). Further analysis with parametric tests revealed that the practitioners only group rated Public Health and Medical Services significantly higher than did the researchers only group; and the practitioners only group rated Security and Terrorism Characteristics and Situations significantly higher than did the researchers only group, researchers and academics group and the group that have been practitioners, researchers, and academics. Note that other differences were not detected as significant.

None of the courses proposed as courses for EM programs with a focus in EMIS or a general focus were significantly different by the role of the respondent. This may be explained by the fact that although the roles in EM were diverse, a majority of the respondents had some focus on information systems in their work.

CONCLUSIONS

The results of this study reveal important insights that can guide the overarching goal of creating a model curriculum for EM master level programs. Our respondents had varying roles and experiences and, yet, all of the proposed courses were highly rated for their need to be included in the curricula. This suggests that the seed list of courses created by the researchers is a robust, appropriate list of courses.

The EMIS course ratings for courses for an EMIS focused program and more generally focused programs were similarly high and highly correlated and yet not exactly the same. This suggests that differences in the goals of the programs need to be considered when creating the model curricula. Likewise, although there were few significant rating differences by demographics, there were some, suggesting that the curricula developed need to be flexible so as to meet differing needs of institutions in different nations and/or with different target students.

Like other curriculum guidelines, these can serve several functions. The most important is to make sure that graduates of the programs have the up to date knowledge and skills necessary not only to do their jobs currently, but also to continue to learn as the field changes. A second major function is to provide local departments of Information Systems or Emergency Management with rationale to obtain proper resources to develop and maintain a program that combines these two disciplines. Often the administration is not aware of the course offerings and other resources (such as laboratories and library resources) that are necessary to provide a high quality program in such fast-evolving areas, or of the need for resources to support constant retooling of faculty (Topi et al., 2010).

LIMITATIONS AND FUTURE RESEARCH

As with all research, there are limitations to this study. One limitation is that only one instrument, a survey, was used which limits generalizability. Future research efforts will include gathering and analysis of qualitative data from open-ended survey questions, interviews, focus groups, etc. to achieve triangulation. Another limitation is that while space was provided for respondents to comment, the list of courses was presented by the researchers. This may have deterred some respondents from adding other courses that they also feel would be important. Future research should elicit descriptions of such additional proposed courses from a broad sample of EM professionals.

This study is the result of dissemination of a survey to a population related to ISCRAM. As such, most of the respondents do research or work in the IS domain. In the future the survey will be disseminated to a more diverse, broader group of professionals in the EM field.

The respondents were placed in groups for some analyses (e.g. Kruskal-Wallis tests), Although we chose the largest size groups that made theoretical sense, some of these groups were small in size. This may have resulted in a reduction of the level of power. That is, some significant differences may not have been detected.

The overarching goal of this series of research projects is to develop model curricula. To achieve that, model curricula will be developed and vetted by global EM professionals with varied demographics. Additionally, other degree programs (e.g. Bachelor, Doctoral) need to have guidance for curricula and we will endeavor to develop them as part of the overall research effort.

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APPENDIX A: DESCRIPTION OF PROPOSED COURSES

General EM Courses	
Course Name	**Description**
Professional Characteristics and Organizational Practices for EM	Included topics will be the responsibility of Emergency Managers in various government agencies and nongovernmental organizations, the functions of the various EM agencies, business continuity, and the phases of emergency management from planning through recovery.
Disaster Types and Characteristics	With a focus on both natural and manmade disasters, this course will focus on the disasters most likely in the country or region where the course is taught. The content will include challenges and necessary responses for specific types of disasters. Disasters in other areas will also be more briefly addressed to inform those who move to new locations.
Planning, Foresight, and Risk Analysis	This course focuses on planning, risk analysis, and mitigation options to make responses more effective and to reduce the size and difficulties of the recovery effort. The course also addresses how to evaluate the effectiveness of the human and system performance. Included would be analyses of approaches to similar disasters in other locations. This course may need to be modified periodically based upon new findings and advances.
Public Health and Medical Services	Topics in this course will include the characteristics of medical facilities in various types of locations and their ability to respond to various types of disasters. Requirements for responding to different types of disasters (e.g. pandemics, release of poisonous materials) will be included in the course. Public Health courses addressing pandemics that may cross international boundaries will require an international treatment.
Fire Fighting Characteristics and Situations	Study of the range of fire types and what resources are needed to respond to them. What are the desirable mitigation factors which will reduce the likelihood of fires? How does one assess the needed resources and the desirable training for the fire fighters to handle an increasing range of possible emergencies? This course is for information and analysis purposes and is not intended to provide the physical training needed by firefighters.
Security and Terrorism Characteristics and Situations	Study of the involvement of Emergency managers in terrorist activity, especially that which has a wide impact (e.g. dirty bomb) or high casualties (e.g. explosion)
Emergencies in Developing Countries	A focus on understanding the difficulties that developing countries have in responding to a wide range of disaster types and how they can best manage to cope with such situations. Other topics include the operations of humanitarian organizations and the problems inherent in the movement of large numbers of refugees
Case Studies of Failures in Emergency Management	Learning from failures in EM has provided for significant improvements and changes in response and recovery practices. Reports and books on prior disasters will be discussed to provide useful insights and an understanding of prior experiences.
Critical Infrastructures and Their Interactions	Understand all of the critical infrastructures that service a populated area is critical for effective response and planning. Disasters often cause unexpected interactions between these infrastructures which makes response more difficult. In the United States the aging of the infrastructure is an additional critical problem which adds to the potential and complexity of failures and disasters.
Legal, Ethical, and Policy Concerns	Topics covered include the legal and ethical (e.g. privacy) issues Emergency Managers face in the development of procedures and policies and their implementations. The primary focus will be on the issues in the location served by the institution with some comparisons with concerns in other locations as well.

Table A1. General EM Courses

EMIS Focused Courses	
Course Name	**Description**
Requirements for Emergency Management Information Systems (EMIS)	A focus on the functions a computer system must be able to perform to assist humans in dealing with emergency situations most effectively and efficiently.
Decision Support Systems for Emergency Management	This course, requiring the proposed course on Requirements for Emergency Management Information Systems as a prerequisite, will focus on the support IS can provide for decision making in all phases of an emergency. It will address individual and group decision processes and how an IS can support them (e.g. the types of information needed, mitigating possible biases through feedback and analysis). All decision makers will be considered. Review of the literature and case studies will uncover ways IS can be improved to better support decision making.
Human Computer Interface (HCI) Design for EMIS	The properties of a computer and information interface that allow humans, as individuals and groups, to focus on complex situations and gather necessary information to determine timely solutions to difficult and rapidly changing events. The similarities and differences in HCI requirements for different systems (e.g. Command and Control, mobile devices deployed in the field) will also be discussed.
Sensor and Network Systems for EMIS	The use of sensors and other field devices to gather timely information about a given situation in order to respond quickly to crisis will be addressed. Both hardware sensors and computing devices used by responders, other professionals, and citizens will be discussed.
Social Media for EMIS	As a communication medium, Social Media is currently used, and has the potential for use, for dissemination and collection of information between government agencies, public entities, and a mixture of the two. Each paradigm has both challenges and opportunities in all phases of Emergency Management. Use by official organizations (e.g. government, NGOs) as well as the public and the benefits and risks of integrating the two will be addressed in the context of processes, procedures, policies, technical requirements, and attitudes.
Participatory Databases for EMIS	Databases that people can contribute to and can extract useful information from as well as engage in topical discussions are the topic of this course. Many of these databases will have public access and/or will be geographically oriented. Being able to set up and administer these databases and applications will be a requirement for many Emergency Managers. A basic understanding of the necessary roles and activities in database management is the goal of this course.
Collaborative Problem Solving Using EMIS	The focus of this course is to be able to evaluate systems and tools that provide for dynamic collaborative solving methods and process in emergency management. As any crisis, or potential crisis, is of mutual interest to different professionals, they need the support of tools that will allow a quick collaborative response to unexpected response problems.
Information Systems Evaluation	Overview and practice with qualitative and quantitative methods for involving users to obtain feedback on usability and usefulness of a system. Includes interviews, "thinking out loud" protocols, surveys and experiments.
Advanced Topics in IS for EM	A survey course to examine the newest trends in IS for Emergency Management. A basic understanding of such systems and tools as modeling and simulation, geographical information systems (GIS), and analytic tools will be discussed. Each semester another topic or type of system can be the focus of the semester. Institutions may choose topics that are especially germaine to their constituency and location.
A Master's Thesis	(Programs with focus on EMIS only) A one or two semester course with representation on the committee from a computing sciences department if possible. Departments are encouraged to hold regular seminars for all master's students at which practitioners will be invited to speak about their real world experience. The regularity and ability of a department to do this will depend upon many factors such as the size of the department.
Digitizing a Paper World	(General EM Master program only) This elective would provide guidance for moving from paper based to electronic based records. Included would be descriptions of different types of systems and applications, processes for transitioning, and training techniques. This course would be more basic than the Requirements for Emergency Management EMIS course and would have more of a practitioner and process focus.

Table A2. EMIS Courses