RIT | **Golisano** College of Computing and Information Sciences
Department of Computing Security

CAPSTONE GUIDE
~ Master of Science in Computing Security ~

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~ A General Guide for the MS Capstone Experience ~

> The term "capstone" refers to a final culminating educational expectation for MS degree candidates. The capstone experience for a given MS program is defined by the faculty to match the educational goals of that program. It can be implemented as an open-ended experience, i.e. a project or thesis, or as a closed-ended development expectation, i.e. a course with specific creative and professional goals.

Introduction

The capstone experience is the final requirement of the Master of Science degrees offered by your department. The topic chosen for a capstone experience should build upon the student's studies to demonstrate mastery and advanced technical ability. Although we expect students to demonstrate their capabilities as computing professionals and to push their investigations beyond their coursework, this is not a time to change direction and attempt to learn something entirely new. Rather, the purpose of this requirement is to allow the student to pull together the knowledge that has been gained during graduate study and to demonstrate, under the guidance of a faculty committee, creativity and professionalism. At the completion of the capstone work (project or thesis), the student writes a scholarly document and defends the work in a public forum to the satisfaction of the faculty committee members. In case of the capstone course, the student writes a final report and presents the findings of his/her work in a poster session. The faculty prefers that students plan for and complete this requirement immediately after finishing their coursework. Under special circumstances, the faculty committee may allow capstone work to be completed at a distance.

Thesis or Project or Capstone Course, What's the Difference?

A thesis, a project or the capstone course is required to complete the requirements of the **MS in Computing Security** program. It should demonstrate your ability as professional and as a creative and independent thinker. It is also intended as an opportunity for you to demonstrate your mental inquisitiveness, creativity, and your ability to independently pursue academic inquiries. In short, it demonstrates and proves your abilities as an academic scholar.

A thesis involves researching a topic of interest. This research is typically based upon a hypothesis or assertion statement. The hypothesis may be verified using mathematical analysis, experiments, simulations or emulation. There may or may not be a development component. It must, however, add some "nugget of knowledge" to the body of literature on the chosen topic. This "nugget" concept refers to originality in thought, application of concepts, implementation, or conclusions on the part of the student. In other words, a thesis is more than simply a large literature review or report on a given topic area. It requires investigation, analysis and creativity of high quality, suitable for external peer-

reviewed publications. The investigation process and the results are documented in a published document, available to the public through the RIT Library and the Internet. An MS thesis is worth 6 credits.

A project involves some type of practical development with a deliverable. This may include development with computer equipment, software packages, and programming or scripting languages. Alternately, it may be the development and demonstration of an innovative process that addresses a current computing issue or problem. As technologies change, capstone resources should keep pace. A well-written professional report is required that details current thinking on the topic in the professional literature, the design and implementation of development that was done, and a critical evaluation of the results. An MS Project is worth 3 credits.

A capstone course has expectations similar to a project. The difference is that the scope of the project is defined so that the results can be achieved within a semester. Also, students work with the instructor of the course (or another faculty member, if required) rather than a faculty committee. Students submit a 2-page proposal to the course instructor, *prior* to obtaining the approval to register for the course. The proposal should outline the problem, the methodology and the deliverables. The scope should be carefully defined so that the work can be completed within the semester timeframe. Although termed as a course, students are expected to carry out independent work with some guidance provided by the instructor. A well-written professional report is required that details current thinking on the topic in the professional literature, the design and implementation of development that was done, and a critical evaluation of the results. Students are expected to present their findings via a departmental poster session. An MS capstone course is worth 3 credits.

Description of Capstone Options (Course Catalog)

CSEC 790 MS Thesis - This course is a capstone course in the MS in Computing Security program. It offers students the opportunity to investigate a selected topic and make an original contribution, which extends knowledge within the computing security domain. As part of their original work students will write and submit for publication an article to a peer reviewed journal or conference. Students must submit an acceptable proposal to a thesis committee (chair, reader, and observer) before they may be registered by the department for the MS Thesis. Students must defend their work in an open thesis defense and complete a written report of their work before a pass/fail grade is awarded. (6 Credits)

CSEC 791 MS Project - This course is a capstone course in the MS in Computing Security program. It offers students the opportunity to investigate a selected topic within the computing security domain. The student may complete a project for real world application or in a laboratory environment. Students must submit an acceptable proposal to a project committee (chair, and reader) before they may be registered by the department for the MS Project. Students must defend their work in an open project

defense and complete a written report of their work before a letter grade is awarded. (3 credits)

CSEC 793 MS Capstone Course - Students will apply their knowledge learned through the program to solve real world problems various areas of computing security. Large size projects will be defined for students to work on throughout the semester. At the end of semester students will present their results and demonstrate their knowledge and skills in problem solving and critical thinking in a setting open to the public. (3 credits)

General Considerations

The capstone experiences for our MS programs are student-directed work with the specific purpose of providing the student with an opportunity to apply the education that he/she has received to an independent creative endeavor. The major difference between a project in a course and a capstone experience is that you must individually move beyond your coursework to investigate a topic, manage the design and planning for this effort, and successfully complete the work with appropriate scholarly depth and professional expertise.

You should plan to spend at least six (6) months completing your capstone. Expect to begin the actual capstone work after – not while – you complete your MS coursework. This is not to imply that you shouldn't be thinking about your capstone while you complete your graduate coursework. Rather that, while you may be gathering resources and planning during your studies, the amount of dedicated time and effort necessary to complete the capstone will not typically be available.

Your capstone work should be interesting and exciting; and the faculty looks forward to working with you as you complete it. However, please be aware that the faculty cannot be expected to respond to any deadline pressures that you may have due to relocating, termination of financial support, employment requirements, promotion opportunities, I-20 or H1-B deadlines, etc. RIT expects a quality effort.

If you disappear for several years after completing your coursework, it will be much more difficult to satisfy your capstone requirement. As your life and career move you in different directions, technology continues to advance and the skills that you developed in your studies may deteriorate. New students join us each year. In addition, faculty members have very busy professional schedules. If you wait to start your capstone, you will find it much more difficult to generate an acceptable topic and to recruit faculty or to return to campus. In addition, you risk losing your previously completed coursework. (Under RIT policy, you have up to seven (7) years from the time that you took your first course towards the MS degree requirements – excluding any prerequisite coursework; see the "Time Limits" section of this document for details.)

For your capstone, it may be possible to work on an appropriate, industry-sponsored topic. However, this can present problems. Issues such as proprietary concerns or conflicts between satisfying academic constraints versus organizational goals can arise.

Students should discuss possible industry projects with the graduate director. If such a project is acceptable, your capstone committee may include an industry representative – either formally or informally. All capstone work is an <u>individual</u> effort, however. In addition, all capstone defenses and the final capstone documentation are public knowledge. Therefore, a letter from your employer confirming that the company approves the project as your capstone, that you will be the only employee working on the project, and that all information included in the final capstone document and defense is non-proprietary is required.

Outline of an Open-Ended Capstone Process (Formal processes applicable for MS Thesis and MS Project)

Creating an Initial Idea Document

1. The first step is to identify some ideas that could become the "seed" of your capstone experience. Review your past classes and your past coursework. What have you learned and what would you like to learn more about? Think carefully about the possible topics you've identified. Can you find faculty in the department who share your interest in this topic? Many students find it helpful to jot down interesting topics and ideas as they go through their coursework.

2. Select your best idea. Write down as much detailed information about it as you can so that you can transform your rough thoughts into a short document that suitably conveys the general direction and purpose of your idea.

For a project, you will want to phrase your initial discussion in terms of the investigation of a practical problem and its significance. Then *describe* your investigational process and development goals. Be sure to include a clear description of the proposed solution.

For a thesis, you can write a succinct objective/assertion statement or state your research goal as a formal "if hypothesis, then scenario" statement. Then describe your proposed plan of research. Your research should be designed to either prove – i.e. substantiate – your assertion (H0, the null hypothesis) or to disprove it (H1, the alternate hypothesis). The formal hypotheses for a thesis typically have the following general format:[1]

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H0:  Application of treatment x will result in no change.
H1:  Application of treatment x will result in a change.
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"Treatment *x*" is what you intend to do for your investigation (e.g. modify the design of some key component of a system; use a different implementation strategy; etc). The "change" is the anticipated impact of your investigation (e.g. no improvement in system performance across a specified set of one or more key dimensions or improvement in … aspect of system performance for measures….; etc). Clearly describe the exact change that you anticipate will occur.

3. The initial document may be any length but, generally, a shorter, well-written description is better than a lengthy, rambling document. In most cases, 2 or 3 pages should be sufficient to convey your initial idea. Take the time to correct grammatical mistakes, spelling errors, and any other ambiguous aspects of this document. Finally, proofread it one more time to make sure that it as well written as you can make it; if necessary, have it critiqued by the RIT University Writing program consultants (https://www.rit.edu/academicaffairs/writing/).

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[1] This is a very general thesis assertion-pair format. Your capstone faculty may suggest a different statement style.

Remember that the capstone experience is a culmination of your previous studies. It is not a time to pursue something entirely new. *Do not be tempted to pursue an idea that is beyond the current scope of your technical skills and coursework.* You should not need to take additional courses to support your capstone. Plus, you will not know the faculty outside your concentration areas and as a result, these faculty members will be less likely to be interested in serving on your committee.

When you're trying to get started, it may help you to look at a few capstone documents completed by other students. Your department maintains an electronic repository of past capstone work. You can stop in to the Student Services office (GOL-2120) or contact your graduate academic advisor to review some of the capstone documents that we maintain.

Identifying Committee Chair

4. It is important that you correctly identify faculty who may be interested in serving on your graduate committee. Do not blindly send your document to all faculty members. Doing so will waste both your time and that of the faculty. You may want to consider making an appointment (office or phone) with your target faculty during their office hours to discuss your ideas. Or you could send your idea to professors who you feel may have some interest in the topic and then follow up with a phone call. As a preface to either method, you will want to elaborate on the information gained in researching individual faculty members. In other words, you should be able to tell the target faculty member *why* you think they might be interested (for example, your idea is an extension of work they've done in the past, your idea builds on the courses that they typically teach, etc.) Additionally, you should be able to explain why you are interested in the topic and detail your coursework and other experiences that have prepared you for your capstone.

Creating a Proposal

5. The expansion of your initial document into a full proposal means creating a document that contains a clear statement of the problem for a project or of the assertion (hypotheses) for a thesis, your reason for choosing this topic, the skills that you have that will support your work, a plan or methodology that you will use to solve the problem (indicating the hardware and software technology that you plan to use or the research you will need to conduct), a list of deliverables that includes how you will know when you are done, and a timeline. This proposal should incorporate the comments or suggestions from your initially targeted faculty members. Please use the appropriate cover page for the proposal, available on the department website (https://www.rit.edu/computing/department-computing-security/resources) . See Appendix A for a sample outline of the proposal.

Finalizing Your Committee

6. If you are completing a project, you need to form a faculty capstone committee of at least two (2) members. If you are completing a thesis, your committee must include three (3) members. The committee chair must be a member of your department's faculty.

7. You can petition to have an outside person on your capstone committee. Your outside member must have at least a master's degree and can be from another department at RIT, another university, or from your workplace. You will need the prior approval of both your committee chair and the graduate director. To obtain initial approval, send a request to your committee chair and if approved, forward his or her approval to your graduate director for final approval. If this person is outside of RIT, attach his or her current resume. You will need to explain why you want an outside member and how he or she is relevant to your capstone. There can only be one outside member on your committee.

Finalizing Your Proposal

8. When all of the members of your committee have indicated their approval by signing off on the proposal, submit both printed and electronic copies of it to the graduate director and request approval to register for your capstone credits.

(Important! You need an approved proposal, approved by the committee and the graduate program director to register for capstone credits. This has to be done within the drop/add period each semester. For Capstone Course (offered in the Spring term only), the 2-page proposal needs to be submitted to the graduate program director before the end of the Fall Semester).

9. When the graduate director approves your proposal, a member of the Student Services staff will contact you (or enroll you in the Capstone Course). At this point, your proposal becomes an informal contract indicating the specific work to be done and the approval of the topic and tasks by the faculty.

Proposal Requirements

- The topic should require the student to leverage his/her studies and engage in additional learning.
- The proposal must be original work
- It may be based on prior work of the student (see "re-use of previous course work" for details)
- The proposal must include at least the following sections (these are the minimum requirements. The committee can have other specific requirements):
  o Problem statement including why this is a problem of interest
  o Literature search describing prior work in this area
  o Description of the work to be done

- o A clear enumeration of deliverables
- o A timeline for the proposed work
- o List of references, consistently formatted
- Although there is no page limit for Capstone proposals, typical project proposals are 8-10 pages long while Thesis proposals are 15-20 pages. The Capstone Course proposal has a 2-page limit. Please check with the graduate program director for details.
- All proposals need approval from the graduate program director
- All proposals will be checked for plagiarism by CSEC office staff

Your approved proposal must precisely define the scope of your work: what you will do, what results will be accomplished, how you know when you are done, etc. This prevents you from becoming stuck in a situation where your capstone requirements shift after you have begun working and you are unable to complete it in a timely manner.

Registration

10. Get registered for your capstone credits. (The Student Services office does this for you!)

When the graduate director has approved your capstone proposal, the office staff will contact you about registering for your capstone credits. (We only register students for capstone credits when they are ready to actively work on and complete it).

We can register you for all of your MS project or MS thesis credits at one time if absolutely necessary. However, you should consider the length of time that it will take you to complete your work. Since capstone work can take several semesters to complete, it is typically best to spread the credits over multiple semesters to maintain your active status and access to RIT resources. Talk with your graduate director or graduate academic advisor if you are not sure about the best registration plan to fit your situation.

For an MS project[2]: If your work is not completed by the end of the semester in which you register for the credits, you will automatically receive an incomplete, 'I', grade. You have the standard two (2) semesters (summer counts as a semester) to complete the work and replace the incomplete grade with the actual capstone grade. After two semesters, the incomplete automatically becomes a grade of 'F'. If you find that you will be unable to complete your project within the two semesters, talk with your committee chair about an extension of the incomplete.

After multiple years have elapsed, it may be difficult to gain approval from the RIT Registrar for changing a grade of 'F' back to an incomplete. The grade can typically be changed when all capstone work has been completed. However, if an extensive period of time has elapsed, the student may have to re-register (and re-pay) for these credits. So, we encourage you to complete your capstone in a timely manner.

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[2] A thesis capstone is pass/fail. The way that the faculty indicates when a thesis has been successfully completed is discussed later in this document.

For an MS thesis, you will receive a grade of 'R' at the end of the semester, which indicates that you worked on the thesis.

You may need a full-time equivalency for semesters in which you are registered for capstone credits to maintain your I-20 status or to work on campus, etc. RIT allows a maximum of three (3) full-time equivalencies for capstone work.

Once you have paid for all of your capstone credits, you may only be registered for zero (0) capstone credits one (1) time (other than in summer terms) to maintain your active academic status. After that you will need to register for capstone continuation credit. The zero-credit or continuation-credit capstone registration options are not a way to postpone your capstone work (and any loan repayment) while you look for employment or engage in other unrelated activities.

If you have used up all your opportunities for zero-credit registration or if you have been away from the RIT environment and are re-establishing contact to complete capstone work, you can be registered for the appropriate course below to maintain your matriculated student status:

- Continuation of MS Thesis
- Continuation of MS Project

There is a one-credit (1) charge for registering for capstone continuation.

Completing the Capstone Experience

11. Consider consulting the GCCIS subject librarian to help organize your research.

Please consider making an appointment to consult with the GCCIS librarian prior to undertaking research for your capstone project or thesis. A one-on-one consultation with your subject librarian is a great way to learn the best information sources available through the RIT Library and beyond. Consultations are in-depth (plan on scheduling at least one hour) and focused on your individual interests and needs. During a consultation, the subject librarian will demonstrate the use of RIT Library's many online research databases, discuss and plan search strategies, help you analyze your topic of interest, and recommend the best databases and sources so that you can maximize the effectiveness of your literature searches. A capstone consultation is also an opportunity to familiarize you with useful services provided by the RIT Library, such as interlibrary loan (acquiring documents from other academic libraries), citation management software[3], and electronic archiving of your capstone work through the RIT Digital Media Library.

To make a capstone consultation appointment, contact the RIT Library Liaison for GCCIS: Roman Koshykar, at Wallace Center 1420 or rgkwml@rit.edu .

12. Do the work.

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[3] Check out the Wallace Library's "Research Help" section at http://library.rit.edu.

A MS capstone generally takes two (2) semesters of effort to complete. Typically, this means one semester to organize your effort (proposal, research, etc.), and another semester to complete the work. The longer you linger, the more likely it is that the technology and the faculty will have changed from when you completed your coursework. Procrastination will only result in lengthy delays and more effort in completing the capstone experience.

13. As you work, keep in touch with your committee members. You should minimally be in contact with them one to two times per month. So, plan to submit frequent drafts of your document and to do periodic demonstrations.

Occasionally, problems can occur during the completion of capstone work: research may not progress as anticipated, development problems can arise, anticipated resources may not become available, etc. If the problem(s) are significant, it may become necessary to revise your capstone proposal. This is the time to talk with your faculty. Your capstone faculty must approve any and all change(s) in advance.

Changing the scope or direction of your project/thesis without your committee's prior approval, invalidates your previously approved proposal and you may be required to change your work, write a new proposal, repeat the approval process, and/or find a new committee. So please stay in close communication with your committee members.

Capstone committee members commit to work with you for up to one (1) year after they approve your proposal. If you delay starting or take longer than a year to complete your work and have not been in communication with them, the faculty may decline to continue on your committee. If this occurs, you will need to form a new committee, and possibly develop a new proposal as well.

Occasionally, students propose an ambitious capstone topic to attract faculty interest and establish a committee quickly. Then, after a proposal is approved, they request that their faculty reduce the proposal requirements because they have insufficient time or knowledge to complete it. Faculty members do not appreciate this type of "bait and switch." They typically cancel the capstone and permanently withdraw from the student's committee.

You should also be aware that if you have been inactive for four (4) semesters or more, you could have been dematriculated from RIT. If this has occurred, your department may be able to reinstate you. However, if it's been over two years and degree requirements have changed, you must reapply for admission through RIT Graduate Enrollment Services. If you need to be readmitted and the degree requirements have changed, you will be readmitted under the degree requirements that are currently in affect. This may mean that you need to do additional coursework in addition to completing your capstone. You should also be aware that you are subject to RIT's 7-year degree completion time limit (discussed under "Time Limits" below).

14. After you have completed your capstone work to the satisfaction of your committee, you will be ready to "defend" it in a public forum. The capstone defense is intended to allow you to demonstrate your expertise, skills, and professionalism within the context of your individual project or thesis. Your committee will set the requirements for the defense. However, it typically involves a formal presentation and, if applicable, a demonstration of your work. The defense may be done on-campus or from a distance. Your committee chair will make the arrangements (scheduling a time, getting a room, etc.) with the Student Services staff for your defense. Since your defense is open to the public, you will need to post an announcement for it <u>at least one week in advance</u> on the graduate bulletin board (see Appendix D for the posting format).

    Your capstone faculty will tell you when you are ready to defend. Do not be tempted to push for an early defense or to announce a defense date without their approval. If you are allowed to defend before you are truly ready, you could fail the defense; be assigned additional work; and have to re-defend later when you are better prepared.

15. Your capstone document is <u>very</u> important. It represents your intellectual effort and professional capabilities. The faculty takes this document very seriously since they are required to sign off on it. Therefore, you can expect to receive extensive feedback on both your technical content and writing style. Please use the appropriate title page and approval form for the report, available on the department website (https://www.rit.edu/computing/department-computing-security/resources) . Details on the capstone document format are included in Appendix A of this handbook; however, please be aware that your capstone faculty may require a different format. Ideally, whenever possible, your final capstone document should be available at the defense.

    Your final capstone document <u>must</u> be of professional quality and written well, in terms of language usage, your expression of ideas, visual presentation, and references. Presenting your committee with a well-written document will speed completion of the capstone requirement. Your committee members have many demands upon their time, so please do not expect them to provide extensive editing support.

Appropriate references are critical to a well-written capstone document. Ideally, you should have a wide range of information sources: books, journals, etc. The Internet is not a dependable source of reference material. If you do cite a reputable website, use an appropriate referencing format (see the APA, MLA and IEEE references in Appendix B) and print the opening page and all directly referenced pages for inclusion in an appendix to your document. The Internet changes constantly, but your references <u>must</u> be "locatable."

If you receive feedback from your faculty that you should "clarify," "explain," or add "depth" to a section of your document, do so. If you're unsure what is meant by a

comment or how to proceed, talk with them. Do not be tempted to just drop that section from your document. Removing important content weakens your document, can aggravate your faculty and delay completion, and ultimately may negatively affect the evaluation of your work.

16. Your defense may result in further suggestions or changes that will need to be incorporated into your capstone work and/or documentation. You may also be required to defend more than once. However, once you have successfully passed your defense, the final step in the capstone process is to complete, bind, and submit your capstone work so that it may be permanently maintained by RIT.

17. When your capstone is successfully defended and your faculty members are satisfied with the capstone document, they will sign the official capstone signature page that must be attached to the front of your capstone document.

Capstone Grade

The MS capstone requirement is successfully completed when all work, the defense, and the capstone document have been completed to the satisfaction of your committee; it has been approved and signed off on by *all* of your capstone committee members; and the required copies of the capstone document have been appropriately submitted per RIT and your department requirements.

After a MS project capstone is successfully completed, the members of the faculty committee award a letter grade based upon the student's demonstrated performance.

The MS thesis capstone is pass/fail and a grade of 'R' is assigned. When your faculty committee members accept the thesis, the name of the thesis is entered into the student's permanent academic record and it is considered "completed" at that point.

Satisfactory completion of the capstone requirement and the final grade is determined by agreement between all of your capstone committee members. This decision is based upon the quality of both your capstone work and your defense.

Final Submission of your report

18. The final step in completing your capstone is to submit your capstone document for permanent retention by RIT. Note that RIT no longer requires hard copies of the final thesis. Thesis capstone reports are maintained by both RIT's Wallace Library and your department. Please submit an electronic copy of the document to the department once you are done with the defense. For submission details on the electronic copy to the library, please refer to https://infoguides.rit.edu/thesis-services

19. Project capstone reports are permanently maintained by your department. Please submit an electronic copy (with the signed signature page) to the staff assistant.

Important! The capstone document (with any digital media) must be submitted <u>before</u> you can be certified for degree completion and graduation. For a MS project capstone, this means electronic copy of the final project document must be submitted to your department prior to certification. For an MS thesis capstone, along with the electronic copy of your thesis, the receipt from your ProQuest/UMI submission must be returned to your department before you can be certified.

<u>Sharing Your Efforts</u>

20. You may want to share your scholarly efforts on the Internet through an electronic theses and dissertation (ETD) site, through publication, or at a conference. Talk with your capstone faculty about this. RIT's Digital Media Library (https://ritdml.rit.edu/) is one option. The Digital Media Library provides electronic documentation of graduate student projects, theses, and doctoral dissertations for the RIT community. The library will post your scholarship efforts or you can post it on your own. For more information see the website or contact the RIT Wallace Library

Alternately, you can find a relevant conference by talking with your committee faculty.

Time Limits

All requirements for the master's degree, including your capstone, must be completed within seven (7) years of the semester in which the first course that is used towards the MS degree was completed. This includes any credit for courses transferred from other universities. For example, if the oldest course on your MS worksheet was taken in the Fall of 2018 (2181), your 7-year deadline would be prior to the start of Fall 2025 (2251).

Additionally, we strongly encourage students to finish their capstone work within one (1) year of the time that your graduate coursework is completed. Remember, your faculty committee is committed to your capstone topic for *one year only*; beyond that time frame it will be up to your committee members to decide whether or not they will continue with you. If they do agree to continue on your committee beyond the one-year time frame, your capstone proposal will have to be reviewed, and possible revisions to the original proposal or a new proposal may be required. Significant revisions may require finding a new committee since the revisions may alter the original proposal in such a way that the topic is no longer within the areas of expertise or interest of your faculty.

Collaborative Work

All capstone work for an MS degree at RIT is an <u>individual</u> effort, even if contributing towards a collaborative project. The standard RIT and department academic honesty expectations and policies apply (https://www.rit.edu/academicaffairs/policiesmanual/d080).

The capstone is your opportunity to display your professionalism. Plagiarism and other acts of academic dishonesty have no place in this process and can have very serious consequences including dismissal from the institute sans degree. Be sure to do your own work and to appropriately and exhaustively reference all material obtained from outside sources.

Re-Use of Previous Course Work

A capstone may be an extension of work that you yourself started in one of your MS courses or that extends the capstone work of a previous student. However your capstone proposal must clearly document your idea as such, so that your faculty committee is aware of and approves of the origin of the idea and any previously completed work. Capstones that extend the work of your classmates, such as team or group course projects, are generally not acceptable unless specifically approved by your capstone committee.

Since the capstone experience is an expectation beyond your MS coursework, projects or papers completed to satisfy assignments in courses taken during your studies either at RIT or at other academic institutions do not satisfy the capstone requirement, although as mentioned above, they may become the basis of it.

Appendix A
Sample Outlines

Below are sample format outlines for capstone proposals and final documents. While the requirements of the final documentation are agreed upon between the student and his/her committee members, the following formats are a general standard. For both the project and thesis capstone options, the proposal and final document <u>must</u> follow the APA, MLA or IEEE style guidelines (see Appendix B).

Project Proposal Outline (recommended)
- Topic Statement (state the problem you will investigate, including history and/or context)
- Significance (the importance of the topic and your interest in it; list, in detail, the concentration coursework and other experiences that will support your proposal)
- Proposed Solution and Deliverable(s) (list exactly what will be done; clearly and specifically describe exactly what the completed work will entail)
- Methodology (list the approach, techniques, and resources needed for implementation)
- Project Timeline or Schedule (anticipated; typically one-two semesters of effort)
- Supporting Research and References (relevant citations in appropriate format)

Thesis Proposal Outline (recommended)
- Hypothesis (hypothesis or assertion statements that clearly define the question to be investigated, the research that will be done, and the scope of your investigations)
- Significance (the importance of the topic and your interest in it; list, in detail, the concentration coursework and other experiences that will support your proposal)
- Literature Review (summarize the background literature that relates to your topic)
- Proposed Research and Deliverable(s) (list exactly what will be done; clearly and specifically describe exactly what the completed work will entail)
- Methodology (list the approach, techniques, and resources needed for implementation)
- Research (and development, if applicable) Timeline (anticipated; typically two semesters)
- Supporting Research and References (relevant citations in appropriate format)

Final Project or Thesis Documentation Format (recommended)
- Title Page
- Signed Project/Thesis Approval Form (https://www.rit.edu/computing/department-computing-security/resources)
- Abstract
- Table of Contents
- List of Tables, Charts, Illustrations, etc.
- Introduction
- Document Body (methods, results, discussion)
- Project/Thesis Conclusions (should reflect your personal thoughts on your work; minimally include results, all lessons learned, recommendations, and future tasks or suggestions for follow-up work)
- Appendices (charts, graphs, supplementary material, documentation of Web references)
- Supplemental Storage Media (with all development artifacts, if applicable)
- Bibliography

Appendix B
Writing Links & Other Helpful References

- **RIT Library:** http://library.rit.edu (Wallace; Building 05)

- **Citations**:

  Various tools, guides and services are available through the Library at
  http://infoguides.rit.edu/citationguide. Some of the more popular citation format
  guides are:

  IEEE Format: http://www.citethisforme.com/citation-generator/ieee
  APA Format: http://www.citethisforme.com/citation-generator/apa
  MLA Format: http://www.citethisforme.com/citation-generator/mla

- **Language Resources:**
  Guide to Grammar & Writing (includes structure and organization under Essay &
  Research Paper Level topic)
  http://grammar.ccc.commnet.edu/grammar/

- **RIT Academic Support Center - Writing Center** (SAU-1180)
  https://www.rit.edu/academicaffairs/writing/

- **Official Copies of Capstone Forms:**
  https://www.rit.edu/computing/department-computing-security/resources

- **Google Scholar:** http://scholar.google.com

Appendix C
Final Helpful Thoughts

Below are some suggestions, which can be used to make an open-ended capstone process go smoother.

- Nobody will "bug" you to complete your capstone work. You <u>must</u> be *self*-motivated!

- Be prepared to work <u>very</u> hard on your capstone.

- Start thinking of capstone ideas at the beginning of your program. Do not wait until the end of your study and say, "What should I do for my capstone?"

- An interesting topic discovered in a course or in a course project course may be the nucleus for a project or thesis. Write ideas down as they occur. That way you can review and develop them later.

- The project or thesis should build on the courses completed in your program of study. If you have a topic area of interest, then select your concentrations and electives to support the idea.

- Make a point of becoming acquainted with the faculty members who teach the courses in your areas of interest. Discuss your ideas with them and get their feedback on your ideas.

- After you have formed your faculty committee, work diligently on your project or thesis. Many graduate students approach the faculty, and they can lose interest in your capstone if you do not keep them regularly updated with your progress.

- Schedules are busy. Reserve time each week on a regular basis to work on your capstone. Don't plan to work on it whenever you have a few spare moments – you generally never do. Plan to reserve at least 4 – 8 hours per week to work on it. This is even more critical if you are now working and/or have a family.

- For on-campus students: while it is possible to complete your capstone from a distance, it is easier to complete it while you are still on campus.

- Complete the documentation for any software development as you write the code or do other implementation. It is easier, and will save time and effort later.

- Obtain feedback on the design of your project/thesis solution from your faculty committee members frequently – before it is difficult to make changes.

- Realize that faculty "turn-around" time for feedback on your work will be longer at busy times of the semester such as around mid-semester and finals. Also, many faculty members have reduced availability during the summer semester.

- While it takes a lot of hard work to complete the project or thesis, it is something that you can be proud of and can show perspective employers.

- Don't let yourself become discouraged. You are neither the first nor the last person to go through this process. Others have succeeded and you can too!