

# COMPETENCIES, COMPETENCY ELEMENTS AND RESOURCES TO MOBILIZE FOR THE DESS, PROFESSIONAL MASTER’S, RESEARCH- BASED MASTER’S AND DOCTORATE

This list of competencies and competency elements to develop was set out as part of the work done by a working group reporting to Polytechnique’s Academic Council. The present document was approved by Polytechnique Montréal’s Commission of Studies (May 26, 2014) and Polytechnique Montréal’s Academic Council (June 2, 2014).

For education purposes, it is useful to identify the hard skills, soft skills and knowledge that support the target competencies and competency elements.

For evaluation purposes, it is useful to distinguish the results aspects from the process aspects; determine the expected degree of complexity and autonomy; determine what will be formally evaluated; and identify the evaluation methods and the people involved in the evaluation process. As well, it is necessary to identify, using a scale, the desired development level for each competency.

To develop these competencies, a variety of internal and external resources must be mobilized. These relate to specific hard skills, soft skills and knowledge that can be developed or acquired within the DESS (specialized graduate diploma), professional master’s, research-based master’s and doctoral programs. They are presented here as a guide for students in order to facilitate the development of their competencies. A colour code helps to identify the nature of the resources to mobilize, which in turn helps guide the choice of appropriate evaluation tools.

Note that the competencies listed in this document replace those set out in the [Terms and Conditions of Application of the Supervision Policy for Graduate Students](#) (document approved by Polytechnique Montréal’s Academic Council on April 17, 2000).

Colour code legend:

Knowledge and understanding	
Hard skills and intellectual abilities	
Soft skills and personal qualities	

DESS (SPECIALIZED GRADUATE DIPLOMA)		PROFESSIONAL MASTER’S		RESEARCH-BASED MASTER’S		DOCTORATE	
Competencies	Competency elements	Competencies	Competency elements	Competencies	Competency elements	Competencies	Competency elements
The representation structure groups competencies of the same type together across programs. The competencies for the DESS start on the next page.		<b>1 Conduct a study or studies, bring about developments or create professional applications based on methodologies or the state of the art in one’s field applicable to a question of interest in one’s professional environment.</b>	<ol style="list-style-type: none"><li>1. Situate the problem under study and document it using the relevant literature.</li><li>2. Use one or more rigorous methodologies to analyze, evaluate or design professional applications or developments.</li><li>3. Act as an agent of change and improvement in your field of activity.</li><li>4. Establish a realistic timeline and plan how to follow it.</li></ol>	<b>1 Conduct rigorous scientific research, under the supervision of an expert and contribute to advancing scientific knowledge in their field and participate in scientific and technological development.</b>	<ol style="list-style-type: none"><li>1. Describe and master the problem under study using a literature review, among others.</li><li>2. Formulate research objectives.</li><li>3. Establish a realistic timeline and carry out your project in such a way as to respect it.</li><li>4. Find documentation about the research method related to your project and apply it; discuss the principles and techniques used.</li><li>5. Analyze and discuss your results in relation to those of the literature.</li></ol>	<b>1 Autonomously and expertly lead a scientific research project that makes an original contribution to knowledge or development in the areas of science and technology.</b>	<ol style="list-style-type: none"><li>1. Justify a research problem supported by an exhaustive literature review.</li><li>2. Formulate original hypotheses or research objectives.</li><li>3. Choose, adapt or design one or more research methods or analysis techniques related to your research area.</li><li>4. Establish a realistic timeline and conduct your project in such a way as to respect it while taking contingencies into account.</li><li>5. Analyze, interpret, summarize and evaluate your own results and locate them in relation to those of the scientific literature.</li><li>6. Evaluate the impact and implications of your research activities.</li></ol>
	Resources to mobilize		Resources to mobilize		Resources to mobilize		Resources to mobilize
INTERNAL		INTERNAL	<div><div>A) Provide proof supporting your ideas.</div><div>B) Explain the relevant methodologies and techniques as well as their appropriate application in your field.</div><div>C) Develop your critical abilities in regard to the approaches, methods and systems used.</div><div>D) Pursue the leads that flow from the synthesis of information, data and ideas.</div><div>E) Apply a problem-solving method that can extend to the use of relevant research methods for solving precise problems.</div><div>F) Manage your stress.</div><div>G) Be open to criticism.</div></div>	INTERNAL	<div><div>A) Know about recent advances related to your research question and project.</div><div>B) Explain your research methodology and relevant techniques as well as their appropriate application for your research project.</div><div>C) Identify the basic knowledge elements, key concepts and issues.</div><div>D) Identify the links between your research work and previous studies.</div><div>E) Identify the core themes of your research project.</div><div>F) Manage your stress.</div><div>G) Be open to criticism.</div></div>	INTERNAL	<div><div>A) Demonstrate in-depth knowledge and remain up-to-date about recent developments in your field of research and related areas.</div><div>B) Recognize the existence of different interpretations of knowledge and schools of thought, including their research methods.</div><div>C) Generate new ideas by using your creativity and capacity for innovation.</div><div>D) Implement a problem-solving method.</div><div>E) Demonstrate open-mindedness and take opportunities for interdisciplinarity.</div><div>F) Demonstrate tenacity, perseverance and resilience.</div><div>G) Manage your stress.</div><div>H) Be open to criticism.</div><div>I) Provide constructive criticism.</div></div>
EXTERNAL		EXTERNAL	<div><div>H) Seek the necessary information using current tools and techniques.</div><div>I) Identify and access appropriate bibliographical resources or other relevant information sources and archive them.</div><div>J) Manage your time effectively.</div><div>K) Ask for expert advice, whether from information and data managers, archivists or librarians.</div></div>	EXTERNAL	<div><div>H) Identify and apply the steps of the methodology under the supervision of your research supervisor.</div><div>I) Manage your time effectively.</div><div>J) Be open to and take the advice of people who are competent in the field, and solicit their help as needed.</div></div>	EXTERNAL	<div><div>J) Identify the links between your research work and the relevant literature.</div><div>K) Put validation processes into place for your research results.</div><div>L) Manage your time effectively.</div><div>M) Take the advice and support of peers, your supervisor, or more advanced researchers, and solicit their help as needed.</div><div>N) Take into account the international and non-academic aspects of knowledge creation.</div></div>

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<b>1 Enhance or attain advanced knowledge in one’s field and be able to call upon such knowledge in diverse professional settings.</b>	<ol style="list-style-type: none"><li>1. Know about recent advances in your field or discipline.</li><li>2. Identify the key knowledge elements and concepts and basic issues in your field or area of activity.</li><li>3. Analyze and make informed judgements on the scientific knowledge with a view to making use of it.</li></ol>	<b>2 Enhance or attain advanced knowledge in one’s field as a means to increase performance in one’s professional environment<sup>1</sup>.</b>	<ol style="list-style-type: none"><li>1. Know about recent advances in your field or discipline.</li><li>2. Identify the key knowledge elements and concepts and basic issues in your field or area of activity.</li><li>3. Analyze and make informed judgements on the scientific activity and knowledge produced with a view to making use of it.</li></ol>	<b>2 Identify, manage and analyze information and resource materials relevant to a research project.</b>	<ol style="list-style-type: none"><li>1. Use information acquisition and collection systems that employ information technologies to carry out documentary research.</li><li>2. Identify and access appropriate bibliographic resources or other pertinent information sources and archive them.</li><li>3. Verify the reliability and relevance of sources.</li></ol>	<b>2 Identify, manage and analyze information and resource materials relevant to one’s field of research.</b>	<ol style="list-style-type: none"><li>1. Use information acquisition and collection systems and surveillance systems that employ information technologies to carry out exhaustive documentary research.</li><li>2. Identify and access appropriate bibliographic resources as well as all other pertinent information sources and archive them.</li><li>3. Evaluate the reliability, reputation and relevance of sources.</li></ol>
Resources to mobilize		Resources to mobilize		Resources to mobilize		Resources to mobilize	
INTERNAL	A) Discover a field of application or theoretical or practical knowledge.	INTERNAL	A) Discover a field of application or theoretical or practical knowledge.	INTERNAL	A) Provide proof to support your ideas.	INTERNAL	A) Provide proof to support your ideas.
	B) Consolidate your knowledge and skills.		B) Consolidate your knowledge and skills.		B) Recognize the quality and authenticity of primary and secondary information and research data.		B) Evaluate the quality and authenticity of primary and secondary information and research data.
	C) Develop a high level of technical competency in one or more engineering specialties.		C) Develop a high level of technical competency in one or more engineering specialties.		C) Pursue the leads that flow from the synthesis of information, data and ideas.		C) Pursue the leads that flow from the synthesis of information, data and ideas.
EXTERNAL	D) Be open to and take the advice of people who are competent in the field, or solicit their help as needed.	EXTERNAL	D) Be open to and take the advice of people who are competent in the field, or solicit their help as needed.	EXTERNAL	D) Be intellectually astute.	EXTERNAL	D) Be intellectually astute.
					E) Become aware of the information and data security and longevity.		E) Become aware of the information and data security and longevity.
					F) Seek the necessary information using current tools and techniques.		F) Use the available research and information management tools.
					G) Ask for expert advice, whether from information and data managers, archivists or librarians.		G) Ask for expert advice, whether from information and data managers, archivists or librarians.
							H) Ask the advice of competent people and experts.

<sup>1</sup> The field of activity may be the industrial, research, public, parapublic or academic milieu.

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<b>2</b> Clearly communicate, across a wide range of professional situations, advanced knowledge in one’s field or discipline.	1. Demonstrate knowledge and mastery of the language pertinent to your field, including technical language, by writing technical reports and giving high-quality oral reports as needed.	<b>3</b> Clearly communicate the results of a study, bring about developments or create professional applications in one’s field.	1. Demonstrate knowledge and mastery of the language pertinent to your field, including technical language. 2. Write a technical report for specialists in a style tailored to the objective and context. 3. Prepare and give high-quality oral presentations and adapt your manner of speaking to the situation.	<b>3</b> Clearly communicate the results of scientific research.	1. Demonstrate knowledge and mastery of the language pertinent to your field, including technical language. 2. Present the specific objectives and the methodological aspects of your research project and justify them. 3. Discuss the results of your research project; formulate conclusions and recommendations. 4. Write a master’s thesis using scientific style. 5. Prepare and give high-quality oral science presentations and adapt your manner of speaking to the situation.	<b>3</b> Clearly communicate, across a wide range of situations, findings from scientific research or knowledge on one’s subject area.	1. Demonstrate in-depth knowledge and solid mastery of the language pertinent to your research field, including technical language. 2. Write a well-structured and well-argued research proposal, highlighting its originality and implications. 3. Discuss the results of your research project; formulate conclusions and recommendations; describe the actual or potential implications of such research. 4. Constructively defend your body of work as related to a research project. 5. Publish and use the research results, including a doctoral dissertation written using scientific style. 6. Communicate orally and in writing in a style tailored to the objective and context, for specialists and non-specialists.
	Resources to mobilize		Resources to mobilize		Resources to mobilize		Resources to mobilize
INTERNAL	A) Demonstrate the ability to understand, interpret and communicate in an appropriate manner in an academic and professional context. B) Choose the elements that should be part of a written paper and oral presentation. C) Structure your arguments in a clear and concise manner.	INTERNAL	A) Demonstrate the ability to understand, interpret and communicate in an appropriate manner in an academic and professional context. B) Demonstrate your ability to write a summary that outlines the problem, the methodological approaches and the results obtained. C) Choose the elements that should be part of a written paper and oral presentation. D) Structure your arguments in a clear and concise manner.	INTERNAL	A) Demonstrate the ability to understand, interpret and communicate in an appropriate manner in an academic and professional context. B) Demonstrate your ability to write a summary concerning the objectives and methodological aspects of your research project. C) Choose the elements that should be part of a written paper and oral presentation. D) Structure your arguments in a clear and concise manner.	INTERNAL	A) Demonstrate the ability to understand, interpret and communicate in an appropriate manner in an academic and professional context. B) Demonstrate your ability to write a summary concerning the objectives and methodological aspects of your research project. C) Choose the elements that should be part of a written paper and oral presentation. D) Structure your arguments in a clear and concise manner. E) Employ autonomous critical thinking.
	D) Engage in knowledge exchange with colleagues. E) Employ a range of communication methods, using interactive technologies or textual and visual media. F) Effectively use audiovisual tools.		E) Engage in knowledge exchange and debates with colleagues. F) Employ a range of communication methods, using interactive technologies or textual and visual media. G) Effectively use audiovisual tools. H) Collaborate for the purpose of seeking solutions and maximizing your impact potential.		E) Engage in knowledge exchange and debates with colleagues. F) Employ a range of communication methods, using interactive technologies or textual and visual media. G) Effectively use audiovisual tools. H) Collaborate for the purpose of seeking solutions and maximizing your impact potential.		F) Engage in knowledge exchange and debates with colleagues. G) Employ a range of communication methods, using interactive technologies or textual and visual media. H) Effectively use audiovisual tools. I) Collaborate for the purpose of seeking solutions and maximizing your impact potential.
EXTERNAL		EXTERNAL		EXTERNAL		EXTERNAL	

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Competencies	Competency elements	Competencies	Competency elements	Competencies	Competency elements	Competencies	Competency elements
<b>3</b> Respect standards, rules of ethics and fairness, as well as best practices in one’s field or discipline.	<ol style="list-style-type: none"><li>1. Know and respect the applicable codes of ethics, deontology and conduct.</li><li>2. Act responsibly and with integrity, particularly in regard to health and safety, while taking into account the factors that have potential impacts on society and the environment.</li><li>3. As needed, respect the rules of probity, confidentiality, anonymity and intellectual property, including copyright and patents.</li></ol>	<b>4</b> Respect standards, rules of ethics and fairness, as well as best practices in relation to one’s work.	<ol style="list-style-type: none"><li>1. Situate the impact and implications of your work on society and on the environment.</li><li>2. Know and respect the applicable codes of ethics, deontology and conduct.</li><li>3. Act responsibly and with integrity in your workplace.</li><li>4. Demonstrate responsible work practices, particularly in regard to health and safety.</li><li>5. As needed, respect the rules of probity, confidentiality, anonymity and intellectual property, including copyright and patents.</li></ol>	<b>4</b> Respect standards, rules of ethics and fairness, as well as best practices for research.	<ol style="list-style-type: none"><li>1. Situate the impact and implications of your research work on society and on the environment.</li><li>2. Know and respect the applicable codes of conduct and the directives regarding ethical and legal aspects.</li><li>3. Act responsibly and with integrity in carrying out your research project.</li><li>4. Demonstrate responsible work practices, particularly in regard to health and safety.</li><li>5. Respect the rules of probity, confidentiality, anonymity and intellectual property, including copyright and patents.</li></ol>	<b>4</b> Respect standards, rules of ethics and fairness, as well as best practices for research.	<ol style="list-style-type: none"><li>1. Analyze and situate the impact and implications of your research work on society and on the environment.</li><li>2. Know and respect the applicable codes of conduct and the directives regarding ethical and legal aspects of your research.</li><li>3. Act responsibly and with integrity in carrying out your research project.</li><li>4. Demonstrate responsible work practices, particularly in regard to health and safety.</li><li>5. Respect the rules of probity, confidentiality, anonymity and intellectual property, including copyright and patents.</li><li>6. Integrate the innovation process into your research approach.</li></ol>
	Resources to mobilize		Resources to mobilize		Resources to mobilize		Resources to mobilize
INTERNAL	<div>A) Practice self-reflection.</div> <div>B) Demonstrate autonomy.</div> <div>C) Consider the needs of others.</div> <div>D) Take sustainable development into account in your work.</div> <div>E) Demonstrate critical thinking.</div> <div>F) Respect others’ rights.</div>	INTERNAL	<div>A) Practice self-reflection.</div> <div>B) Demonstrate autonomy.</div> <div>C) Consider the needs of others.</div> <div>D) Take sustainable development into account in your work.</div> <div>E) Demonstrate critical thinking.</div> <div>F) Respect others’ rights and consider the other people who may be affected.</div>	INTERNAL	<div>A) Practice self-reflection.</div> <div>B) Demonstrate autonomy.</div> <div>C) Consider the needs of others.</div> <div>D) Take sustainable development into account in your work.</div> <div>E) Recognize the contributions of co-authors in an equitable manner.</div> <div>F) Respect the rights of other researchers, research subjects and other people who may be affected by the research.</div>	INTERNAL	<div>A) Practice self-reflection.</div> <div>B) Demonstrate autonomy.</div> <div>C) Consider the needs of others.</div> <div>D) Take sustainable development into account in your work.</div> <div>E) Recognize the contributions of co-authors in an equitable manner.</div> <div>F) Respect the rights of other researchers, research subjects and other people who may be affected by the research.</div>
	<div>G) Call upon outside help as needed.</div> <div>H) Make effective use of the available resources.</div>		<div>G) Consult your supervisor or collaborators.</div> <div>H) Call upon outside help as needed.</div> <div>I) Adopt an approach that makes it possible to obtain advice, and recognize the risks related to changes.</div> <div>J) Make effective use of the available resources.</div>		<div>G) Consult your supervisor or collaborators.</div> <div>H) Call upon outside help as needed.</div> <div>I) Adopt an approach that makes it possible to obtain advice, and recognize the risks related to changes.</div> <div>J) Make effective use of the available resources.</div>		<div>G) Consult your supervisor or collaborators.</div> <div>H) Call upon outside help as needed.</div> <div>I) Adopt an approach that makes it possible to obtain advice, and recognize the risks related to changes.</div> <div>J) Make effective use of the available resources.</div> <div>K) Know and follow the rules, codes, norms and standards in a context of national and international collaboration.</div>
EXTERNAL		EXTERNAL		EXTERNAL		EXTERNAL	

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<b>4</b> Commit to a process of lifelong learning and improvement.	<ol style="list-style-type: none"><li>1. Recognize the value and limits if your competencies and experience.</li><li>2. Be aware that it’s necessary to update your knowledge and skills to develop your expertise and maintain your employability.</li><li>3. Establish your career plan while considering various employment sectors.</li></ol>	<b>5</b> Commit to a process of lifelong learning and improvement.	<ol style="list-style-type: none"><li>1. Recognize the value and limits if your competencies and experience.</li><li>2. Be aware that it’s necessary to update your knowledge and skills to develop your expertise and maintain your employability.</li><li>3. Initiate the creation of your professional network, or extend it.</li><li>4. Establish your career plan while considering various employment sectors.</li></ol>	<b>5</b> Commit to a process of lifelong learning and improvement.	<ol style="list-style-type: none"><li>1. Recognize the value and limits if your competencies and experience.</li><li>2. Be aware that it’s necessary to update your knowledge and skills to develop your expertise and maintain your employability.</li><li>3. Initiate the creation of your professional network.</li><li>4. Establish your career plan while considering various employment sectors.</li></ol>	<b>5</b> Commit to a process of lifelong learning and improvement.	<ol style="list-style-type: none"><li>1. Recognize the value and limits if your competencies and experience.</li><li>2. Update your knowledge and skills to maintain and develop your expertise.</li><li>3. Develop and consolidate your professional research network.</li><li>4. Establish your career plan while considering various employment sectors.</li></ol>
	Resources to mobilize		Resources to mobilize		Resources to mobilize		Resources to mobilize
INTERNAL	A) Demonstrate the desire and ability to learn and acquire knowledge.	INTERNAL	A) Demonstrate the desire and ability to learn and acquire knowledge.	INTERNAL	A) Demonstrate the desire and ability to learn and acquire knowledge.	INTERNAL	A) Demonstrate the desire and ability to learn and acquire knowledge.
	B) Invest time in reflecting on your practice.		B) Invest time in reflecting on your research practice, the experience you have acquired, and the progress you have made; document and report on this reflection.		B) Invest time in reflecting on your research practice, the experience you have acquired, and the progress you have made; document and report on this reflection.		B) Recognize the transferability of your knowledge and experience, and share that insight with interested parties.
	C) Make the most of your strengths and improve your weak points.		C) Make the most of your strengths and improve your weak points.		C) Make the most of your strengths and improve your weak points.		C) Invest time in reflecting on your research practice, the experience you have acquired, and the progress you have made; document and report on this reflection.
	D) Demonstrate flexibility and open-mindedness, including with regard to the international.		D) Demonstrate flexibility and open-mindedness, including with regard to the international.		D) Demonstrate flexibility and open-mindedness, including with regard to the international.		D) Make the most of your strengths and improve your weak points.
	E) Be aware of the challenges inherent in achieving work-life balance.		E) Be aware of the challenges inherent in achieving work-life balance.		E) Be aware of the challenges inherent in achieving work-life balance.		E) Demonstrate flexibility and open-mindedness, including with regard to the international.
EXTERNAL	F) Identify the job and professional development opportunities within and outside universities.	EXTERNAL	F) Identify the job and professional development opportunities within and outside universities.	EXTERNAL	F) Identify the job and professional development opportunities within and outside universities.	EXTERNAL	G) Identify the job and professional development opportunities within and outside universities.
	G) Seek others’ advice.		G) Seek others’ advice.		G) Seek others’ advice.		H) Seek others’ advice.
	H) Use support and advising resources to avoid excessive stress and to improve your well-being.		H) Use support and advising resources to avoid excessive stress and to improve your well-being.		H) Use support and advising resources to avoid excessive stress and to improve your well-being.		I) Use support and advising resources to avoid excessive stress and to improve your well-being.
			I) Get involved with scholarly societies and public organizations.		I) Get involved with scholarly societies and public organizations.		J) Get involved with scholarly societies and public organizations.