McMaster University

UNIVERSITY SECRETARIAT
- Board of Governors
- Senate

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February 21, 2018

TO: Members of Undergraduate Council

FROM: Tamara Bates
Governance Advisor and Assistant University Secretary

RE: **Notice of Meeting**

The next meeting of Undergraduate Council will be held on **Tuesday, February 27, 2018 at 2:30 p.m., in the Council Room, Gilmour Hall (GH 111)**. The items of business to be discussed are outlined on the agenda provided with this meeting notice.

Should you be unable to attend the meeting, please notify the University Secretariat at extension 24337 or e-mail univsec@mcmaster.ca

McMaster University
UNDERGRADUATE COUNCIL

Tuesday, February 27, 2018 at 2:30 p.m.
in the Council Room (GH 111)

AGENDA

I MINUTES of the meeting of November 14, 2017, December 5, 2017 (forthcoming) and January 30, 2018 (attached– for approval)

II BUSINESS ARISING

III CHAIR'S REMARKS

IV REPORT FROM THE CERTIFICATES AND DIPLOMAS COMMITTEE (attached – for approval/information)

For Approval

i. Establishment of New Certificate and Diploma Programs
   a. Concurrent Certificate in the Language of Medicine and Health
   b. Concurrent Ethics and Policy for Technological Innovation Certificate

ii. Revisions to Existing Certificate and Diploma Programs
   a. Concurrent Certificate in Applied Social Sciences Research

iii. New Certificate of Completion Programs
   a. Industry 4.0 Certificate of Completion
   b. Operations Leadership and Management Certificate of Completion

For Information

iv. New Certificate of Attendance Programs
   a. The Art of Seeing: Perception and Resilience through Visual Art Certificate of Attendance

V REPORT FROM THE CURRICULUM AND ADMISSIONS COMMITTEE (attached – for approval)

i. Addenda to Curriculum Revisions for the 2018-2019 Undergraduate Calendar
   a. Faculty of Social Sciences
   b. Faculty of Humanities
   c. Faculty of Business

VI OTHER BUSINESS

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REPORT TO UNDERGRADUATE COUNCIL FROM THE UNDERGRADUATE COUNCIL CERTIFICATES AND DIPLOMAS COMMITTEE

FOR APPROVAL

I Establishment of New Certificate Programs (Attachment I)

i. Concurrent Certificate in the Language of Medicine and Health

At its meeting of February 6, 2018 and by e-mail vote conducted on February 12-15, 2018, the Certificate and Diplomas Committee approved, for recommendation to Undergraduate Council, a proposal for the establishment of a concurrent *Certificate in the Language of Medicine and Health* program. The proposed concurrent certificate will be administered similarly to a minor in that it will be declared upon graduation. The program includes the two Ancient Roots of Medical Terminology courses and language courses in Latin and Greek.

The Undergraduate Council Certificates and Diplomas Committee now recommends

that Undergraduate Council approve, for recommendation to Senate, the establishment of a concurrent *Certificate in the Language of Medicine and Health* program, for inclusion in the *2018-2019 Undergraduate Calendar*, as recommended by the Faculty of Humanities and set out in Attachment I (i).

ii. Concurrent Ethics and Policy for Technological Innovation Certificate

At the same meeting and e-mail vote, the Certificates and Diplomas Committee approved, for recommendation to Undergraduate Council, a proposal to establish a concurrent *Ethics and Policy for Technological Innovation Certificate* program. The proposed concurrent certificate will require a supplementary application process with applications vetted by a review committee, the details of which are still to be determined.

The Undergraduate Council Certificates and Diplomas Committee now recommends

that Undergraduate Council approve, for recommendation to Senate, the establishment of a concurrent *Ethics and Policy for Technological Innovation Certificate* program, for inclusion in the *2018-2019 Undergraduate Calendar*, as recommended by the Faculty of Humanities and set out in Attachment I (ii).

II Revisions to Certificate and Diploma Program (Attachment II)

i. Concurrent Certificate in Applied Social Sciences Research

At its meeting of February 6, 2018 and by e-mail vote conducted on February 12-15, 2018, the Certificates and Diplomas Committee approved, for recommendation to Undergraduate Council, minor revisions to courses required for the concurrent *Certificate in Applied Social Sciences Research* program.

The Certificates and Diplomas Committee now recommends,

that Undergraduate Council approve the proposed revisions to the concurrent *Certificate in Social Sciences Research* program, for inclusion in the *2018-2019 Undergraduate Calendar,* as recommended by the Faculty of Social Sciences and set out in Attachment II.[1]

III Establishment of New Certificate of Completion Programs (Attachment III)

i. Industry 4.0 Certificate of Completion

At its meeting of February 6, 2018 and by e-mail vote conducted on February 12-15, 2018, the Certificates and Diplomas Committee approved, for recommendation to Undergraduate Council, a proposal to establish an Industry 4.0 Certificate of Completion. The proposed program is a professional development program and is targeted toward people already working in industry, particularly in engineering or managers in technical areas. The program focusses on the development of interconnected devices, components and systems, particularly across multiple sectors. The program addresses, for example, digitization of manufacturing, big data and the internet of things.

The Certificate and Diplomas Committee now recommends,

that the Undergraduate Council approve, for recommendation to the University Planning Committee, the establishment of an *Industry 4.0 Certificate of Completion*, as recommended by the Faculty of Engineering and set out in Attachment III (i).

ii. Operations Leadership and Management Certificate of Completion

At its meeting of October 31, 2017, the Certificate and Diplomas Committee approved, for recommendation to Undergraduate Council, the establishment of an *Operations Leadership and Management Certificate of Completion*. The proposed program is targeted at people working in the industry who want to acquire and practice the

[1] Secretary's Note: Following the meeting of the Certificates and Diplomas Committee, the Faculty of Social Sciences approved additional revisions to the courses for the concurrent Certificate in Applied Social Sciences Research, consisting of deleting three Social Work courses, SOCWORK 2A06A/B, SOCWORK 3DD6, and SOCWORK 4DD6, from the course lists. These changes were made at the meeting of the Curriculum and Admissions Committee when the original revisions were introduced for inclusion in the *2018-2019 Undergraduate Calendar* and will be reported back to the Certificates and Diplomas Committee at its next meeting.

professional, ethical, and technical behaviors and competencies required to lead and manage high performance teams.

The Certificate and Diplomas Committee now recommends,

that the Undergraduate Council approve, for recommendation to the University Planning Committee, the establishment of an *Operations Leadership and Management Certificate of Completion*, as recommended by the Faculty of Engineering and set out in Attachment III (ii).

FOR INFORMATION

IV New Certificate of Attendance Program (Attachment IV)

i. The Art of Seeing: Perception and Resilience through Visual Art Certificate of Attendance

At its meeting of February 6, 2018, the Certificates and Diplomas Committee reviewed information about a new *The Art of Seeing: Perception and Resilience through Visual Art Certificate of Attendance* program offered by the Centre for Continuing Education. Details of the program are set out in Attachment IV.

Undergraduate Council
February 27, 2018

FACULTY OF HUMANITIES

REPORT TO UNDERGRADUATE COUNCIL

PROPOSED CONCURRENT CERTIFICATES FOR THE 2018-19 UNDERGRADUATE CALENDAR

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Summary of Changes

1. **Department of Classics**
   - **Proposed Concurrent Certificate in the Language of Medicine and Health**

2. **Department of Philosophy**
   - **Proposed Concurrent Ethics and Policy for Technological Innovation Certificate (EPTIC)**

FACULTY OF HUMANITIES

PROPOSAL FOR A CONCURRENT CERTIFICATE IN THE LANGUAGE OF MEDICINE AND HEALTH

1 Certificate Overview

The concurrent Certificate in *The Language of Medicine and Health* will recognize the course work completed and the skills mastered by students who have taken *The Ancient Roots of Medical Terminology* (CLASSICS 2MT3), *Advanced Roots of Medical Terminology* (CLASSICS 3MT3), a selection of courses in Latin and Greek (which provide the etymological source of almost all medical words as well as the grammatical basis of the Latin anatomical naming systems found in the *Nomina Anatomica* and *Terminologia Anatomica*), and (potentially) courses in Linguistics and English that provide important backgrounds and contexts.

The proposed Certificate provides students with formal recognition of competency in the etymology, word-formation, and logic of medical terminology.

2 Academic Merit

2.1 Learning Outcomes

Upon completion of the concurrent Certificate in the Language of Medicine and Health, students

- will have acquired mastery of the etymology of the technical terminology of medicine and science and be able to interpret the entire corpus of anatomical Latin phraseology
- will have developed receptive linguistic skills in this technical terminology (listening, reading, comprehension)
- will have acquired productive linguistic skills by which they can produce technical terms as needed
- depending on course selection, maybe have acquired backgrounds and contexts for modern understandings of health

2.2 Certificate Requirements

Any student in an undergraduate degree program at McMaster may declare the certificate, at the time of graduation, and upon completion of the following courses

Requirements (15 units).

6 units:

CLASSICS 2MT3 - Ancient Roots of Medical Terminology

CLASSICS 3MT3 - Advanced Ancient Roots of Medical Terminology

6 units:

LATIN 1Z03 - Beginner's Intensive Latin I

LATIN 1ZZ3 - Beginner's Intensive Latin II

GREEK 1Z03 - Beginner's Intensive Ancient Greek I

GREEK 1ZZ3 - Beginner's Intensive Ancient Greek II

3 units:

LATIN 1Z03 - Beginner's Intensive Latin I

LATIN 1ZZ3 - Beginner's Intensive Latin II

GREEK 1Z03 - Beginner's Intensive Ancient Greek I

GREEK 1ZZ3 - Beginner's Intensive Ancient Greek II

LATIN 2A03 - Intermediate Latin I

GREEK 2A03 - Intermediate Greek I

LINGUIST 1A03 - Introduction to Linguistics I

LINGUIST 3F03 - Anatomy and Physiology of Speech and Hearing

ENGLISH 2NH3 - Narratives of Health

Any student seeking a Classics programme may satisfy no more than 2 courses (six units) of the Classics programme’s requirements with courses that the student counts toward the satisfaction of the Certificate’s requirements.

Any student wishing to declare a Minor in Classics, Latin, or Greek may satisfy no more than 2 courses (six units) of the Minor’s requirements.

Students who have Grade 12 Latin or Greek and are therefore not eligible to take Beginner’s Intensive Latin or Greek can substitute the Intermediate Latin or Greek.

3 Statement of Academic Responsibility

The Department of Classics and the Faculty of Humanities will oversee the administration of the concurrent Certificate in *The Language of Medicine and Health*. The Department of Classics will review, evaluate and approve any non-McMaster courses to serve as equivalents, as is currently the practice.

Faculty of Humanities
Proposal for an Ethics and Policy for Technological Innovation Certificate

1. Certificate Overview

The Ethics and Policy for Technological Innovation Certificate (the Certificate) is designed to prepare undergraduate students from health science, engineering, business, humanities, science, and social sciences to work together on teams to identify and resolve the ethical, institutional, and policy challenges posed by novel technologies that are highly promising but also potentially socially disruptive. The Certificate will recognize students for having gained core subject matter competencies and experience that significantly enhance their ability to work together and communicate effectively as members of such interdisciplinary research teams. The Certificate comprises 15 units (5 courses total). Four of the courses (12 units) in this sequence of courses will prepare the student for the certificate's culminating fifth course (3 units), a 4th year seminar (PHILOS 4V03) in which students will work together on interdisciplinary teams under the direction of faculty and staff associated with the McMaster University Institute for Ethics and Policy Innovation (IEPI).

2. Academic Merit

2.1. Learning Outcomes

The sequence of courses required by this certificate will:

(a) Provide students with a grounding in ethical, moral and political philosophy necessary to work collaboratively on teams to identify and resolve the ethical, institutional, and policy challenges posed by novel technologies that are highly promising but also potentially disruptive.

(b) Provide students with experience working collaboratively on interdisciplinary teams of the sort described in (a), thereby enhancing and consolidating the background philosophical knowledge requisite to such collaborative work.

(c) Provide students with experience working collaboratively on interdisciplinary teams of the sort described in (a), thereby enhancing and consolidating the students' ability to communicate and work effectively with others on interdisciplinary teams in an organized and inclusive fashion.

2.2. Certificate Requirements

Any student in an undergraduate program at McMaster may declare the certificate at the time of graduation and **ONLY** upon satisfaction of each of the following requirements:

1.) The student must be accepted by the Ethics and Policy for Technological Innovation Certificate Committee (the EPTIC Selection Committee).
2.) The student must complete 15 units in accordance with the following schedule:
    a. 3 units: Intro to Bioethics (PHILOS 2D03);
    b. 3 units: History of Political Philosophy (PHILOS 2S03) or Social and Political Philosophy (PHILOS 2G03);
    c. 3 units: Business Ethics (PHILOS 2N03), Communication Ethics (PHILOS 2TT3), or Intro to Ethics (PHILOS 2YY3);
    d. 3 units: Advanced Bioethics (PHILOS 3C03), Advanced Ethics (PHILOS 3CC3), Feminist Philosophy (PHILOS 3I03), Environmental Ethics (PHILOS 3L03), Philosophy of Law (PHILOS 3Q03), or Political Philosophy (PHILOS 3N03), and;
    e. 3 units: (PHILOS 4VO3): Multidisciplinary Workshop in the Ethics and Policy of Technological Innovation

2.3. The EPTIC Selection Committee Requirements

The EPTIC Selection Committee will consider supplemental applications soon after the end of Winter term of each academic year, but only from students who are enrolled in an undergraduate program at McMaster University and who have completed PHILOS 2D03 and either (or both) PHILOS 2S03 or PHILOS 2G03. The EPTIC Selection Committee's selections will be made on the basis of the student's cumulative grades and answers to the supplemental application questions. Because enrollment in the capstone PHILOS 4V03 is limited to 25 students per academic year, the Selection Committee will enroll no more than approximately 20 to 25 students to the Certificate program each academic year.

Students accepted and enrolled in the Justice, Political Philosophy, and Law Honours BA Program are not eligible to apply for the Certificate.

Any student seeking a Philosophy Honours BA may satisfy no more than 2 courses (6 units) of the Philosophy Honours BA Program requirements with courses that the student has also designated as counting toward the satisfaction of the Certificate's requirements.

Students who declare the certificate are precluded from declaring a philosophy minor.

Transfer credits will not be accepted in lieu of PHILOS 4V03. Students accepted into the certificate program are free to request transfer credit in lieu of any other

certificate course requirement. The student may submit such a request to the Selection Committee (via philadm@mcmaster.ca) at any time.

Note that selection by the selection committee is distinct from the successful declaration of the certificate, and a student's selection does not imply that the candidate has satisfied all certificate requirements. It is the student's responsibility to make sure that at the time of graduation, all requirements of the certificate as enumerated above have been fulfilled.

3. Resources

3.1. Multidisciplinary Workshop in the Ethics and Policy of Technological Innovation (PHILOS 4V03)

The department will introduce one new course in service of the Certificate. The course will be a 4th year seminar capped at 25 students. In this course, teams comprising undergraduate students from health science, engineering, business, humanities, science, and social science will work together in order to identify and generate proposed solutions to the ethical, institutional, and policy challenges posed by novel technologies that are highly promising but also potentially socially disruptive.

3.2. Faculty Resources

The main resource constraint is the one novel course under the certificate: PHILOS 4V03 Multidisciplinary Workshop in the Ethics and Policy of Technological Innovation, a 4th year seminar that will be capped at 25 students. This course will be provided by faculty that works closely with the Institute on Ethics and Policy for Innovation (IEPI). IEPI-associated faculty will teach this course pursuant to IEPI's undergraduate pedagogical mission. At the present time, there are sufficient resources to accommodate one 25-student capstone course per academic year.

Proposal for Concurrent Certificate

Faculty of Social Sciences

Proposal for a Concurrent Certificate in Applied Social Sciences Research

1.0 Certificate Overview

15-18 units

1.1 Context

Canadian employers increasingly prioritize hiring employees with a range of soft skills, rather than industry-specific or functional knowledge. These skills include working well with others, written and organized communication, problem solving, and analytical skills. Despite evidence that in the medium-term that earnings of social science graduates mostly catch up with those in STEM fields, enrolments in the social sciences have grown more slowly than those in STEM fields. The rapid growth of post-graduate diplomas and certificates at Ontario colleges also reflects an interest among university graduates for hands-on experience, training, and credentialing in specific skills, including many of the research methodologies already offered as part of social science undergraduate degrees. This proposed concurrent certificate aims to provide opportunities for interested students to acquire broader exposure and competencies in applied research methods to meet the needs of the labour market and student interests. It also provides a way to reflect these types of skill development within the structure of a certificate.

2.0 Academic Merit

As outlined below, the certificate helps students develop the key competencies for career development, regardless of whether or not they are seeking employment immediately upon graduation.

2.1 Learning Outcomes

Upon completion of the Certificate in Applied Social Sciences Research, students will have had the opportunity to achieve a deeper understanding of the following competencies, along with ability to apply them in practice:

- Identify and define appropriate methods for studying a wide range of topics;
- Define and operationalize concepts;
- Statistical/quantitative data analysis (including the use of software);
- Qualitative data analysis (including the use of software);
- Create original surveys/questionnaires;
- Identify, gather and clean (original and secondary) data;
- Presentation of research findings.

2.2 Certificate Requirements

Any McMaster student in an undergraduate degree program in the Faculty of Social Sciences or in a Combined Honours degree program with a Social Sciences subject may declare the certificate, at the time of graduation, and upon completion of the following courses. Non-McMaster credit may not be utilized in fulfilment of certificate requirements.

Students are advised to consult with the Undergraduate Chair or Academic Advisor for their program of study in Social Sciences to ensure individual courses (such as their project plan for an Independent Study course) meet the criteria of a research course.

Requirements (15-18 units)

3 units **Foundations Course in Research Methods in the Social Sciences**

SOCSCI 1RM3 HOW DO WE KNOW?: DOING SOCIAL SCIENCES RESEARCH *(See description below)*

6-9 units **Research Methods and/or Analysis courses**

ANTHROP 3IS3	Independent Study in Anthropology
ANTHROP 3K03	Archaeological Interpretation
ANTHROP 3P03	Doing Ethnography: Theory and Research Methods
ECON 2B03	Analysis of Economic Data
ECON 3E03	Applied Econometrics (*formerly ECON 3WW3*)
ECON 4F03	Methods of Inquiry in Economics (*formerly ECON 3F03*)
ECON 4FF3	Research Methods in Economics (*formerly ECON 3FF3)*
ECON 4G03	Econometrics II
GEOG 2GI3	Geographic Information Systems
GEOG 3MA3	Research Methods in Human Geography
GEOG 3MB3	Statistical Methods
GEOG 4GA3	Applied Statistical Analysis
HLTHAGE 2A03	Research Methods in Health and Aging I
HLTHAGE 3B03	Advanced Research Inquiry
HLTHAGE 3G03	Community Based Research
HLTHAGE 3I03	Independent Study in Health, Aging and Society
HLTHAGE 3G03	Community Based Research
HLTHAGE 3G03	Community Based Research
INDIGST 2M03	Indigenous Research Methods and Ethics
INDIGST 2MM3	Indigenous Ways of Knowing: Theory
LABRST 3H03	Research Methods
LABRST 3J03	Independent Study
POLSCI 2NN3	Politics by Design
POLSCI 3NN3	Statistical Analysis of Primary Data
POL SCI 4SS3	Public Opinion and Policy
PNB 2XE3	Descriptive Statistics
PNB 3XE3	Inferential Statistics
PNB 3RM3	Research Methods Lab
PSYCH 3MT3	Psychometrics
PSYCH 4KK3	Bayesian Inference
RELIGST 3F03	Approaches to the Study of Religion

SOCPSY 2K03	Research Methods in Social Psychology
SOCSCI 2J03	Introduction to Statistics
SOCWORK 2A06 A/B	Theory, Process and Communication Skill for Social Work
SOCIOL 2Z03	Introduction to Sociological Research
SOCIOL 3FF3	Introductory Statistics for Sociology
SOCIOL 3W03	Historical Methods in Sociology
SOCIOL 4FF3	Applications of Quantitative Methods in Social Sciences

3-6 units Experiential/Capstone courses

ANTHROP 3CC6	Archaeological Field School
ANTHROP 4D03	Practicing Anthropology: Ethics, Theory, Engagement
ANTHROP 4G03	Independent Research I
ANTHROP 4GG3	Independent Research II
ECON 4A03	Honours Economics Analysis
ECON 4AA3	Honours Economics Specialist Seminar
GEOG 3ME3	Environmental Studies Field Camp
GEOG 3MF3	Human Geography Field Camp
GEOG 3MI3	Geography Internship
GEOG 4MF3	Senior Human Geography Field Camp
GEOG 4MT6 A/B	Senior Thesis
GEOG 4MS3	Independent Study
HLTHAGE 3BB3	Field Experience
HLTHAGE 3EE3	The Practice of Everyday Life: Observations and Inquiry
HLTHAGE 4Z06 A/B	Health, Aging and Society Thesis
INDIGST 4A03	Storytelling and Environmental Conservation
INDIGST 4T06A/B	Honours Thesis
LABRST 4A06 A/B	Research and Field Experience
POLSCI 4Z06 A/B	Honours Essay
POLSCI 4ZZ6 A/B	Experiential Learning in Research
PNB 4D06 A/B	Senior Thesis
PNB 4D09 A/B	Senior Thesis
PNB 4J03	Inquiry in Psychology, Neuroscience & Behaviour
PNB 4Q03 A/B S	Advanced Individual Library Study
PNB 4QQ3 A/B S	Advanced Individual Lab Study
RELIGST 4RP6 A/B	Honours Thesis
SOCPSY 4IS3	Independent Research
SOCPSY 4IS6 A/B	Independent Research
SOCPSY 4ZZ6 A/B	Social Psychology Research Project
SOCSCI 3F03 A/B S	Social Sciences in Action
SOCWORK 3DD6 A/B	Field Practicum I
SOCWORK 4DD6 A/B	Field Practicum II
SOCIOL 4M03	Directed Research I for Honours Students
SOCIOL 4MM6 A/B	Directed Research for Honours Students
SOCIOL 4N03	Directed Research II for Honours Students
SOCIOL 4VV3	Introduction to Post-Graduate Research in Sociology

2.3 Competencies at a glance

The concurrent certificate is intended to recognize students' competencies to integrate social sciences skills and knowledge when performing quantitative or qualitative analyses within their program of study. The coursework will provide the working knowledge required in statistics, principles of experimental design, survey and data analysis techniques, and qualitative methodologies. This may include learning to understand and use some of the statistical and qualitative software packages available. Students will learn how to apply research methods to real social science phenomenon and interpretation of findings. Students are encouraged to complete a research, experiential or capstone project in their program of study.

3.0 Statement of Academic Responsibility

The Associate Dean's Office, Faculty of Social Sciences, will oversee the administration of the concurrent Certificate in Applied Social Sciences Research.

New Courses:

SOCSCI 1RM3 HOW DO WE KNOW?: DOING SOCIAL SCIENCES RESEARCH

This course provides students with a glimpse in at the diversity among the types of research methods used within the social sciences. Students will learn how we study the things we do, such as economic inequality, access to health care, changing patterns of crime, the interplay of religious practice and civil rights, by providing students with basic concepts and language related to conducting research.

Prerequisite: Registration in Social Sciences I and credit or registration in SOCSCI 1SS3; or registration in Level II or above in a program in the Faculty of Social Sciences.

Three hours; one term

Enrollment cap: 100 TBD

Reserve Capacities: SS1 50%; SS2 50%

Justification: This new course is being created as a broad overview course on research methods in the Social Sciences for a new concurrent Certificate in Applied Social Sciences Research. This course is not intended to replace the introductory research methods courses within each program, but rather to demonstrate the diversity of methods used across the Social Sciences.

McMaster University

NEW PROGRAM PROPOSAL

Industry 4.0

Certificate of Completion

(courses + project)

November 10, 2017

TABLE OF CONTENTS

1 PROGRAM

1.1 PROGRAM DESCRIPTION

The proposed ‘certificate of completion’ combines professional development, advanced technical skills and competencies, and understanding of systems integration required for a candidate to be successful in introducing their organization to Industry 4.0 in either the public or private sectors. The candidates are expected to take roles in leading and managing the transformation journey required to make their organization more efficient and competitive in the new digital age.

This Industry 4.0 certificate of completion is the first practical and applied program of its kind in Canada. The audience of the program is intended to be mainly engineers or managers in technical areas in both the principal operations and support functions (engineering, quality, supply chain…) in the manufacturing or service industries across multiple sectors. It is complementary as well to more formal academic program offered at the W Booth School of Engineering Practice and Technology.

Background: Industry 4.0 or the fourth revolution of manufacturing and services

The following report is based on several sources particularly work by McKinsey & Company which highlights key findings for the successful implementation of Industry 4.0.

Few technological innovations have steered as much conversations, ideas, debates, uncertainties and doubts as the digitization of manufacturing or Industry 4.0 has, in the past few years. Full of promises and potentials, the concept still remains largely unclear and complex, which seems largely due to the lack of understanding, training, and willingness from organizations to embrace it. Indeed, according to several worldwide surveys, most major industries and services, still lack understanding , vision, direction and utilization of those tools and techniques, even though most of the technological innovations are known. The situation is even more drastic for SMEs which are simply left out of the revolution.

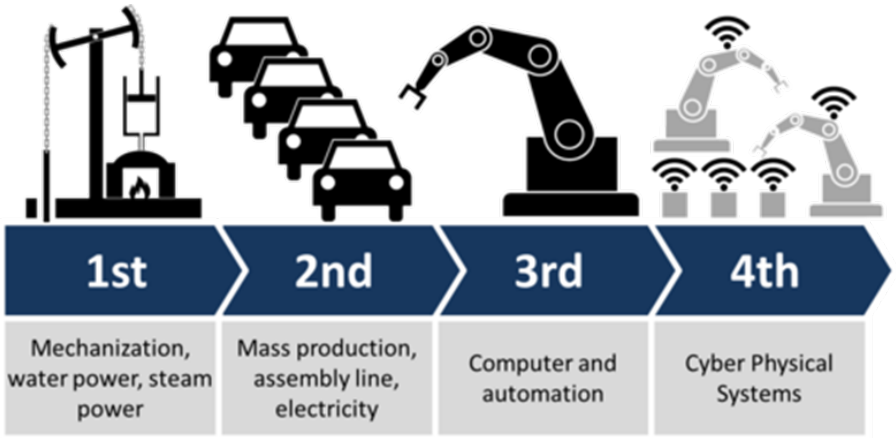

Figure 1: The fourth industrial revolution

The essence of Industry 4.0 is the evolution of industries towards the development of interconnected devices, components and systems (figure 1), and can be summarized as the integration of cyber-physical systems inside and outside an organization. It encompasses not only internal physical and cyber assets such as machinery, equipment, processes, and databases but also the integration of external components such as suppliers, supply chain and customers. Although, initial definitions were targeted at manufacturing industries, it has become more and more apparent that the ramifications of Industry 4.0 principles are spreading across multiple sectors (figure 2).

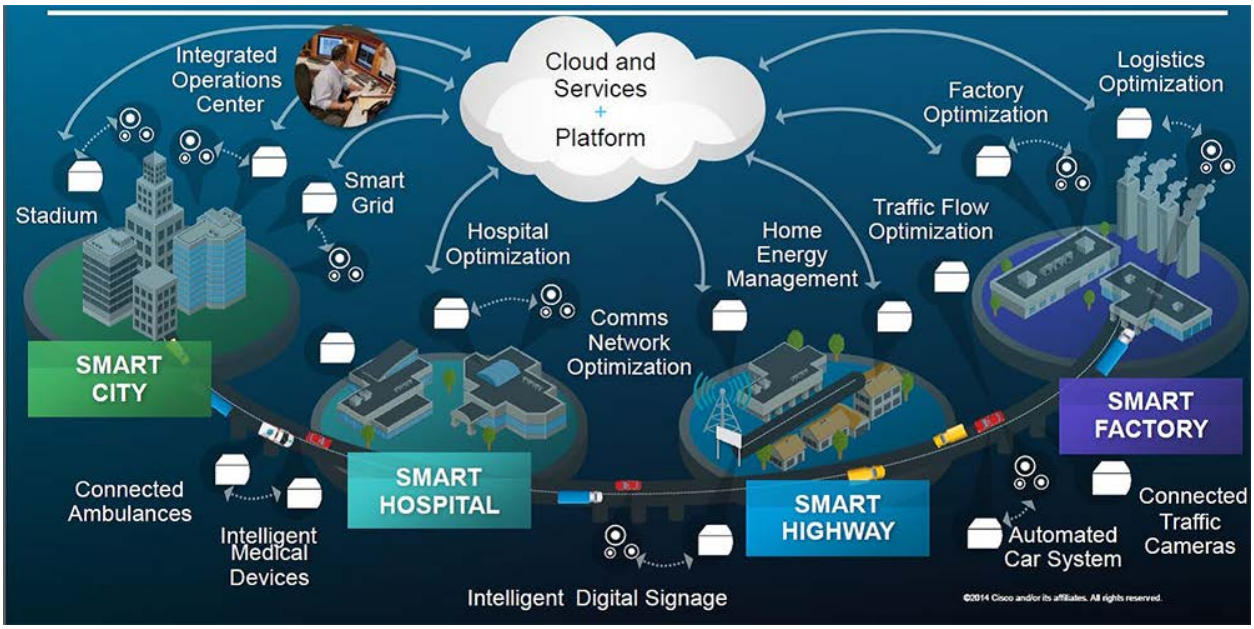

Figure 2: industry 4.0 and interconnectivity across multiple sectors.

Interestingly, manufacturing seems to be lagging behind the service industries mostly due to the fact that the latter is more prone to frequent technological upgrades.

Beyond Industry 4.0 hype: Five core principles for creating value at lean's next level

Based on experience working with clients on digital and Industry 4.0 transformations, they have identified five principles that can help companies successfully convert Industry 4.0 solutions into real value and bottom-line impact. Industry 4.0 is the source of the next horizon of productivity gains

1. As cost pressure across all industries continually increases, companies face the need to improve productivity by two to four percentage points every year. Our estimates, based on numerous studies, show that digitally enabled advancements are unleashing the potential to create value equivalent to efficiency improvements of 15 to 20 percent. This productivity leap will not come from the application of a single solution. To generate meaningful impact, companies will have to address all elements of profit and loss while also applying a broad range of solutions at scale.

   For example, a reduction of total machine downtime by 30 to 50 percent-a feat possible with predictive maintenance or remote monitoring will greatly increase asset utilization. Labour efficiency is another area with high potential. Digital performance management combined with advanced robotics and automated guided vehicles can further automate manual work (for example, in picking and in-plant transportation) and has the potential to improve labour productivity by an additional 40 to 50 percent.

2. Advanced analysis of granular data on machining processes, generated in real time, will be fundamental to identifying and addressing the underlying causes of process inefficiencies and problems with quality—faster and more effectively. Furthermore, forecasting processes that draw heavily on big data already can drastically reduce inventories and improve service levels today.
3. Industry 4.0 is a topic for the business, not just the IT department; IT enables Industry 4.0 but should not drive implementation. Companies tend to start by considering how to apply the new approaches to their IT systems. They should focus instead on how they will conduct their business in the future, thinking through changes from a value-chain and business-case standpoint.

   For example, one global sportswear company is working to bring its shoe manufacturing closer to the customer. This move changes the traditional long cycle of production in low-cost countries and subsequent shipping to stores. As inexpensive, faster, and more flexible robots become available, manufacturing of products such as shoes and clothing can be located near customers even in high-cost locations such as Germany. In short, time to market, delivery time, freight costs, and customer focus (based on personalization) dramatically improve when taking advantage of the new opportunities provided by digitization.

4. Industry 4.0 efforts need to be led by top management—they cannot be delegated. Few companies are taking a structured approach to implementing Industry 4.0 levers. According to McKinsey research, only 16 percent have a clear strategy in place, and only 24 percent have assigned clear responsibilities regarding Industry 4.0 efforts. Even

companies in this select group tend to make one of two missteps: either they assign Industry 4.0 responsibility to a staff function with no direct execution power, or they place the required responsibility far too low in the management hierarchy. In either case, realizing full impact potential is jeopardized.

Ultimately, embarking on the Industry 4.0 journey means taking a risk—and risk taking cannot be delegated. Top management must therefore take ownership and apply a programmatic approach in order to drive value quickly and effectively. This high level of prioritization helps determine the success of an Industry 4.0 transformation, just as it did for lean. Both technology and people are critical, as they were for classic lean approaches Technological solutions, such as those including robots or advanced-analytics algorithms, are easy to access and install; in fact, such tools are already commodities in many situations. However, it takes a combination of technology and the corresponding domain knowledge (in value chains, maintenance, or process modeling, for example) to produce actions that deliver value.

5. What's more, implementing these actions typically requires redesigned work processes and new capabilities, both of which necessitate organizational transformation. Company leaders must lay out a strategy in advance to build or buy the capabilities they will need or to partner with organizations that can provide the capabilities. Industry 4.0 requires transformational and holistic thinking Successful lean transformations do not focus on improving the maintenance process alone but consider the production site as a whole. Work toward Industry 4.0 requires a similarly broad approach. In this case, companies will need to address the entire value chain, apply a full set of levers or solutions, and have a clear plan for scaling up new approaches across their entire network.

In addition, Industry 4.0 is defined as the next phase in the digitization of the manufacturing sector, driven by four disruptions: the astonishing rise in data volumes, computational power, and connectivity, especially new low-power wide-area networks; the emergence of analytics and business-intelligence capabilities; new forms of human-machine interaction such as touch interfaces and augmented-reality systems; and improvements in transferring digital instructions to the physical world, such as advanced robotics and 3-D printing. (The four trends are not the reason for the "4.0," however. Rather, this is the fourth major upheaval in modern manufacturing, following the lean revolution of the 1970s, the outsourcing phenomenon of the 1990s, and the automation that took off in the 2000s.)

Most of these digital technologies have been brewing for some time. Some are not yet ready for application at scale. But many are now at a point where their greater reliability and lower cost are starting to make sense for industrial applications. However, companies are not consistently aware of the emerging technologies. Out of a survey of 300 manufacturing leaders in January 2015; only 48 percent of manufacturers consider themselves ready for Industry 4.0. Seventy-eight percent of suppliers say they are prepared.

Consider an actual example of each disruptive trend:

- Big data. An African gold mine found ways to capture more data from its sensors. New data showed some unsuspected fluctuations in oxygen levels during leaching, a key process. Fixing this increased yield by 3.7 percent, worth up to $20 million annually.
- Advanced analytics. Stronger analysis can dramatically improve product development. One automaker uses data from its online configurator together with purchasing data to identify options that customers are willing to pay a premium for. With this knowledge, it reduced the options on one model to just 13,000—three orders of magnitude fewer than its competitor, which offered 27,000,000. Development time and production costs fell dramatically; most companies can improve gross margin by 30 percent within 24 months.
- Human-machine interfaces. Logistics company Knapp AG developed a picking technology using augmented reality. Pickers wear a headset that presents vital information on a see-through display, helping them locate items more quickly and precisely. And with both hands free, they can build stronger and more efficient pallets, with fragile items safeguarded. An integrated camera captures serial and lot ID numbers for real-time stock tracking. Error rates are down by 40 percent, among many other benefits.
- Digital-to-physical transfer. Local Motors builds cars almost entirely through 3-D printing, with a design crowd sourced from an online community. It can build a new model from scratch in a year, far less than the industry average of six. Vauxhall and GM, among others, still bend a lot of metal, but also use 3-D printing and rapid prototyping to minimize their time to market.

These changes and many others like them are sure to be far reaching, affecting every corner of the factory and the supply chain. The pace of change, however, will likely be slower than what has been seen in the consumer sector, where equipment is changed frequently. The coming of steam power and the rise of robotics resulted in the outright replacement of 80 to 90 percent of industrial equipment. In coming years, it is not expected that such capital investments will happen. Still, the executives surveyed estimate that 40 to 50 percent of today's machines will need upgrading or replacement."

Industry 4.0: what does it mean in practice and how does it look like?

The major challenges which industries will face are however not necessarily technological in nature. Indeed the majority of the innovations have been made and proven. So the question remains, what is hindering industries from developing their infrastructure? Several issues can be advanced:

1. **Training:** In a similar manner to LEAN manufacturing principles, the vision is in essence simple, but the inherent concepts and principles supporting that vision are complex, not fully known yet, and require a culture change from organizations, which means a culture change from the workforce (employees, and management). This implies that organizations need to commit to training and in managing change. Let us recall that the average age of the workforce in manufacturing in Canada is 57 years old. It is

doubtful that this aged workforce will embrace easily the implementation of new technologies they probably do not understand.

2. **Translating the vision into simple actionable tasks:** Figure 3 is an attempt to provide granularity from a conceptual vision of what is Industry 4.0. The challenge will be to develop/design and implement extra layers of granularity. In addition, what works for one company will not necessarily work for another one. As such, organizations will have to practice in safe environments new tools and techniques before they can safely commit to implementing them. This point actually goes back to the first challenge in the sense that it will be more beneficial for organizations to have a workforce with the right knowledge, understanding, mindset and culture rather than a workforce which knows how to use specific tools.

The 'digital compass' helps companies find tools to match their needs.

Figure 3: First steps into making Industry 4.0 real.

3. **Big data:** The age of analytics, competing in a data-driven world

Data and analytics capabilities have made a leap forward in recent years. The volume of available data has grown exponentially, more sophisticated algorithms have been developed, and computational power and storage have steadily improved. The convergence of these trends is fuelling rapid technology advances and business disruptions.

- Most companies are capturing only a fraction of the potential value from data and analytics. A 2011 report estimated this potential in five domains; revisiting them today shows a great deal of value still on the table. The greatest progress has occurred in location-based services and in retail, both areas with digital native competitors. In contrast, manufacturing, the public sector, and health care have captured less than 30% of the potential value highlighted five years ago. Further, new opportunities have arisen since 2011, making the gap between the leaders and laggards even bigger.
- The biggest barriers companies face in extracting value from data and analytics are organizational; many struggle to incorporate data-driven insights into day-to-day business processes. Another challenge is attracting and retaining the right talent; not only data scientists but business translators who combine data savvy with industry and functional expertise.

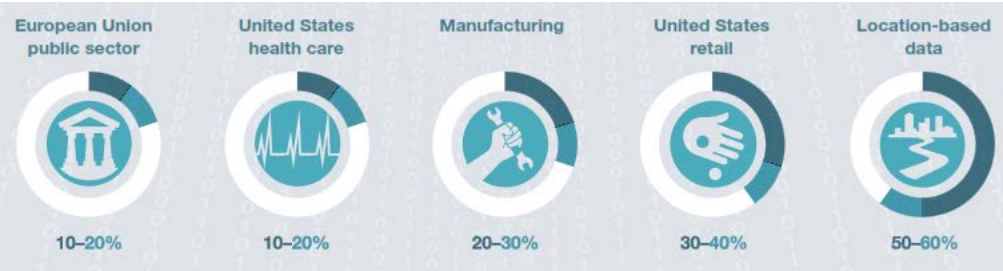

Figure 4: Only a fraction of the value we envisioned in 2011 has been captured to date.

- Data and analytics are changing the basis of competition. Leading companies are using their capabilities not only to improve their core operations but to launch entirely new business models. The network effects of digital platforms are creating a winner-take-most dynamic in some markets.
- Data is now a critical corporate asset. It comes from the web, billions of phones, sensors, payment systems, cameras, and a huge array of other sources, and its value is tied to its ultimate use. While data itself will become increasingly commoditized, value is likely to accrue to the owners of scarce data, to players that aggregate data in unique ways, and especially to providers of valuable analytics.
- Data and analytics underpin several disruptive models. Introducing new types of data sets ("orthogonal data") can disrupt industries, and massive data integration capabilities can break through organizational and technological silos, enabling new insights and models. Hyperscale digital platforms can match buyers and sellers in real time, transforming inefficient markets. Granular data can be used to personalize products and services and, most intriguingly, health care. New analytical techniques can fuel discovery and innovation. Above all, data and analytics can enable faster and more evidence based decision making.

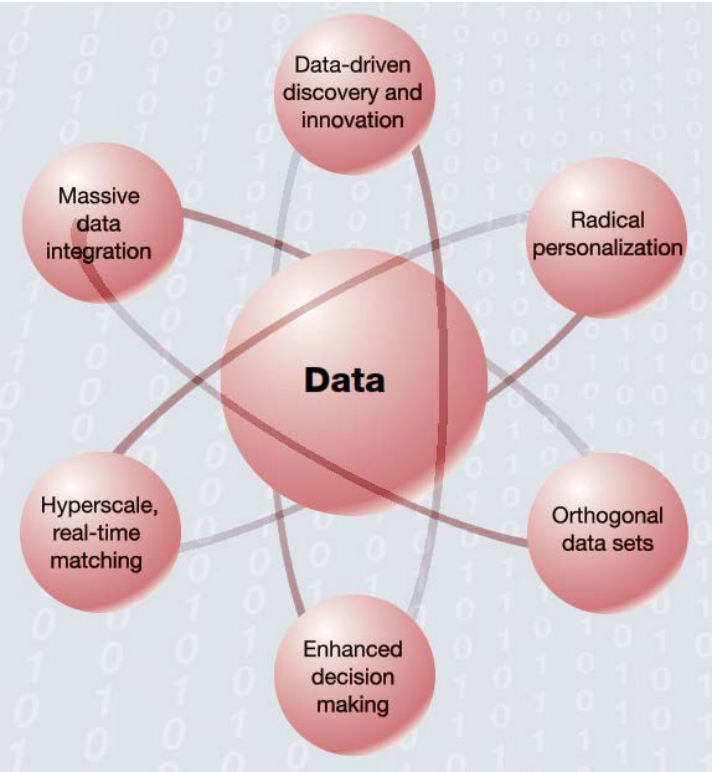

Figure 5: Data and analytics fuel 6 disruptive models that change the nature of competition.

- Recent advances in machine learning can be used to solve a tremendous variety of problems and deep learning is pushing the boundaries even further. Systems enabled by machine learning can provide customer service, manage logistics, analyze medical records, or even write news stories. The value potential is everywhere, even in industries that have been slow to digitize. These technologies could generate productivity gains and an improved quality of life along with job losses and other disruptions. Previous MGI research found that 45% of work activities could potentially be automated by currently demonstrated technologies; machine learning can be an enabling technology for the automation of 80% of those activities. Breakthroughs in natural language processing could expand that impact even further.

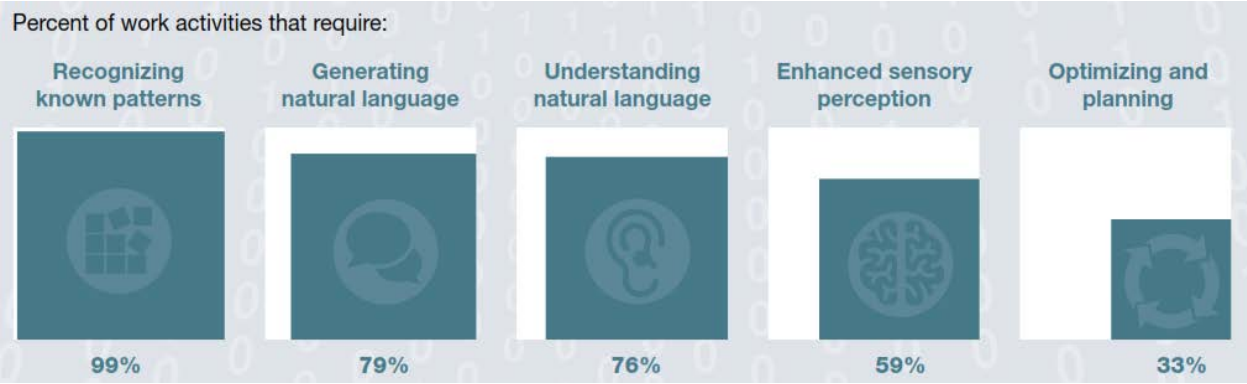

Figure 6: Machine learning has broad applicability in many common work activities.

Data and analytics are already shaking up multiple industries, and the effects will only become more pronounced as adoption reaches critical mass. An even bigger wave of change is looming on the horizon as deep learning reaches maturity, giving machines unprecedented capabilities to think, problem-solve, and understand language. Organizations that are able to harness these capabilities effectively will be able to create significant value and differentiate themselves, while others will find themselves increasingly at a disadvantage.

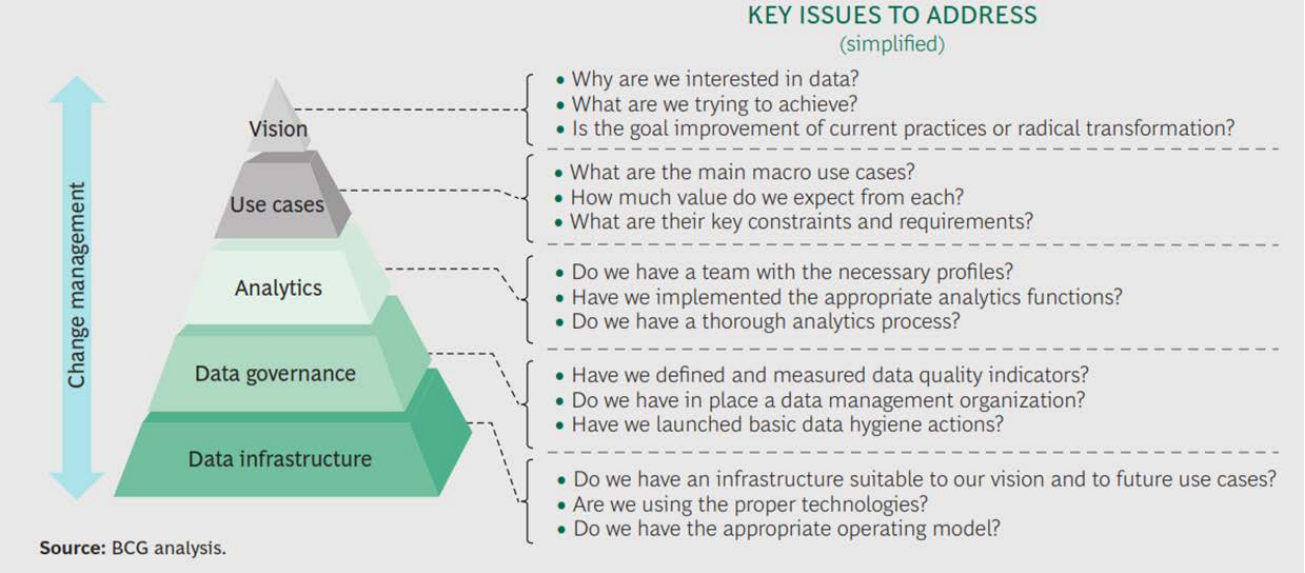

Figure 7: Leveraging data requires a comprehensive model.

4. **Internet of things**

Enterprise IoT is gaining momentum Although enterprise IoT is a relatively new development, 98% of a survey respondents reported that most companies within their industry include enterprise IoT initiatives in their strategic road maps, including those related to improving service operations, increasing visibility into operations, enabling new business models, and creating new product and service offerings (Figure 8).

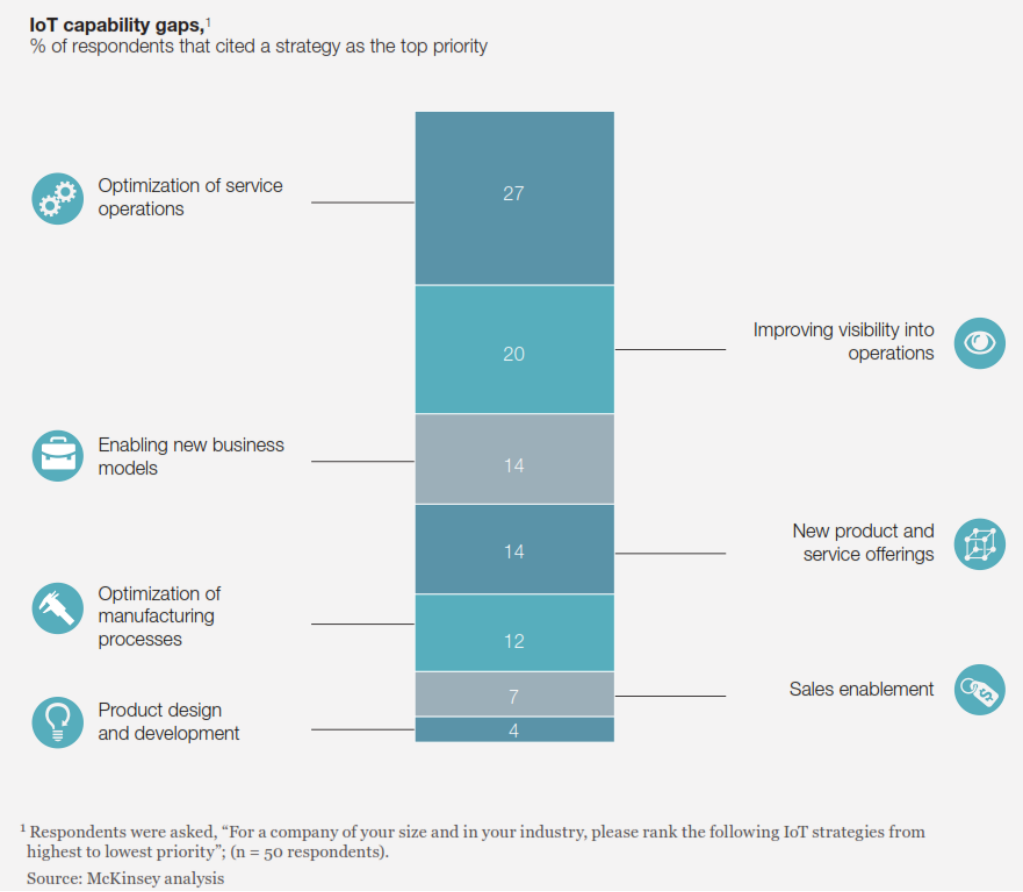

Figure 8: Executives have identified many strategic priorities for the Internet of Things (IoT).

Examples of these new programs in these areas abound. For instance, an elevator company is creating a suite of IoT-enabled services to improve the reliability of its products and decrease downtime. In addition to lowering operating costs for the company's customers, these applications could potentially transform its business model.

The survey respondents had a favorable view of enterprise IoT's increased importance, with 92% stating that it would have a positive impact over the next three years, either by improving operations or by allowing companies to develop new products with embedded IoT capabilities. The latter development could eventually translate into higher revenues. Equally important, 62% of respondents stated that enterprise IoT's impact will either be very high or transformative. That means it could produce many more benefits than the modest improvements seen to date. Respondents also noted that top executives recognized IoT's potential value, with 48% reporting that company leaders either strongly supported or were directly engaged in IoT initiatives. Enterprise IoT could produce the greatest benefits in manufacturing and service operations Enterprise IoT can help improve multiple functions. When asked which department would benefit most, 40% of survey respondents cited service operations and 30% chose manufacturing, making them the clear leaders (Figure 9).

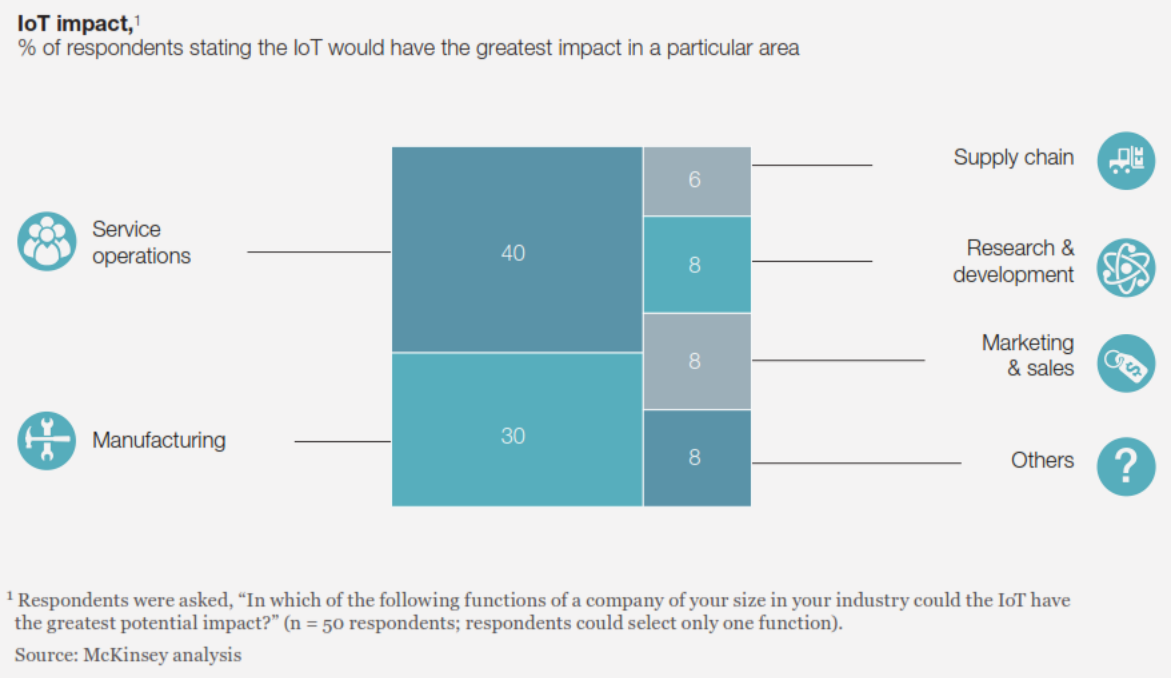

Figure 9: Survey respondents believe the Internet of Things (IoT) would convey most value to manufacturing and service operations.

For service operations, respondents believed that enterprise IoT would produce the most value in three areas: diagnostics and prognostics, predictive maintenance, and monitoring and inspection. In manufacturing, the top use cases were resource and process optimization (for instance, improving yield, throughput, or energy consumption), asset utilization, and quality management.

Challenges persist in enterprise IoT Despite these encouraging findings; the survey uncovered some reasons for concern; particularly with respect to how companies are using IoT data. Respondents agreed that information from IoT sensors was valuable, with 60% stating that it provides significant insights, such as data on customer demographics or shopping patterns. But an almost equal number (54%) claimed that companies used 10% or less of this information. These findings are consistent with the evidence we have seen in the field. At one gas rig, for instance, managers only used 1% of data from the ship's 30,000 sensors when making decisions about maintenance planning.

The survey also uncovered serious capability gaps that could limit enterprise IoT's potential. Some of these related to the sensor data discussed above, with survey respondents reporting that businesses often struggle with data extraction, management, and analysis (Figure 10). But there were also significant capability problems in other areas. For instance, 70% of respondents stated that companies have not yet integrated IoT solutions into their existing business work flows; in other words, they are not using enterprise IoT to optimize day-to-day tasks. Respondents also noted that companies had difficulty identifying use cases for enterprise IoT applications and conducting end-to end prototyping for connected products.

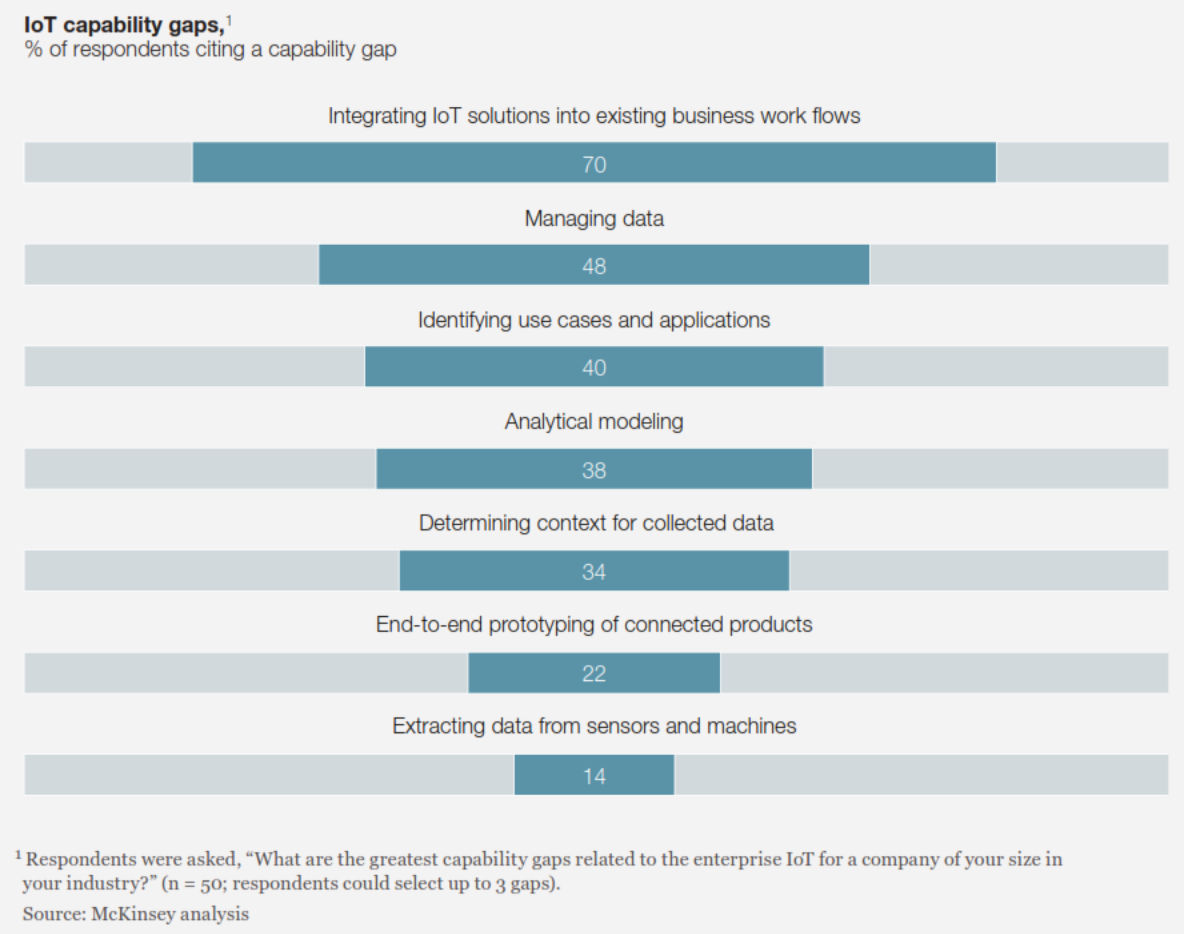

Figure 10: Companies have many capability gaps related to the Internet of Things (IoT).

Addressing these capability gaps may be challenging because companies often concentrate on piloting a single enterprise IoT program. With such a narrow focus, they do not consider the big picture, including the organizational capabilities and change-management programs required for the rollout of large-scale initiatives. This problem may become less intense as more business leaders begin recognizing enterprise IoT's value and place more emphasis on capability building. There is confidence that more companies will make a greater effort to incorporate enterprise IoT into their daily operations as its benefits become clearer. A few have already reported strong gains by moving in this direction. For example, Boeing workers now use IoT wearables and augmented-reality tools on wiring-harness assembly lines, which have resulted in up to 25% improvement in productivity.

5. **Cyber-physical system**:

Since 1970s there have been a rapid advancements in computing hardware and software which have provided a basis for a continuing development of novel manufacturing methods, better decision making (based on models) in management of manufacturing processes and the supply chain, as well as paradigm-altering computing and communication devices which we encounter in our daily lives. This new manufacturing paradigm started with stand-alone

computer applications which paved the way for the integration of manufacturing equipment with computer-based decision-making applications. Presently a vast change is underway in all aspects of the societal infrastructure and the way we live. Physical world, real space within which we reside is being increasingly augmented by its representation in digital software models, data and inferences engines which reside in various forms of computing systems. New domains of knowledge, which are being continuously discovered in this digital world, require new capabilities for engineering graduates.

Cyber-physical world is becoming a reality (Figure 11) which is comprised of a variety of cyber-physical systems (see examples in Figure 12). Cyber-physical systems (Figure 13) are characterized by a physical asset (e.g. machine) and its digital twin, i.e. a model which mimics the behavior of the physical asset. They are comprised of integrated, hybrid networks of cyber and engineered physical elements. They are co-designed and co-implemented to create adaptive and predictive systems which respond in real time to enhance the performance. Let us note that the Internet of Thing (IoT) is a subset of cyber-physical systems, since its prevailing definition limits it to the physical assets, not including their digital models.

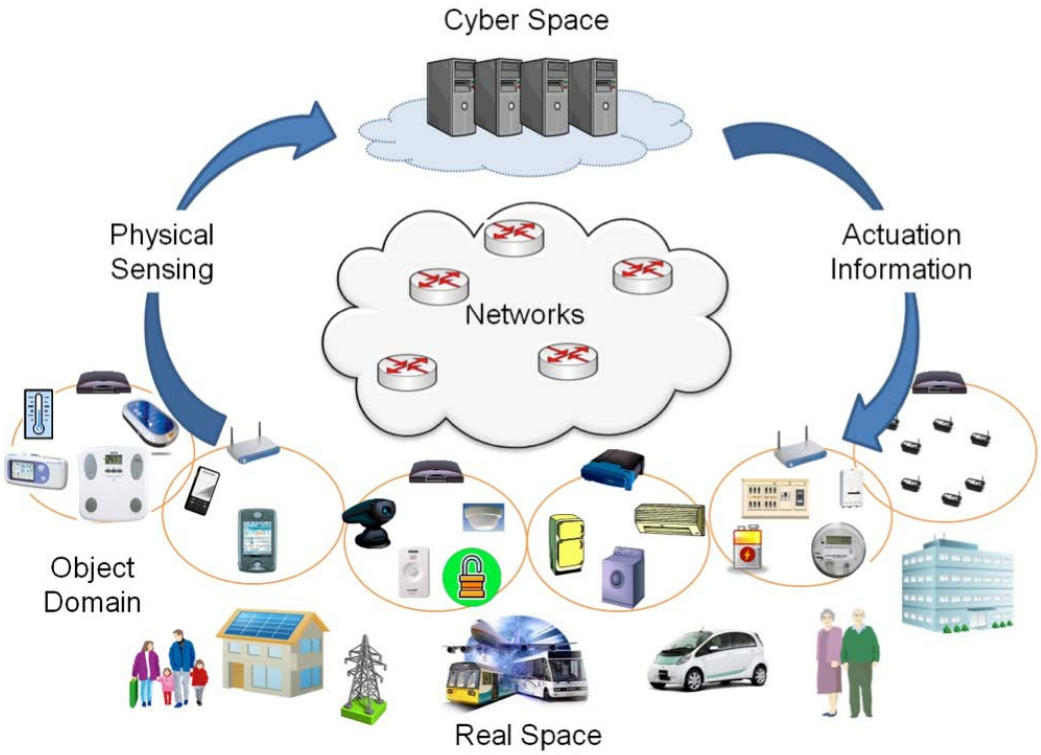

Figure 11: Cyber-physical world.

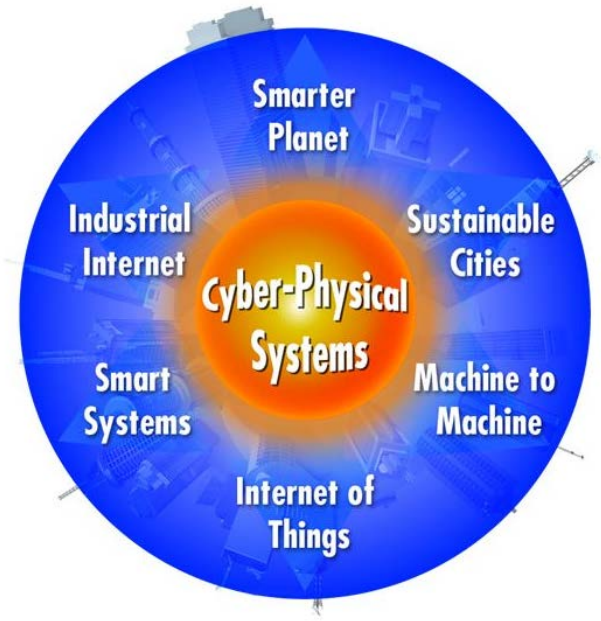

Figure 12: Cyber-physical systems

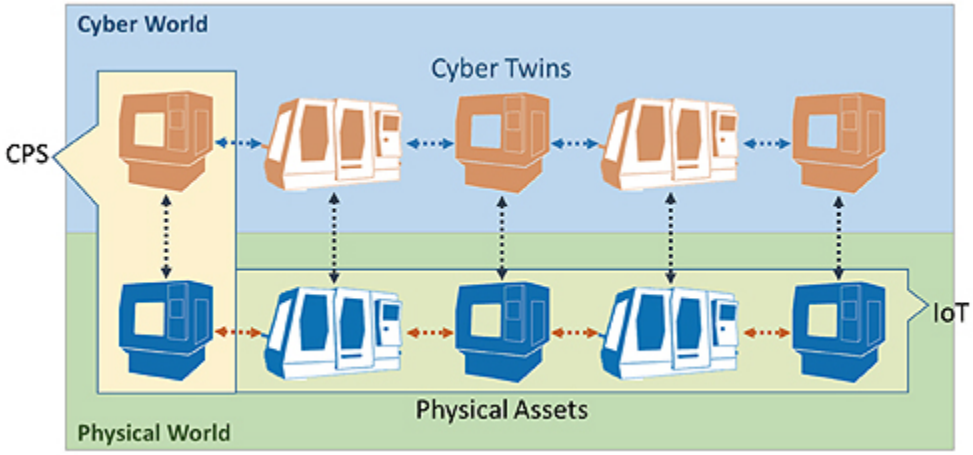

Figure 13: A cyber physical system is comprised of a physical asset and its software model

A new era of integrated cyber-physical manufacturing systems has begun, requiring engineering graduates to have professional and technical capabilities which have not been associated with the traditional engineering disciplines. In other words, an engineer ready for the 21st century needs to have the knowledge and capabilities required to understand, design, and improve systems which are comprised of humans interacting with both physical and cyber components. Terms “Industry 4.0” and “Advanced Manufacturing” have been coined to designate such manufacturing systems (Figure 14).

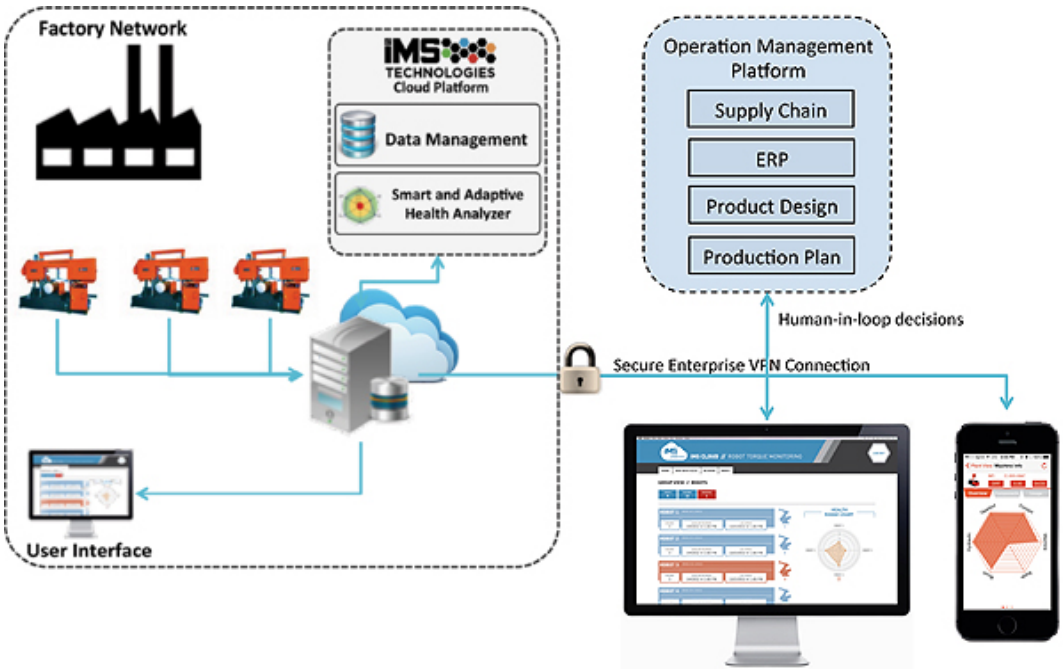

Figure 14: Operators and manager interact with CPSs through a variety of interfaces by utilizing analytical data and models stores in the cloud.

Cyber-physical systems can be viewed from two vantage points:

- System structure, which has a lot of characteristics common across different domains. This is reflected in modeling methodologies and algorithms for optimization of the system performance.
- Technology required to build such systems, including the technologies specific to a given domain (e.g. internal combustion or electric engines in automotive).

The case of Canada

In 2016, CME (Canadian Manufacturers & Exporters) conducted several surveys and consultation sessions with leaders of manufacturing organizations Canada wide. The purpose of these projects was to understand and define a strategy (named “Industry 2030, a national strategy”) required in order to enable Canadian manufacturers to double the sales output by 2030 (Figure 15).

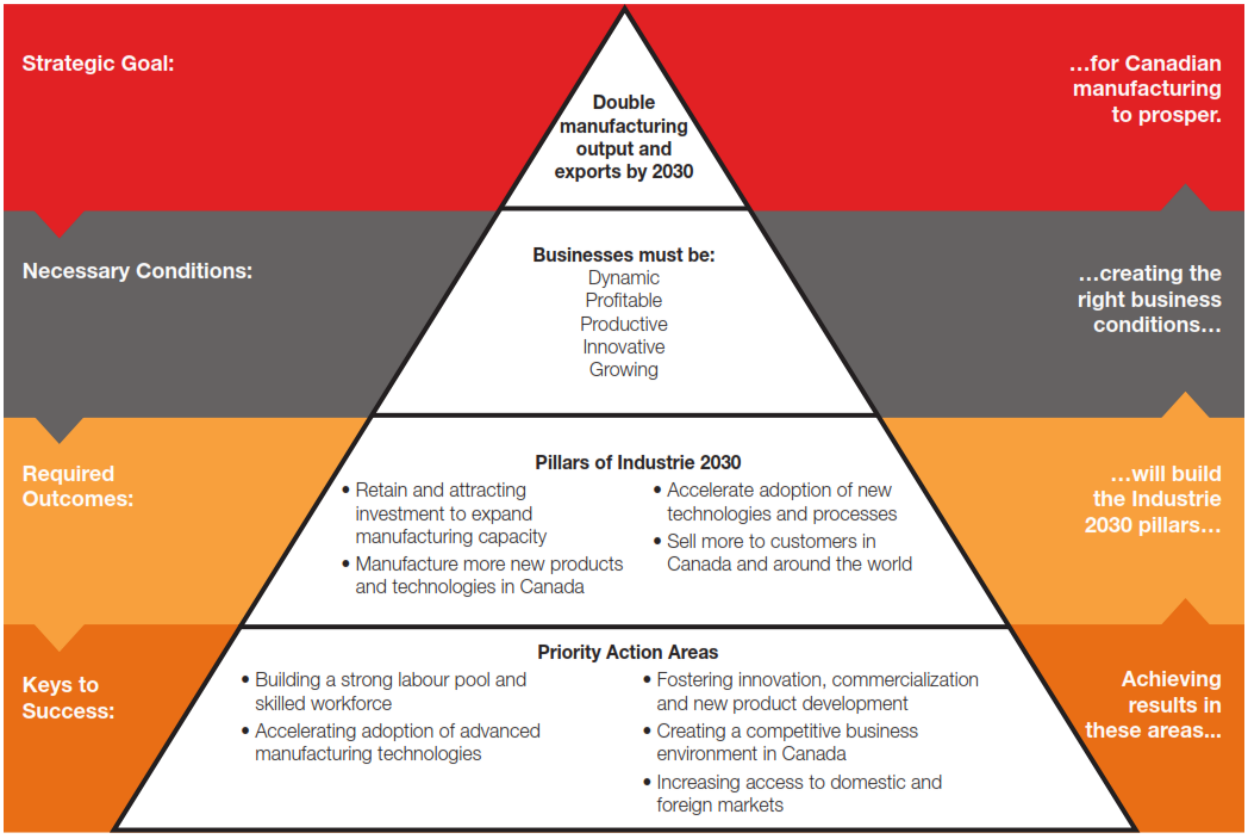

Figure 15: The Industry 2030 strategy roadmap

The overall proposed strategy focuses on five points:

a. Building a strong and skilled workforce for growth.
b. Accelerating the adoption of advanced manufacturing technologies.
c. Fostering innovation, commercialization and new product development in Canadian markets.
d. Manufacturing a competitive business environment in Canada.
e. Increasing sales in domestic and foreign markets.

Technology, global competition, and customer expectations are also shaping the evolution of our industry, our workforce, and what products and services we ultimately offer. The pace of change is getting faster, and we need to do more than simply keep pace, or we run the risk of being left behind.

Manufacturing leaders rank skills and labour shortages as the most important issues they face today [4]. This message came through loudly and clearly from both the Industry 2030 consultations, as well as from the results of the 2016 Management Issues Survey. Specifically, executives noted deep concern both about the availability of workers as well as the skill level of existing and future employees at all levels of the organization. These skills gaps are undermining the current performance and future growth of their companies. Today, Canadian manufacturers directly employ 1.7 million people throughout their domestic operations. The skills of the workforce range from general labourers, to skilled tradespeople, to designers, to sales and service

representatives, to management. However these skills sets are constantly being redefined as technology and business opportunity reshape the business of manufacturing. Technology is changing both the type of workers being used – a shift from general labour to specialized work – and the type of skills that are needed – from single-skilled and repetitive to multi-skilled and flexible. Technology is also impacting the type of products and services being offered, as well as how manufacturers operate; instead of merely building and selling a product in a local or regional market, businesses are now offering a range of customer services that are anchored around a manufactured product. Jobs are becoming more multi-skilled and specialized, and they are growing more valuable and less interchangeable. As a result, workers are becoming more difficult to find and harder to replace.

In Canada there exist significant gaps in talent in highly-educated and skilled population. According to the results of the 2016 Management Issues Survey, roughly 40 per cent of businesses face labour and skills shortages today. Five years from now, close to 60 per cent anticipate such shortages (Figure 16).

Figure 16: Immediate and future skilled labour shortages in industry

These shortages stem from three primary sources:

1. An inability to attract youth into skilled trades relevant to manufacturing;
2. A disconnect between the formal training system and industry needs
3. An aging workforce.

These shortages are driving up costs, undermining productivity and eroding our global competitiveness. This is causing businesses to forego production opportunities and delay investment. In some cases, shortages of skilled workers are causing companies to consider relocating their operations outside Canada in order to sustain production. Skills shortages are also causing companies to under-invest in a range of advanced manufacturing technologies because their workers do not have the necessary technical skills, thus limiting manufacturers' ability to use these technologies to their fullest potential. Simply put, a lack of a sufficiently-sized and skilled labour pool is directly impacting the growth of manufacturing in Canada today, and will continue to restrict growth moving forward if substantial changes are not made.

Another issue repeatedly arose in the Industry 2030 consultations: the deficit of manufacturing leadership in Canada. While Canada does create great leaders, there are not enough of them. Leadership gets to the heart of manufacturing strategy and entrepreneurship. It affects how companies operate, how they invest, how they create new products and open new markets. It also affects how manufacturers train and develop their workforce. There is a major lack of capacity in training the next generation of innovative manufacturing leaders (in all levels of organizations) with up to date and applied skill sets.

The distribution of labour and skills shortage is widespread throughout functions of the manufacturing sector. It is the main incentive for companies to refocus on performance and efficiency, and the first consideration for their decision making process for investments (Figure 17 & 18).

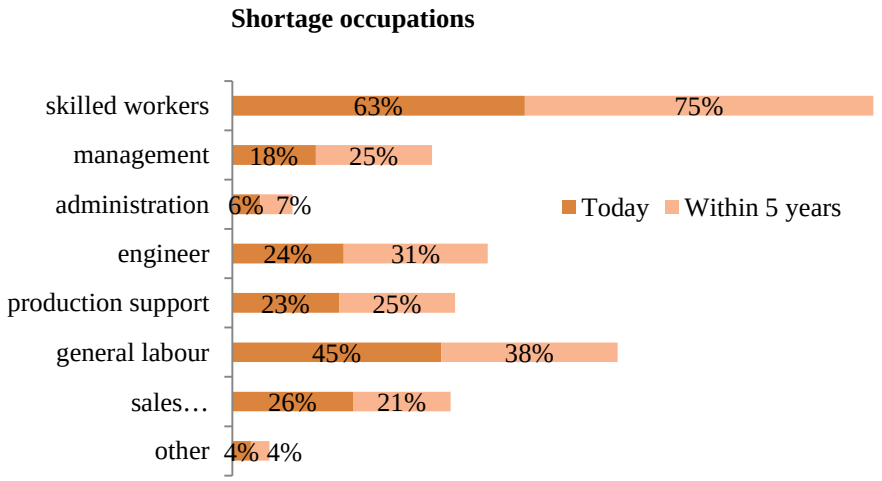

Figure 17: Occupational distribution in skilled labour shortages in industry

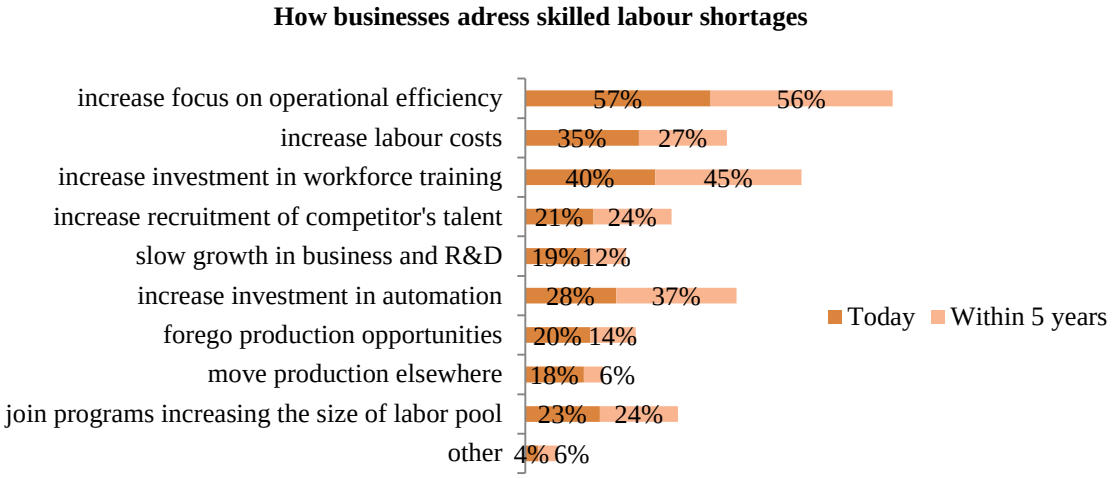

Figure 18: Response from industry to skilled labour shortages

As part of the strategy to address the issues pertaining to building a strong and skilled workforce for growth, CME proposed a set of general recommendations:

- Increase the effective engagement of youth, women and under-represented groups in the manufacturing labour force. Programs such as “open doors” that introduce underrepresented groups to opportunities in manufacturing should be expanded nation-wide. Post-secondary science, technology, engineering and mathematics (STEM) training also needs to be improved, with an increased emphasis on workplace-focused technical, social and safety skills.
- Improve linkages between industry and post-secondary institutions. Manufacturers need to work more closely with educators to develop and fine-tune program curricula, as well as to offer feedback on the skills that recent graduates bring to the table so that curriculum adjustments can be made in a timely, relevant manner. The network of work-integrated learning programs across Canada needs, to be expanded to create better pathways to the development of work-related skills and ensure a better match between education and manufacturing workforce needs, including increased corporate participation and government support through incentives aimed at student wages.
- Expand supports for business-led training and management leadership. Better the Canada Job Grant, by increasing the program funding size and making it permanent (multi-year training, more on-the-job training, Industry 4.0, LEAN manufacturing…). Canadian manufacturers should work with post-secondary institutions to create new programs to support management training. The emphasis of these programs should be entrepreneurship, leadership (at the group and company level), operations management, LEAN techniques, and combined technical and management training (such as combined engineering and MBA programs).
- Improve access to foreign-trained skilled workers.

In addition, the manufacturers have found that young graduates are not armed with the skillset they require to be integrated in industry. As a consequence, the average time to develop a new hire is reported as 2 years and is deemed too long. It is thus crucial that post-secondary curriculums be better aligned and emphasizes multi-disciplinary skills rather than specialization.

1.2 PROPOSAL PREPARATION AND CONSULTATION PROCESS

Not applicable.

1.3 CONSISTENCY WITH MCMASTER'S MISSION AND ACADEMIC PLAN

i. McMaster's Strategic Mandate Agreement:

This Certificate of Completion will strengthen the relationship between McMaster and local industry.

ii. McMaster's current priorities

The goal of the proposed certificate is to transfer the latest technologies in operations leadership to the local community of businesses. The primary learning mode will be experiential learning, particularly during the workshops in which hands-on role play type activities will give the students the time and opportunity to practice in a safe environment what they have learned during the classes.

1.4 PROGRAM LEARNING OUTCOMES

Upon completion of the Certificate the student will have acquired the knowledge and practical skills to:

PLO #1. Develop a fundamental and strong understanding of Industry 4.0, its meaning, the challenges industries are facing, the potential applications and opportunities, the technical and organizational limits which hinder its implementation.

PLO #2. Become an agent of change and develop the skill set and understanding in order to successfully communicate and lead initiatives of Industry 4.0 within their organizations.

PLO #3. Identify and quantify opportunities for implementing Industry 4.0 tools and techniques within their organization, and in various functions (operations, sales, supply chain…).

PLO #4. Apply fundamental knowledge, technical tools and techniques to implement elements of Industry 4.0 within their organization such as smart systems, shadow factory, machine controls.

PLO #5. Communicate clearly and in simple concepts the current innovations in manufacturing and servicing (Industry 4.0), and become an ambassador promoting the adoption of new technologies.

1.5 CONSISTENCY WITH DEGREE LEVEL EXPECTATIONS

Not applicable.

1.6 DEMAND FOR THE PROGRAM

EVIDENCE OF SOCIETAL/LABOUR MARKET NEED

Note: Some elements of this was mentioned in section 1.1. After a brief review, this section will present some data about the status of the labour market.

As mentioned, CME conducts a biannual management survey across Canada, in order to get into the mindset, aspirations and concerns of manufacturers. The demographics of the survey are shown in figure 19.

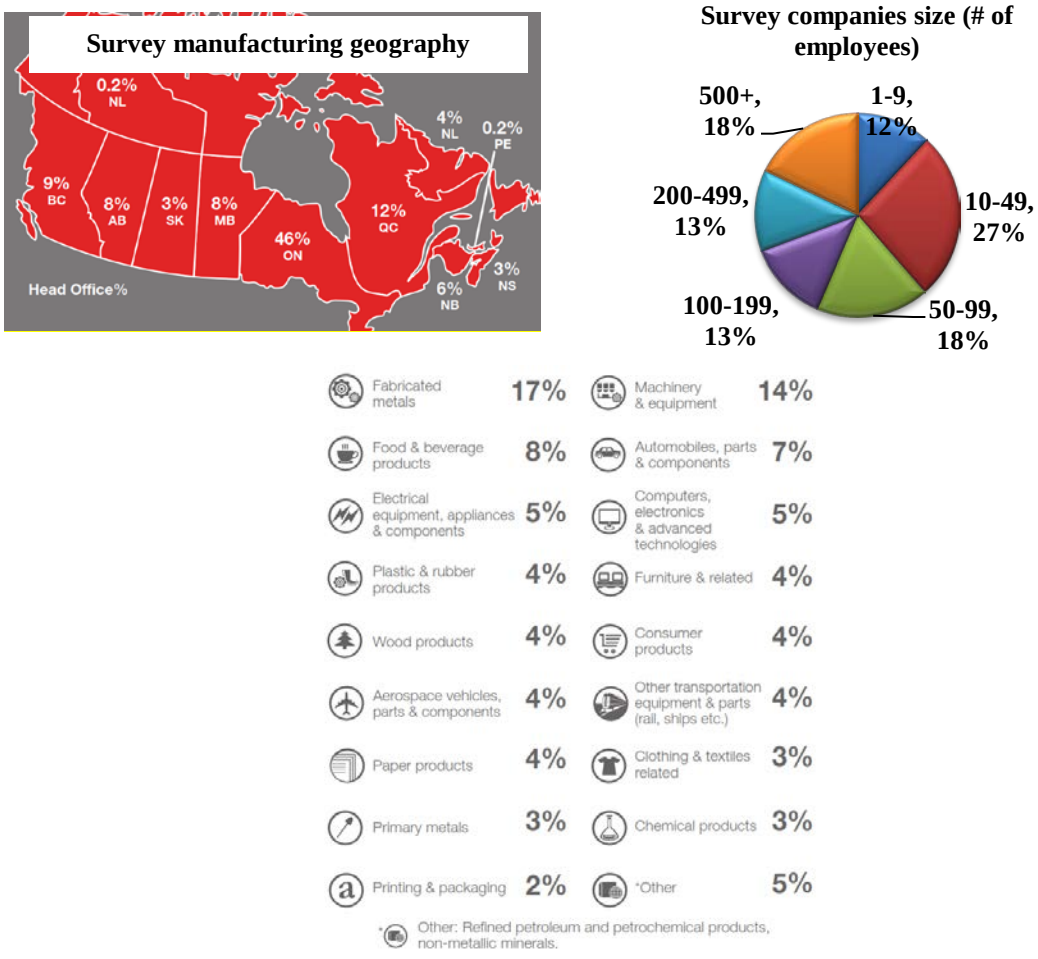

Figure 19: Distribution of survey respondents, companies' sizes and industrial sectors

From the management survey, 2 of the top 5 concerns are finding a skilled and quality labour workforce, and the adoption and implementation of new technology to promote innovation. Overall, 4 main actions were identified as essential for the future of manufacturing in Canada from a management perspective, 2 of which are more of interest:

- Labour, skills and training: Manufacturers want improvements to the suite of programs available for in-house training, and they want more financial support for that training. They also want governments to work with post-secondary institutions to improve existing training programs and to expand work-integrated learning programs in Canada.

- Innovation and technology adoption: Uptake of advanced manufacturing technologies in Canada is low, but businesses want to reverse that trend. Respondents believe tax credits and other incentives will help offset investment risks. They also want more opportunities to examine and test these technologies.

In summary, the concerns of companies from a manpower perspective are aligned with the identified needs and requirements of manufacturing in Canada to be competitive; there is an urgent need to develop a training platform aligned between post-secondary institutions and industry to educate and develop a skilled and quality workforce which can be seamlessly integrated by industry. A particular attention needs to be given to the training of employees and managers on Industry 4.0, as they are the first enablers and engagers of the work force, particularly in the adoption of new technologies.

In addition, one cannot ignore the dramatic shift in societal needs which is the natural evolution following the innovations in technology trends. For example, the following table presents the shift in demand of the top 10 jobs that has occurred within the last 15 years. This data was gathered from many sources around the world (Forbes, globe and mail, World economic Forum, Statistics Canada, monster…).

Table 1: change in demand for top jobs for the past 15 years.

15 years ago	Now
Administrative assistant	Online community manager/chief listening officer
Sales clerk	Sustainability manager
Teacher	Educational/admission consultant
Transportation operator	Data miner
Hospitality manager	Millennial generational expert
Medical assistant	Cloud computing/IT architecture expert
Investment banker	Engineering technician
Mechanic	User experience manager
Real estate agent	Manufacturing functions (quality, supply chain…)
Social worker	Elder care

Complementary to the change in job demand, studies have showed that the skill set required for employees to thrive in the fourth industrial revolution, is expected to shift as well (Figure 20).

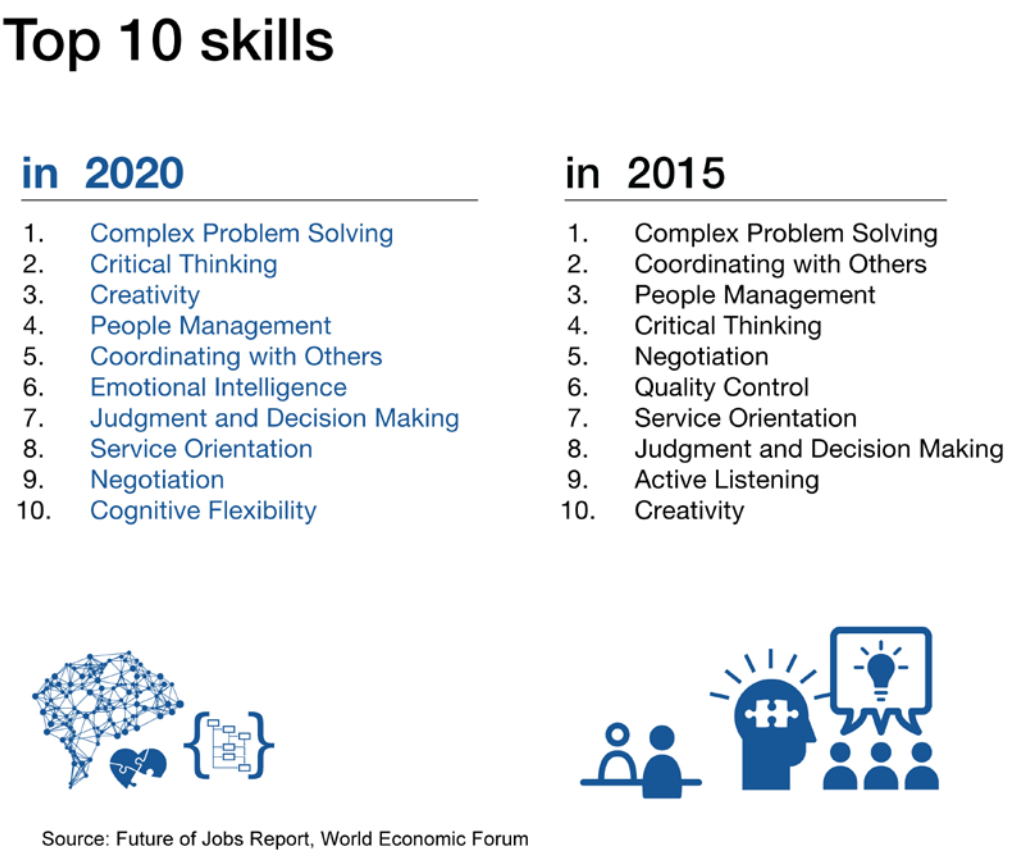

Figure 20: changes in skill set required for Industry 4.0.

In addition, SEPT already has a past history of developing industry specific programs for employees such as the Technology Leadership Certificate.

1.7 DEGREE NOMENCLATURE

Not applicable.

2 ADMISSION & ENROLMENT

2.1 ADMISSION REQUIREMENTS

Applicants with a 4 year undergraduate degree in engineering or science, as well as applicants with an advanced 3-year college diploma will be admitted to the Certificate. A letter of support from the applicant's employer will also be required.

2.2 ENROLMENT PLANNING AND ALLOCATIONS

Not applicable.

2.3 ALTERNATIVE REQUIREMENTS

Not applicable.

3 STRUCTURE

3.1 ADMINISTRATIVE, GOVERNANCE AND COMMUNICATION

The proposed program resides within the W Booth School of Engineering Practice and Technology; a School within the Faculty of Engineering. The School is led by a Director who reports to the Dean of Engineering. The Director of the School serves a 5-year term and is appointed by the Senate. The program will be lead and administered by a program leader reporting to the director of the school.

3.2 STRUCTURE AND REGULATION

Program Structure

The proposed certificate will provide participants with technical and professional capabilities. In order to successfully complete the Program, the students must complete 8 - ¼ courses, plus a ½ course project. The content of the Certificate is equivalent to 5 – ½ courses.

It is a 12 month program.

Modes of Delivery

The coursework for this Certificate will be offered as four modules based on a theme, via a blend of on-line, in-class, and a final 3 days in laboratory delivery at the end of each 3 months period. The courses will be scheduled in 'blocks' of time which are intended to make the Certificate more appealing and accessible to working professionals (see calendar below).

Period	**Q3**		**Q4**		**Q1**		**Q2**	
Module 1 Industry 4.0	**Course**	**Lab**						
Module 2 The real factory			**Course**	**Lab**				
Module 3 The shadow factory					**Course**	**Lab**		
Module 4 The people component							**Course**	**Lab**

3.3 GRADUATE PROGRAMS - PROGRAM LENGTH

Not applicable.

4 CURRICULUM AND TEACHING

4.1 PROGRAM CONTENT

The Industry 4.0 Certificate is focused on engaging and enabling its graduates to acquire and practice the knowledge, technical background, professional behaviors and competencies required in order to lead initiatives within their organization involving the implementation of innovations and technologies supportive of Industry 4.0. It is interdisciplinary in nature, and the knowledge built ranges from communication, innovation and technologies, processes, LEAN manufacturing, and financials.

The current states and emerging trends in Industry 4.0 will be the subject of the program. Term workshops and practical activities in this program will facilitate in-depth and practical exploration of specific topics as well as a survey of the broad system aspects by the students.

The latest industry-applicable methods and standards will be addressed in the corresponding courses. Relevant infrastructure standards from different parts of the globe will be presented as needed and their impact Industry 4.0 will be discussed.

4.2 PROGRAM INNOVATION

The program is structured and delivered in an innovative way more suitable for training of professionals working in industry. Each one of the 8 courses will be delivered in 4 steps as part of 4 modules. This will promote the multidisciplinary aspects of operations management and allow students to integrate aspects of each course into learning activities which will culminate at the end of each quarter during the workshops. The following table highlights the module/course matrix.

Table 2: Training matrix showing the relations between four thematic modules and the 8 courses.

Course	Module 1 Industry 4.0	Module 2 The real factory	Module 3 The shadow factory	Module 4 The people component
Digital manufacturing	Introduction	The learning factory	PLC, modelling	Communicating change
Internet of things	IoT infrastructure, sensors and connectivity		Security	Building and leading a X-team
Big data and analytics	Data for decision making	Learning machines	AI	
Cyber-physical systems	Organizational structure and systems integration	AR, 3D printing	Virtual reality	
Project management	Risk analysis and financials	Building a project plan	Project plan toolkit	Managing a team

The core architecture of the courses delivery and knowledge acquisition is as follow:

- Practical knowledge based on simple tools and techniques which focus on the fundamentals of Industry 4.0.
- Experiential learning: students will be asked to bring forward real issues they are facing or best practices. These scenarios will be used during the workshops by applying what they have learned in class.
- Problem solving: The purpose of the curriculum is to guide the students so that they build confidence in tackling and solving problems or initiating improvements.
- Role playing: multiple activities are planned as part of the learning curve of the students. This is a known method particularly to teach LEAN manufacturing.
- Team based activities are planned as well, not only as part of the learning experience, but also as part of networking practice. The intent is for the team to stay in contact professionally.
- Industrial speakers will be invited as well, to share their own experience with the students in terms of Industry 4.0 (and their career).

4.3 MODE(S) OF DELIVERY

The program is delivered in a blended learning environment including online lectures, forums, self-directed learning and hands-on applications.

4.4 EXPERIENTIAL LEARNING

The program is uniquely defined through a strong experiential learning component. Each course is specifically oriented towards problem-solving, the intensive workshops provide a

hands-on learning experience and courses emphasize a “learn-by-doing” approach. Work on industry or civic oriented problems will provide further opportunities for experiential learning by solving problems encountered in real industry situations.

4.5 ACCESSIBILITY

The program supports an environment in which race, age and gender are irrelevant. The program is focused on helping students to attain the level of capabilities corresponding to their role and function irrespective of their abilities or disabilities.

4.6 RESEARCH REQUIREMENTS (IF APPLICABLE)

Not applicable

5 ASSESSMENT OF LEARNING

5.1 METHODS FOR ASSESSING STUDENTS

Student assessment during the course of the Program will be based on demonstrated learning outcomes in each course. Assessments in the courses will be based on

- Assignments
- Demonstrated learning during workshop
- Questionnaire

5.2 CURRICULUM MAP

Program Learning Outcome			
By the end of the program, students will	Expectations	Teaching activities & learning opportunities	Assessments & evidence
Develop a fundamental and strong understanding of Industry 4.0, its meaning, the challenges industries are facing, the potential applications and opportunities, the technical and organizational limits which hinder its implementation.	Understand industry 4.0 Communication Leadership Basic financials	Each module will have a blend of online lectures, scenario assignments, and inspirational videos or texts. A final 3 day workshop will give the students hands-on experience in applying the fundamental concepts reviewed during the module.	Assignments, questionnaires, and activity during the workshops.
Become an agent of change and develop the skill set and understanding in order to successfully communicate and lead initiatives of Industry 4.0 within their organizations.	Communication Active listening Leadership Initiative		
Identify and quantify opportunities for implementing Industry 4.0 tools and techniques within their organization, and in various functions (operations, sales, supply chain…).	Communication Continuous improvement Problem solving Project management		
Apply fundamental knowledge, technical tools and techniques to implement elements of Industry 4.0 within their organization such as smart systems, shadow factory, machine controls.	Problem solving Project management Team management		
Communicate clearly and in simple concepts the current innovations in manufacturing and servicing (Industry 4.0), and become an ambassador promoting the adoption of new technologies.	Entrepreneurship & Intrapreneurship Communication		

5.3 DEMONSTRATING STUDENT ACHIEVEMENT

The assessment tasks will be designed to measure the achievement of program and course level learning outcomes throughout the program and will be embedded into each course.

The following assessment tools will be used to measure student achievements: assignments, and questionnaires. These will be graded using the McMaster University grading system.

The data collected from each of these activities will be analysed using a variety of methods that are currently used in the department.

We will be conducting a survey of students asking them to reflect on their learning experiences. A similar survey of faculty and the students' respective organizations will also be conducted to assess the achievement of learning outcomes by the students and their efforts to provide activities for assessment of the learning outcomes, levels of achievement, and any associated challenges.

6 RESOURCES

ADMINISTRATIVE, PHYSICAL AND FINANCIAL RESOURCES

The Program will be hosted by the W.Booth School of Engineering Practice. The School has administrative staff experienced in the operation of graduate, undergraduate and industry oriented programs. The Director of the School is responsible for the programs offered by the School. Day to day operation of the programs will be managed by a Program Leader who will assume the responsibility for the management of the new program.

The program will be funded from the courses fees. Immediately after the program is approved, the School will start implementing a marketing program which will be prepared in advance in cooperation with the marketing group in the Faculty of Engineering.

At the time of processing applications for the first cohort (expected in 2018/2019) of approximately 20 accepted students, it is anticipated the Program Leader will be responsible for the administrative tasks related to this Certificate. The need for admin support will be assessed in future years of the program.

The delivery of the program will use sessional lecturers with very specific and relevant industry experience. This will likely include the Program Leader which will also be a contract position.

SEPT physical space in ETB building will be used to provide a working and teaching space for the students and instructors.

LIBRARY, TECHNOLOGY, AND LABORATORY RESOURCES

Library facilities in the traditional sense (books and journals on the shelves and space to sit and read them in the library) are not needed by the Program. On-line availability of the journal and books will provide the students with access to the material required for their course work.

W. Booth School of Engineering Practice and Technology has a unique Learning Factory which will be used as sand box for role plays, case scenario study, and learning environment for Industry 4.0.

Learning Factory (Industry 4.0)

SEPT is currently creating a Learning Factory which will provide hands-on learning of systems and components which constitute Industry 4.0. Most of the required equipment is already available at SEPT and we are confident that this learning facility will be ready well before 2018/2019.

The Learning Factory will provide integration from enterprise planning level to the production equipment. It will include prototyping tools, actual cyber-physical systems examples (discrete manufacturing, continuous manufacturing, smart homes/buildings, smart grid, and smart transportation).

A simplified representation of the Learning Factory is given in Fig. 1.

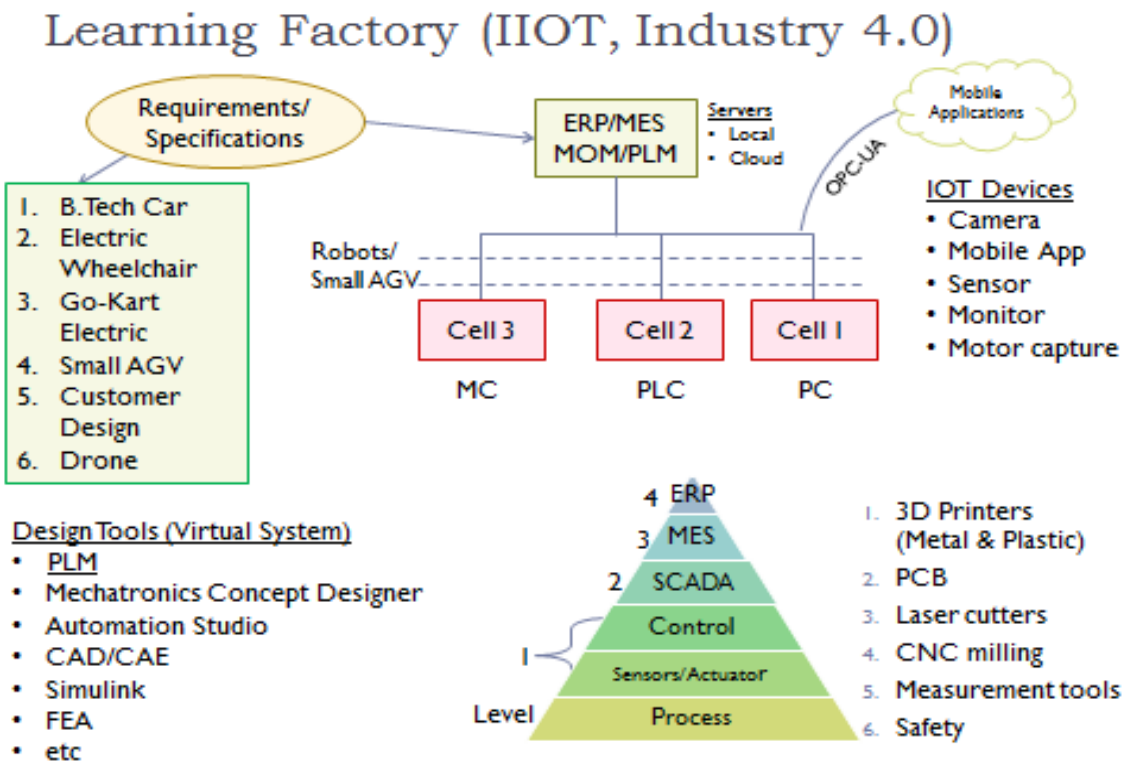

Fig. 1 Simplified representation of the Learning Factory

FACULTY

The proposed program has been budgeted using sessional lecturers. However, several current SEPT Faculty members may fill teaching roles within the Certificate as appropriate.

Table 2 Faculty Members for W. Booth School of Engineering Practice and Technology who may teach courses with the Certificate Program

Name	Rank	M/F	Dept.
Mo Elbestawi	Professor	M	SEPT
Vladimir Mahalec	Professor	M	SEPT
Fleising, Robert	Associate Professor	M	SEPT
David Potter	Associate Professor	M	SEPT
Dan Centea	Assistant Professor	M	SEPT
Gao, Zhen	Assistant Professor	M	SEPT
Jeff Fortuna	Assistant Professor	M	SEPT
Mehrtash, Moein	Assistant Professor	M	SEPT
Tom Wanyama	Assistant Professor	M	SEPT
Yuam, Timber	Assistant Professor	M	SEPT
Long, Jennifer	Lecturer	F	SEPT
Singh, Ishwar	Adjunct Professor	M	SEPT
Mikhail Hanna	Adjunct Professor	M	SEPT

STUDENT FINANCIAL SUPPORT

The program will not offer financial support to the students.

FACULTY RESEARCH FUNDING – ***NOT APPLICABLE; THIS IS NOT A RESEACH PROGRAM***

7 QUALITY AND OTHER INDICATORS

7.1 ACADEMIC QUALITY OF THE PROGRAM

This certificate will be added to the school's IQAP process.

7.2 INTELLECTUAL QUALITY OF THE STUDENT EXPERIENCE

The fundamental nature of the program based on problem solving of real issues the students are facing, improvement of their work area, and interaction with peers from other sectors should encourage 'crosspollination' of knowledge and experience.

SEPT Faculty have been recognized as having one of the highest student ratings in the Faculty of Engineering, which is a clear indication of their ability to engage students and create an engaging working environment.

In addition to the classes, the students will be able to participate in the social activities in SEPT. Remotely located students will be able to interact with their colleagues via social media platforms (e.g. Facebook group for each class is a tradition at SEPT).

McMaster University

NEW PROGRAM PROPOSAL

Operations Leadership & Management

Certificate of Completion

(courses + project)

October 10, 2017

TABLE OF CONTENTS

1 PROGRAM

1.1 PROGRAM DESCRIPTION

The proposed certificate combines professional development, advanced technical skills and competencies, and understanding of laws and regulations required for the successful leadership, management and performance improvement of an operation in the context of the 21st century industrial and civic systems. This Operations Leadership & Management Certificate is the first practical and applied program of its kind in Canada complementing a handful more theoretical program initiatives in North America. The audience of the program is intended to be mainly the current and future, first and second levels of management (supervisor of people and manager of business unit), in both the principal operations and support functions (engineering, quality, supply chain, human resources …) in a manufacturing environment across multiple industrial sectors. However, it is readily applicable to the service industries as well. It is complementary as well to more formal academic program offered at the W Booth School of Engineering Practice and Technology.

Background: a perspective on the Canadian manufacturing landscape

The manufacturing sector is the single largest business sector in Canada (Fig. 1).

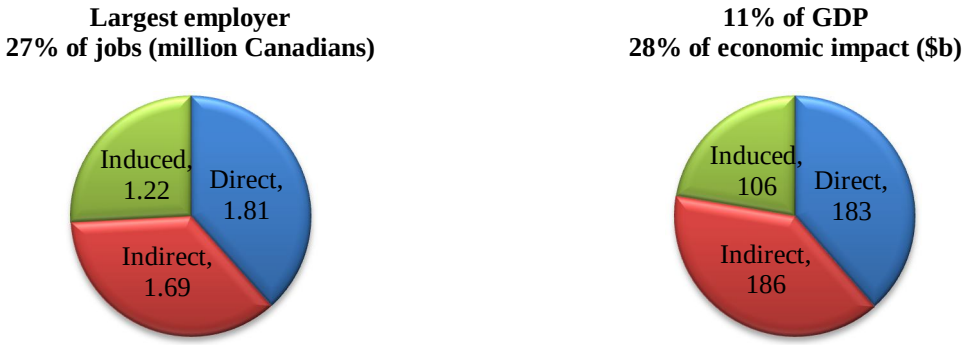

Figure 1: Impact of the manufacturing sector in Canada [1,2,3]

However, it is facing several challenges and uncertainties. In 2016, CME (Canadian Manufacturers & Exporters) conducted several surveys and consultation sessions with leaders of manufacturing organizations Canada wide. The purpose of these projects was to understand and define a strategy (named “Industry 2030, a national strategy”) required in order to enable Canadian manufacturers to double the sales output by 2030 (Fig. 2) [2].

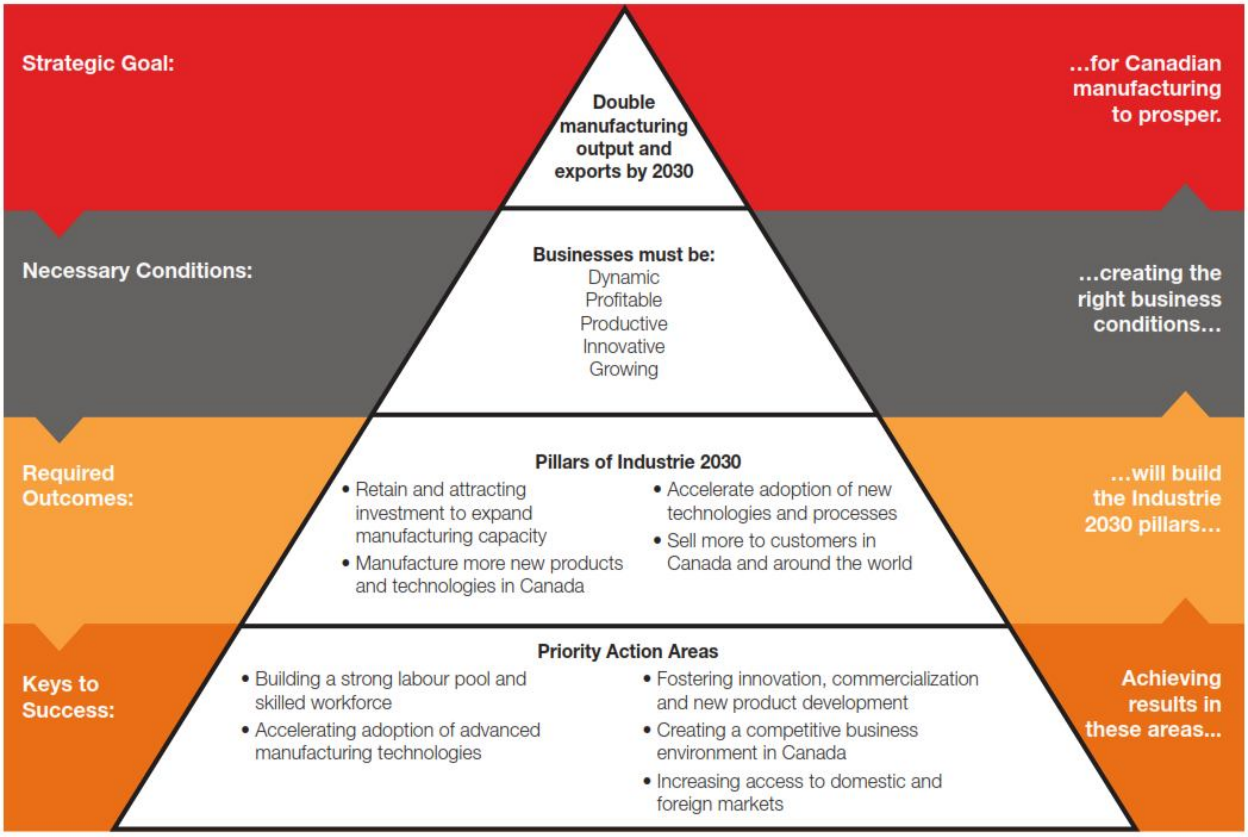

Figure 2: The Industry 2030 strategy roadmap

The overall proposed strategy focuses on five points:

a. Building a strong and skilled workforce for growth.
b. Accelerating the adoption of advanced manufacturing technologies.
c. Fostering innovation, commercialization and new product development in Canadian markets.
d. Manufacturing a competitive business environment in Canada.
e. Increasing sales in domestic and foreign markets.

Technology, global competition, and customer expectations are also shaping the evolution of our industry, our workforce, and what products and services we ultimately offer. The pace of change is getting faster, and we need to do more than simply keep pace, or we run the risk of being left behind.

Manufacturing leaders rank skills and labour shortages as the most important issues they face today [4]. This message came through loudly and clearly from both the Industry 2030 consultations, as well as from the results of the 2016 Management Issues Survey. Specifically, executives noted deep concern both about the availability of workers as well as the skill level of existing and future employees at all levels of the organization. These skills gaps are undermining the current performance and future growth of their companies. Today, Canadian manufacturers directly employ 1.7 million people throughout their domestic operations. The skills of the workforce range from general labourers, to skilled tradespeople, to designers, to sales and service

representatives, to management. However these skills sets are constantly being redefined as technology and business opportunity reshape the business of manufacturing. Technology is changing both the type of workers being used – a shift from general labour to specialized work – and the type of skills that are needed – from single-skilled and repetitive to multi-skilled and flexible. Technology is also impacting the type of products and services being offered, as well as how manufacturers operate; instead of merely building and selling a product in a local or regional market, businesses are now offering a range of customer services that are anchored around a manufactured product. Jobs are becoming more multi-skilled and specialized, and they are growing more valuable and less interchangeable. As a result, workers are becoming more difficult to find and harder to replace.

In Canada there exist significant gaps in talent in highly-educated and skilled population. According to the results of the 2016 Management Issues Survey, roughly 40 per cent of businesses face labour and skills shortages today. Five years from now, close to 60 per cent anticipate such shortages (Fig. 3).

Figure 3: Immediate and future skilled labour shortages in industry

These shortages stem from three primary sources:

1. An inability to attract youth into skilled trades relevant to manufacturing;
2. A disconnect between the formal training system and industry needs
3. An aging workforce.

These shortages are driving up costs, undermining productivity and eroding our global competitiveness. This is causing businesses to forego production opportunities and delay investment. In some cases, shortages of skilled workers are causing companies to consider relocating their operations outside Canada in order to sustain production. Skills shortages are also causing companies to under-invest in a range of advanced manufacturing technologies because their workers do not have the necessary technical skills, thus limiting manufacturers' ability to use these technologies to their fullest potential. Simply put, a lack of a sufficiently-sized and skilled labour pool is directly impacting the growth of manufacturing in Canada today, and will continue to restrict growth moving forward if substantial changes are not made.

Another issue repeatedly arose in the Industry 2030 consultations: the deficit of manufacturing leadership in Canada. While Canada does create great leaders, there are not enough of them. Leadership gets to the heart of manufacturing strategy and entrepreneurship. It affects how companies operate, how they invest, how they create new products and open new markets. It also affects how manufacturers train and develop their workforce. There is a major lack of capacity in training the next generation of innovative manufacturing leaders (in all levels of organizations) with up to date and applied skill sets.

The distribution of labour and skills shortage is widespread throughout functions of the manufacturing sector. It is the main incentive for companies to refocus on performance and efficiency, and the first consideration for their decision making process for investments (Fig. 4 & 5).

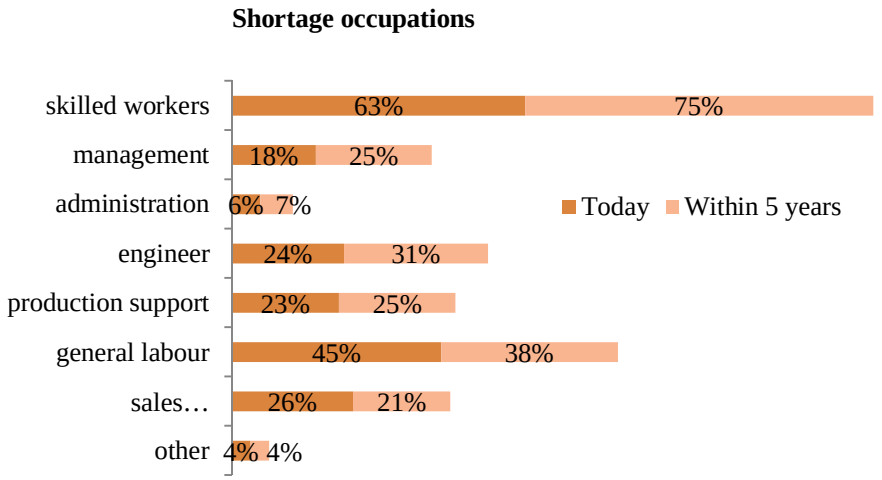

Figure 4: Occupational distribution in skilled labour shortages in industry

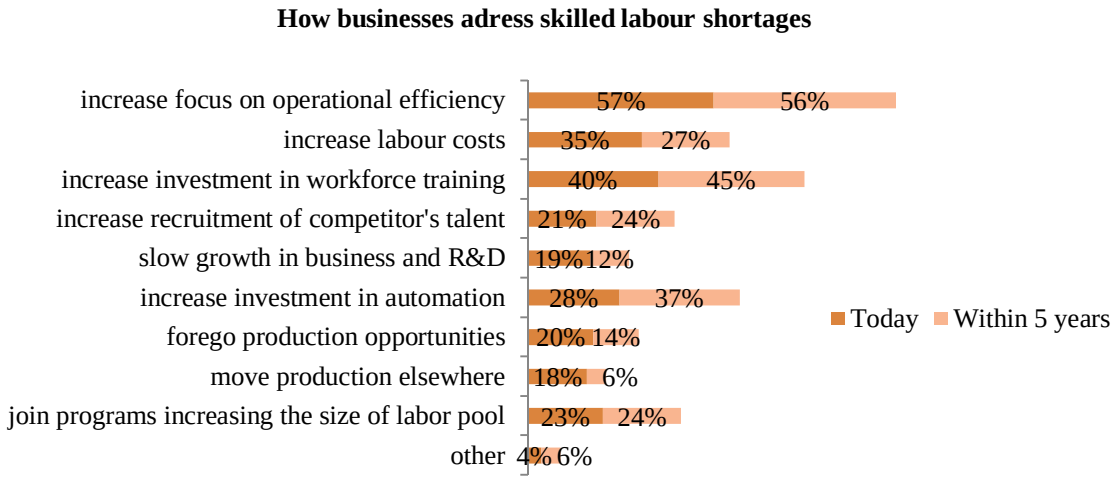

Figure 5: Response from industry to skilled labour shortages

As part of the strategy to address the issues pertaining to building a strong and skilled workforce for growth, CME proposed a set of general recommendations:

- Increase the effective engagement of youth, women and under-represented groups in the manufacturing labour force. Programs such as “open doors” that introduce underrepresented groups to opportunities in manufacturing should be expanded nation-wide. Post-secondary science, technology, engineering and mathematics (STEM) training also needs to be improved, with an increased emphasis on workplace-focused technical, social and safety skills.
- Improve linkages between industry and post-secondary institutions. Manufacturers need to work more closely with educators to develop and fine-tune program curricula, as well as to offer feedback on the skills that recent graduates bring to the table so that curriculum adjustments can be made in a timely, relevant manner. The network of work-integrated learning programs across Canada needs, to be expanded to create better pathways to the development of work-related skills and ensure a better match between education and manufacturing workforce needs, including increased corporate participation and government support through incentives aimed at student wages.
- Expand supports for business-led training and management leadership. Better the Canada Job Grant, by increasing the program funding size and making it permanent (multi-year training, more on-the-job training, LEAN manufacturing…). Canadian manufacturers should work with post-secondary institutions to create new programs to support management training. The emphasis of these programs should be entrepreneurship, leadership (at the group and company level), operations management, LEAN techniques, and combined technical and management training (such as combined engineering and MBA programs).
- Improve access to foreign-trained skilled workers.

In addition, the manufacturers have found that young graduates are not armed with the skillset they require to be integrated in industry. As a consequence, the average time to develop a new hire is reported as 2 years and is deemed too long. It is thus crucial that post-secondary curriculums be better aligned and emphasizes multi-disciplinary skills rather than specialization.

The case of management.

In addition, CME conducts a biannual management survey across Canada, in order to get into the mindset, aspirations and concerns of manufacturers. The demographics of the survey are shown in figure 6.

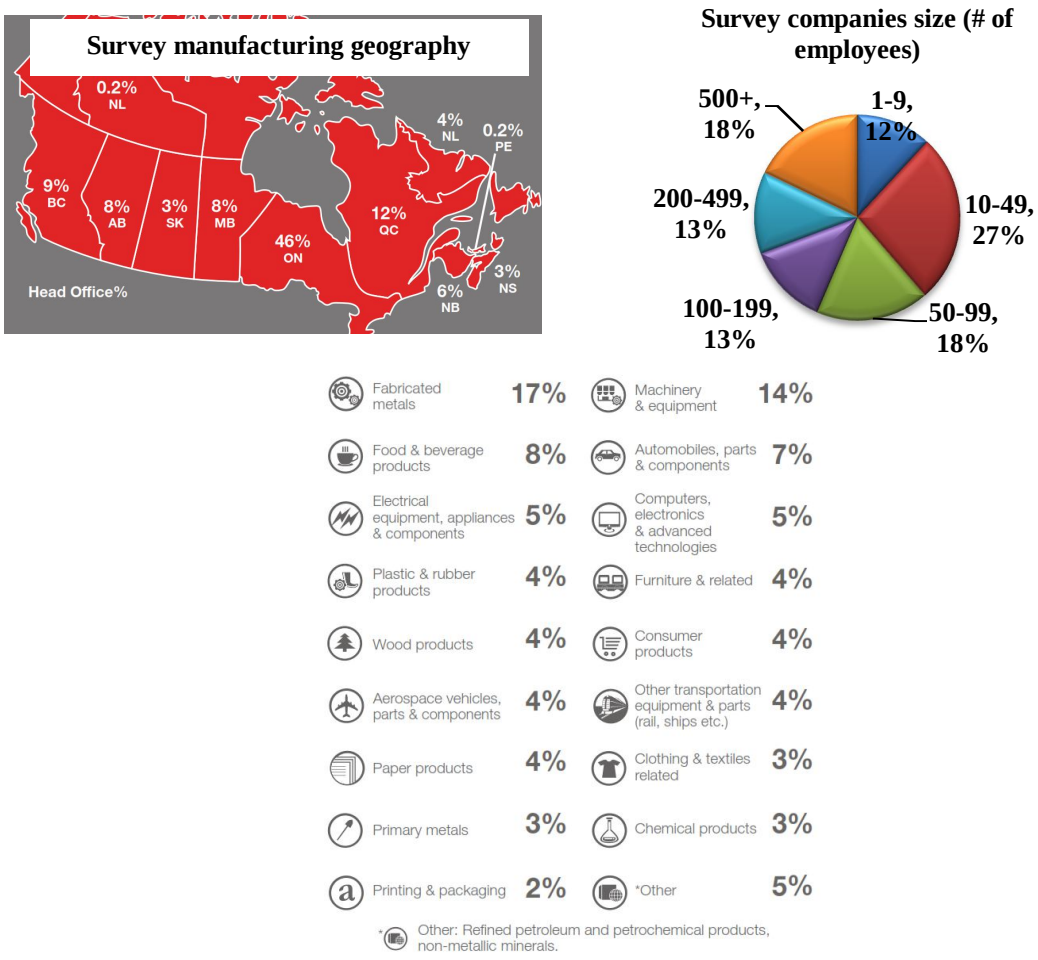

Figure 6: Distribution of survey respondents, companies' sizes and industrial sectors

From the management survey, 2 of the top 5 concerns are finding a skilled and quality labour workforce, and the adoption and implementation of new technology to promote innovation. Overall, 4 main actions were identified as essential for the future of manufacturing in Canada from a management perspective, 2 of which are more of interest:

- Labour, skills and training: Manufacturers want improvements to the suite of programs available for in-house training, and they want more financial support for that training. They also want governments to work with post-secondary institutions to improve existing training programs and to expand work-integrated learning programs in Canada.
- Innovation and technology adoption: Uptake of advanced manufacturing technologies in Canada is low, but businesses want to reverse that trend. Respondents believe tax credits

and other incentives will help offset investment risks. They also want more opportunities to examine and test these technologies.

In summary, the concerns of companies from a managerial perspective are aligned with the identified needs and requirements of manufacturing in Canada to be competitive; there is an urgent need to develop a training platform aligned between post-secondary institutions and industry to educate and develop a skilled and quality workforce which can be seamlessly integrated by industry. A particular attention needs to be given to the training of managers of people (level 1 and 2), who are the first enablers and engagers of the work force, particularly in the adoption of new technologies.

The adoption of new technologies and practices

Since 1970s there have been a rapid advancements in computing hardware and software which have provided a basis for a continuing development of novel manufacturing methods, better decision making (based on models) in management of manufacturing processes and the supply chain, as well as paradigm-altering computing and communication devices which we encounter in our daily lives. This new manufacturing paradigm started with stand-alone computer applications which paved the way for the integration of manufacturing equipment with computer-based decision-making applications. Presently a vast change is underway in all aspects of the societal infrastructure and the way we live. Physical world, real space within which we reside is being increasingly augmented by its representation in digital software models, data and inferences engines which reside in various forms of computing systems. New domains of knowledge, which are being continuously discovered in this digital world, require new capabilities for employees and particularly management. Manufacturing systems are evolving towards cyber-physical systems (Fig. 7) which are characterized by a physical asset (e.g. machine) and its digital twin, i.e. a model which mimics the behavior of the physical asset. They are comprised of integrated, hybrid networks of cyber and engineered physical elements. They are co-designed and co-implemented to create adaptive and predictive systems which respond in real time to enhance the performance. Let us note that the Internet of Thing (IoT) is a subset of cyber-physical systems, since its prevailing definition limits it to the physical assets, not including their digital models.

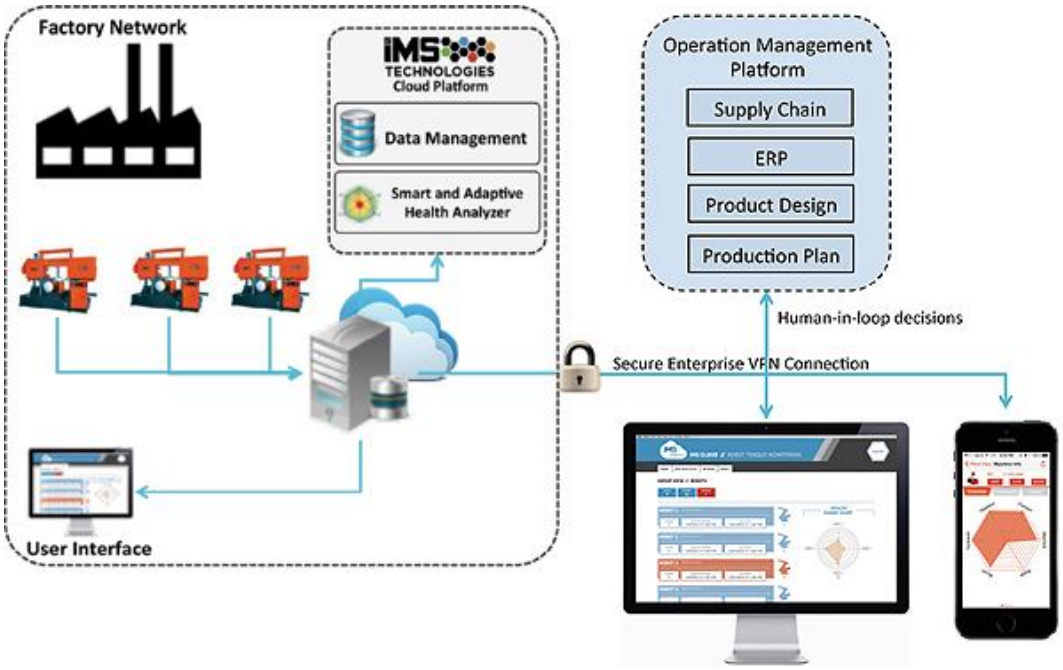

Figure 7: Operators and manager interact with CPSs through a variety of interfaces by utilizing analytical data and models stores in the cloud [5]

A new era of integrated cyber-physical manufacturing systems has begun, requiring managers to have professional and technical capabilities which have not been associated with the traditional manufacturing systems. In other words, a manager ready for the 21st century needs to have the knowledge and capabilities required to understand, design, and improve systems which are comprised of humans interacting with both physical and cyber components. Terms "Industry 4.0" and "Advanced Manufacturing" have been coined to designate such manufacturing systems.

LEAN manufacturing principles

One could argue that ever since mankind developed manufacturing technologies, so were quality control systems, process improvement techniques and so on. Probably, none has had a significant and positive impact, and been talked about as much as LEAN manufacturing. Since its birth and development in the early 1940s in Japan, and most notably by Toyota, it has seen much iteration in implementations, tools and techniques development, and applications to different sectors. However, mostly Japanese, Korean, and German companies have been regularly successful at applying its core principles and benefiting from long lasting consistent results.

This is primarily attributed to the main foundation of LEAN manufacturing, which is an integrated socio-technical system fundamentally driven by the culture of the company in which it is implemented [6]. Indeed, the core principles guiding good LEAN practices are:

1. Continuous improvement
2. Respect for people
3. Long-term philosophy

4. The right process will produce the right results
5. Add value to the organization by developing your people and partners
6. Continuously solving root problems drives organizational learning

It is a long term cultural change focused on adding value for the customer, which is often undermined by short term pressure to perform and lack of clear training and understanding of its principles, particularly at the managerial level. Two of the major pitfalls of training people to LEAN practices are:

- To try to teach too rapidly, too many and complex tools (Fig 8) which can only be used successfully if fully supported by a mature organization.
- Try to force a culture change in people and organizations rapidly.

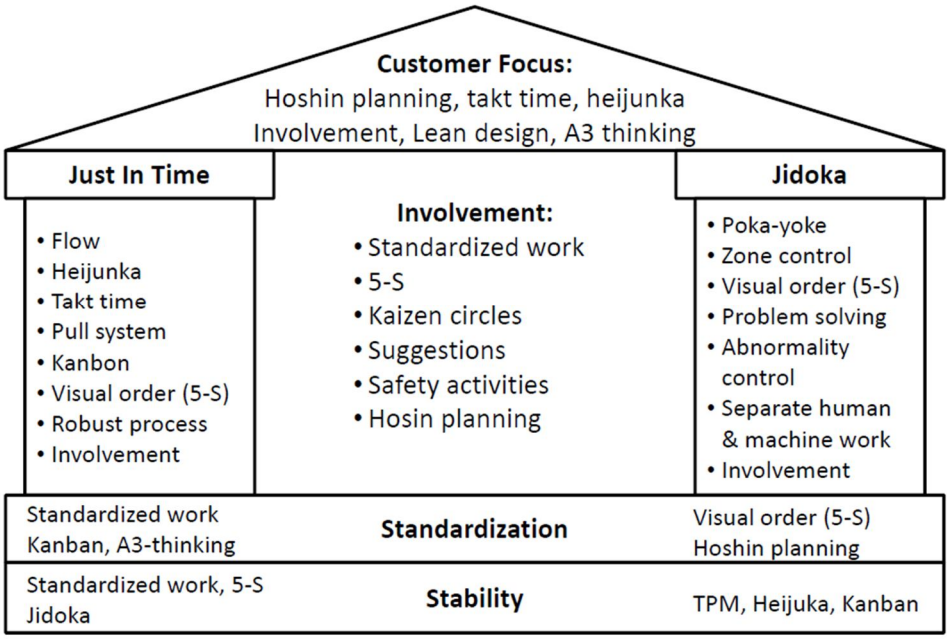

Figure 8: The house of LEAN, a panoply of tools and techniques

There are however basic, simple tools and techniques, which can be learned, practiced and implemented using the current framework of any organization, and which will give fairly rapidly tangible results. These are the tools and techniques that management need to focus on.

References:

1. CME report 'Roadmap to 2030', 2016.
2. CME report 'Industry 2030 building a strong and skilled work force for growth', 2016
3. Industry Canada
4. CME report 'Management issues survey', 2016
5. Bagher, B. , 2015, Big future for cyber-physical manufacturing systems, Design World, Sept. 23, http://www.designworldonline.com/big-future-for-cyber-physical-manufacturing-systems/
6. 'The Toyota Way Fieldbook', J.K. Liker, 2005

1.2 PROPOSAL PREPARATION AND CONSULTATION PROCESS

Not applicable.

1.3 CONSISTENCY WITH MCMASTER'S MISSION AND ACADEMIC PLAN

i. McMaster's Strategic Mandate Agreement:

This Certificate of Completion will strengthen the relationship between McMaster and local industry.

ii. McMaster's current priorities

The goal of the proposed certificate is to transfer the latest technologies in operations leadership to the local community of businesses. The primary learning mode will be experiential learning, particularly during the workshops in which hands-on role play type activities will give the students the time and opportunity to practice in a safe environment what they have learned during the classes.

1.4 PROGRAM LEARNING OUTCOMES

Upon completion of the Certificate the student will have acquired the knowledge and practical skills to:

PLO #1. Understand and apply leadership skills in order to engage and enable direct and indirect reports, unionized and non-unionized, as well as peers and teams.

PLO #2. Apply fundamental managerial tools and techniques to create a solid and stable performance based business unit; define and achieve a budget.

PLO #3. Lead continuous improvement initiatives and problem solving activities. Become an agent of change.

PLO #4. Understand roles and responsibilities within an organization, including relevant laws and regulations.

PLO #5. Communicate clearly and in simple concepts the current innovations in manufacturing and servicing (Industry 4.0), and become an ambassador promoting the adoption of new technologies.

1.5 CONSISTENCY WITH DEGREE LEVEL EXPECTATIONS

Not applicable.

1.6 DEMAND FOR THE PROGRAM

EVIDENCE OF SOCIETAL/LABOUR MARKET NEED

Note: Some elements of this was mentioned in section 1.1. After a brief review, this section will present some data about the status of the labour market.

As mentioned, CME conducts a biannual management survey across Canada, in order to get into the mindset, aspirations and concerns of manufacturers. The demographics of the survey are shown in figure 9.

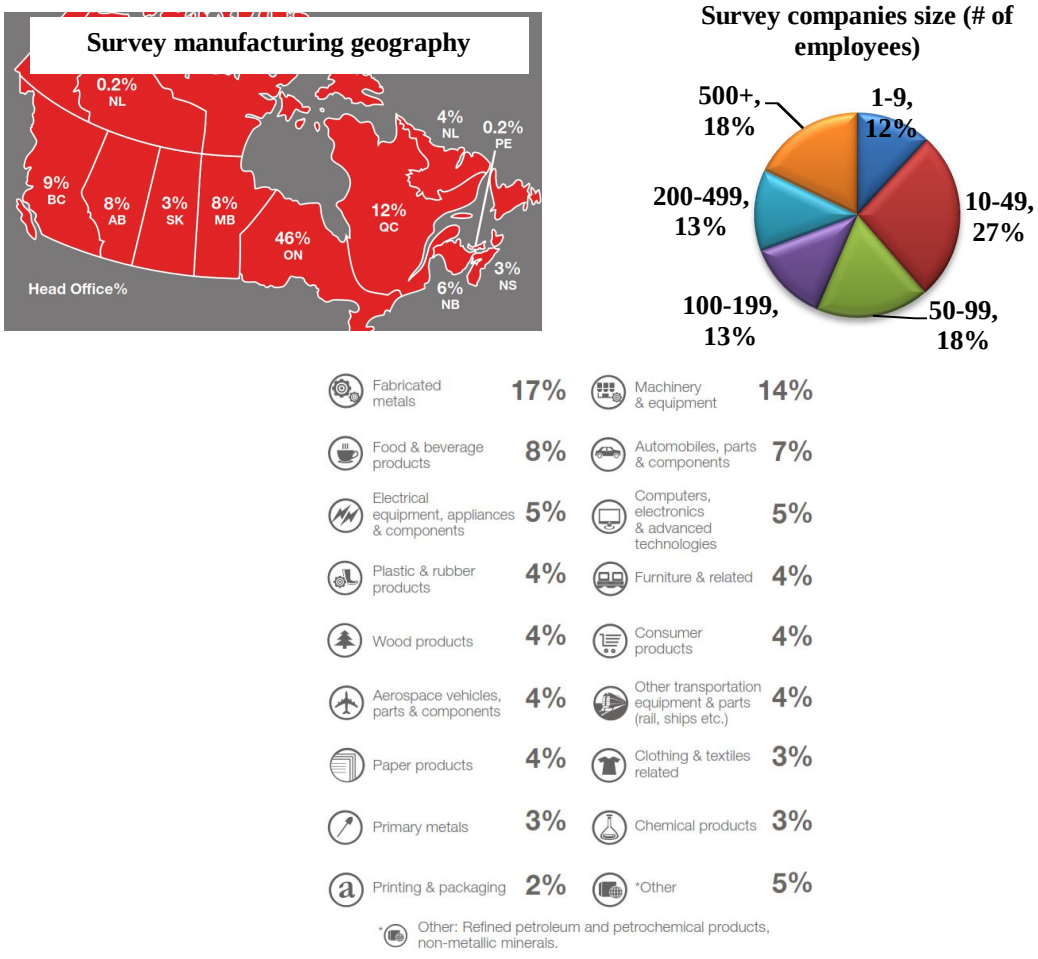

Figure 9: Distribution of survey respondents, companies' sizes and industrial sectors

From the management survey, 2 of the top 5 concerns are finding a skilled and quality labour workforce, and the adoption and implementation of new technology to promote innovation. Overall, 4 main actions were identified as essential for the future of manufacturing in Canada from a management perspective, 2 of which are more of interest:

- Labour, skills and training: Manufacturers want improvements to the suite of programs available for in-house training, and they want more financial support for that training. They also want governments to work with post-secondary institutions to improve existing training programs and to expand work-integrated learning programs in Canada.

- Innovation and technology adoption: Uptake of advanced manufacturing technologies in Canada is low, but businesses want to reverse that trend. Respondents believe tax credits and other incentives will help offset investment risks. They also want more opportunities to examine and test these technologies.

In summary, the concerns of companies from a managerial perspective are aligned with the identified needs and requirements of manufacturing in Canada to be competitive; there is an urgent need to develop a training platform aligned between post-secondary institutions and industry to educate and develop a skilled and quality workforce which can be seamlessly integrated by industry. A particular attention needs to be given to the training of managers of people (level 1 and 2), who are the first enablers and engagers of the work force, particularly in the adoption of new technologies.

In the May 2011 employment survey [1], almost 30% of the Canadian workforce was in the National Occupation Class A (or NOC A) (management & professionals (often with a university degree). Of that, about a third was in middle management (Fig. 10).

Employed population aged 15 years and over	Number
All	**16,595,035**
Employed population aged 15 years and over	**Percentage**
NOC skill level A	**29.9**
Management positions	**11.5**
Senior management	1.3
Middle management	10.2
Professionals	**18.3**
NOC skill level B[2]	**31.5**
Level B occupations usually requiring college education	17.0
Level B occupations usually requiring trade certificate	7.9
Level B supervisory occupations[3]	6.6
NOC skill level C	**27.7**
NOC skill level D	**11.0**
Total	**100.0**

1. See Box 2: Concepts and definitions for information on the National Occupational Classification (NOC) skill levels.
2. To break down the level B occupations as shown in this table, see Box 2: Concepts and definitions.
3. Also includes certain occupations other than supervisory but which have high levels of responsibility in health care and security (e.g., firefighters, police and registered nursing assistants).

Figure 10: Distribution of the employed population aged 15 years and over, by NOC skill level

In the May 2017 employment survey ([8]), the proportion of managerial roles in Canada was of as well of about 10%, showing a fairly stable employment. However, a major finding of the various surveys is the aging labour population. In 2016, 38% of the working population was 55 and older, and 14% was 65 and older. It is predicted that the proportion of 55 + will reach 40% by 2026. As a consequence, the proportion of young people in the workforce is decreasing. Although no statistics is readily available, it could be argued that this situation is hindering the adoption of innovation and new technologies.

From 2012 to 2016 there is a steady increase in the number of jobs in professional, scientific, and technical services in Canada, rising from 1,270,700 in to 2012 to 1,393,700 in 2016 (Statistics Canada, CANSIM, table 282-0008, last modified 2017-01-05).

As of the end of 2014 almost 30% of all enterprises invested in at least one advanced technology between 2012 and 2014. Almost 18% of enterprises invested in advanced logistics technology, while about 16% invested in advanced design and fabrication technologies and about 13% invested in advanced business intelligence (Survey of Advanced Technology 2104, Statistics Canada, Dec 11 2015).

The following table presents some data gathered through the indeed.ca website.

Search criteria	Counts
Operations supervisor/manager	11070
Manufacturing supervisor/manager	3301
Production supervisor/manager	3695

It is obvious that there is a very strong demand for middle management in industry.

In addition, SEPT already has a past history of developing industry specific programs for employees such as the Technology Leadership Certificate.

1. http://www.statcan.gc.ca/eng/subjects/Labour?HPA=1

1.7 DEGREE NOMENCLATURE

Not applicable.

2 ADMISSION & ENROLMENT

2.1 ADMISSION REQUIREMENTS

Applicants with a 4 year undergraduate degree in engineering or science, as well as applicants with an advanced 3-year college diploma will be admitted to the Certificate. A letter of support from the applicant's employer will also be required.

2.2 ENROLMENT PLANNING AND ALLOCATIONS

Not applicable.

2.3 ALTERNATIVE REQUIREMENTS

Not applicable.

3 STRUCTURE

3.1 ADMINISTRATIVE, GOVERNANCE AND COMMUNICATION

The proposed program resides within the W Booth School of Engineering Practice and Technology; a School within the Faculty of Engineering. The School is led by a Director who reports to the Dean of Engineering. The Director of the School serves a 5-year term and is appointed by the Senate. The program will be lead and administered by a program leader reporting to the director of the school.

3.2 STRUCTURE AND REGULATION

Program Structure

The proposed certificate will provide participants with technical and professional capabilities. In order to successfully complete the Program, the students must complete 8 - ¼ courses, plus a ½ course project. The content of the Certificate is equivalent to 5 – ½ courses.

It is a 12 month program.

Modes of Delivery

The coursework for this Certificate will be offered as four modules based on a theme, via a blend of on-line, in-class, and a final 3 days in laboratory delivery at the end of each 3 months period. The courses will be scheduled in 'blocks' of time which are intended to make the Certificate more appealing and accessible to working professionals (see calendar below).

Period	Q3		Q4		Q1		Q2	
Module 1 "Lead it"	**Course**	**Lab**						
Module 2 "Run it"			**Course**	**Lab**				
Module 3 "Control it"					**Course**	**Lab**		
Module 4 "Improve it"							**Course**	**Lab**

3.3 GRADUATE PROGRAMS - PROGRAM LENGTH

Not applicable.

4 CURRICULUM AND TEACHING

4.1 PROGRAM CONTENT

The Operations Leadership and Management Certificate is focused on engaging and enabling its graduates to acquire and practice the professional, ethical, and technical behaviors and competencies required to lead and manage high performance teams. It is interdisciplinary in nature, and the knowledge built ranges from people management, laws and regulations, LEAN manufacturing, financials to innovation and technologies.

The current states and emerging trends in operations management will be the subject of the program. Term workshops and practical activities in this program will facilitate in-depth and practical exploration of specific topics as well as a survey of the broad system aspects by the students.

The latest industry-applicable methods and standards will be addressed in the corresponding courses. Relevant infrastructure standards from different parts of the globe will be presented as needed and their impact on leadership and operations management will be discussed.

4.2 PROGRAM INNOVATION

The program is structured and delivered in an innovative way more suitable for training of professionals working in industry. Each one of the 8 courses will be delivered in 4 steps as part of 4 modules. This will promote the multidisciplinary aspects of operations management and allow students to integrate aspects of each course into learning activities which will culminate at the end of each quarter during the workshops. The following table highlights the module/course matrix.

Table 1: Training matrix showing the relations between four thematic modules and the 8 courses.

Course	Module 1 Lead it	Module 2 Run it	Module 3 Control it	Module 4 Improve it
Industry 4.0	Communicating change	Implementing change	Systems integration	Data management
Leadership & management	Leadership skills	Managerial skills	Performance management	Building a team
Continuous improvement and quality system	Lean philosophy Learning to see	Lean tool kit and quality control	Balanced score card and business management	Problem solving
Sustainability & supply chain management	Introduction to supply chain and sustainability	Understanding WIP	Supplier quality	JIT/parts presentation
Decision making using financial information	Introduction to financial statements	Budgeting	Integration of cost in day to day management	Fore planning and forecasting
Project management	Introduction Roles & responsibilities	Building a project plan	Project plan toolkit	Communicating
Laws & regulations	Laws & regulations in manufacturing	Integration in day to day activities	Audits	Organizational systems
People (unionized/non-unionized)	Understanding demographics	Managing people and training	Managing performance	Giving/asking for feedback

The core architecture of the courses delivery and knowledge acquisition is as follow:

- Practical knowledge based on simple tools and techniques which focus on the fundamentals of operations management.
- Experiential learning: students will be asked to bring forward real issues they are facing or best practices. These scenarios will be used during the workshops by applying what they have learned in class.
- Problem solving: The purpose of the curriculum is to guide the students so that they build confidence in tackling and solving problems or initiating improvements.
- Role playing: multiple activities are planned as part of the learning curve of the students. This is a known method particularly to teach LEAN manufacturing.
- Team based activities are planned as well, not only as part of the learning experience, but also as part of networking practice. The intent is for the team to stay in contact professionally.
- Industrial speakers will be invited as well, to share their own experience with the students in terms of operations management (and their career).

4.3 MODE(S) OF DELIVERY

The program is delivered in a blended learning environment including online lectures, forums, self-directed learning and hands-on applications.

4.4 EXPERIENTIAL LEARNING

The program is uniquely defined through a strong experiential learning component. Each course is specifically oriented towards problem-solving, the intensive workshops provide a hands-on learning experience and courses emphasize a "learn-by-doing" approach. Work on industry or civic oriented problems will provide further opportunities for experiential learning by solving problems encountered in real industry situations.

4.5 ACCESSIBILITY

The program supports an environment in which race, age and gender are irrelevant. The program is focused on helping students to attain the level of capabilities corresponding to their role and function irrespective of their abilities or disabilities.

4.6 RESEARCH REQUIREMENTS (IF APPLICABLE)

Not applicable

5 ASSESSMENT OF LEARNING

5.1 METHODS FOR ASSESSING STUDENTS

Student assessment during the course of the Program will be based on demonstrated learning outcomes in each course. Assessments in the courses will be based on

- Assignments
- Demonstrated learning during workshop
- Questionnaire

5.2 CURRICULUM MAP

Program Learning Outcome			
By the end of the program, students will	Expectations	Teaching activities & learning opportunities	Assessments & evidence
Understand and apply leadership skills in order to engage and enable direct and indirect reports, unionized and non-unionized, as well peers and teams.	Communication Active listening Project management Leadership	Each module will have a blend of online lectures, scenario assignments, and inspirational videos or texts. A final 3 day workshop will give the students hands-on experience in applying the fundamental concepts reviewed during the module.	Assignments, questionnaires, and activity during the workshops.
Apply fundamental managerial tools and techniques to create a solid and stable performance based business unit, define and achieve a budget.	Basic financials Budgeting LEAN Performance management		
Lead continuous improvement initiatives and problem solving activities. Become an agent of change.	Communication Initiative Continuous improvement Problem solving		
Clearly understand roles and responsibility, within the organization and laws and regulations	Leadership Understanding of laws and regulations Roles & responsibilities		
Communicate clearly and in simple concepts the current innovations in manufacturing and servicing (Industry 4.0), and become and ambassador promoting the adoption of new technologies.	Entrepreneurship & Intrapreneurship Communication Understand industry 4.0		

5.3 DEMONSTRATING STUDENT ACHIEVEMENT

The assessment tasks will be designed to measure the achievement of program and course level learning outcomes throughout the program and will be embedded into each course.

The following assessment tools will be used to measure student achievements: assignments, and questionnaires. These will be graded using the McMaster University grading system.

The data collected from each of these activities will be analysed using a variety of methods that are currently used in the department.

We will be conducting a survey of students asking them to reflect on their learning experiences. A similar survey of faculty and the students' respective organizations will also be conducted to assess the achievement of learning outcomes by the students and their efforts to provide activities for assessment of the learning outcomes, levels of achievement, and any associated challenges.

6 RESOURCES

ADMINISTRATIVE, PHYSICAL AND FINANCIAL RESOURCES

The Program will be hosted by the W.Booth School of Engineering Practice. The School has administrative staff experienced in the operation of graduate, undergraduate and industry oriented programs. The Director of the School is responsible for the programs offered by the School. Day to day operation of the programs will be managed by a Program Leader who will assume the responsibility for the management of the new program.

The program will be funded from the courses fees. Immediately after the program is approved, the School will start implementing a marketing program which will be prepared in advance in cooperation with the marketing group in the Faculty of Engineering.

At the time of processing applications for the first cohort (expected in 2018/2019) of approximately 20 accepted students, it is anticipated the Program Leader will be responsible for the administrative tasks related to this Certificate. The need for admin support will be assessed in future years of the program.

The delivery of the program will use sessional lecturers with very specific and relevant industry experience. This will likely include the Program Leader which will also be a contract position.

SEPT physical space in ETB building will be used to provide a working and teaching space for the students and instructors.

LIBRARY, TECHNOLOGY, AND LABORATORY RESOURCES

Library facilities in the traditional sense (books and journals on the shelves and space to sit and read them in the library) are not needed by the Program. On-line availability of the journal and books will provide the students with access to the material required for their course work.

W. Booth School of Engineering Practice and Technology has a unique Learning Factory which will be used as sand box for role plays, case scenario study, and learning environment for Industry 4.0.

Learning Factory (Industry 4.0)

SEPT is currently creating a Learning Factory which will provide hands-on learning of systems and components which constitute Industry 4.0. Most of the required equipment is already available at SEPT and we are confident that this learning facility will be ready well before 2018/2019.

The Learning Factory will provide integration from enterprise planning level to the production equipment. It will include prototyping tools, actual cyber-physical systems examples (discrete manufacturing, continuous manufacturing, smart homes/buildings, smart grid, and smart transportation).

A simplified representation of the Learning Factory is given in Fig. 1.

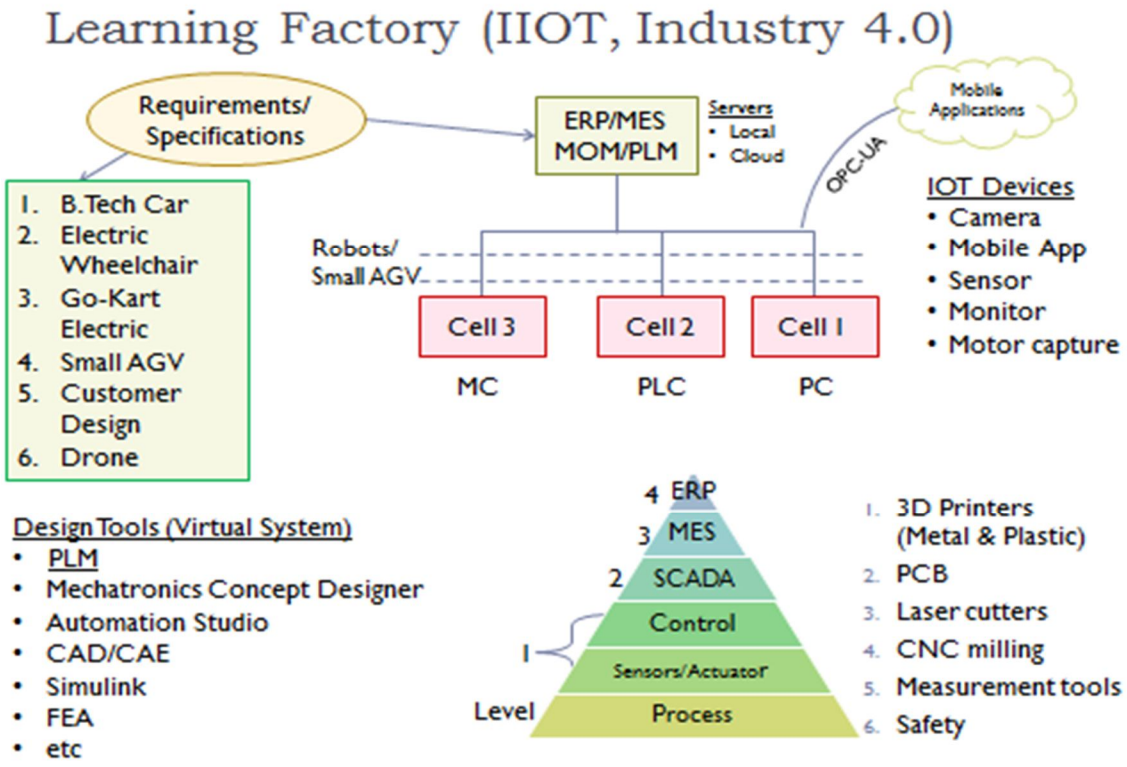

Fig. 1 Simplified representation of the Learning Factory

FACULTY

The proposed program has been budgeted using sessional lecturers. However, several current SEPT Faculty members may fill teaching roles within the Certificate as appropriate.

Table 2 Faculty Members for W. Booth School of Engineering Practice and Technology who may teach courses with the Certificate Program

Name	Rank	M/F	Dept.
Mo Elbestawi	Professor	M	SEPT
Vladimir Mahalec	Professor	M	SEPT
Fleising, Robert	Associate Professor	**M**	SEPT
David Potter	Associate Professor	M	SEPT
Dan Centea	Assistant Professor	M	SEPT

Gao, Zhen	Assistant Professor	M	SEPT
Jeff Fortuna	Assistant Professor	M	SEPT
Mehrtash, Moein	Assistant Professor	M	SEPT
Tom Wanyama	Assistant Professor	M	SEPT
Yuam, Timber	Assistant Professor	M	SEPT
Long, Jennifer	Lecturer	F	SEPT
Singh, Ishwar	Adjunct Professor	M	SEPT
Mikhail Hanna	Adjunct Professor	M	SEPT

STUDENT FINANCIAL SUPPORT

The program will not offer financial support to the students.

*FACULTY RESEARCH FUNDING – **NOT APPLICABLE; THIS IS NOT A RESEACH PROGRAM***

7 QUALITY AND OTHER INDICATORS

7.1 ACADEMIC QUALITY OF THE PROGRAM

This certificate will be added to the school's IQAP process.

7.2 INTELLECTUAL QUALITY OF THE STUDENT EXPERIENCE

The fundamental nature of the program based on problem solving of real issues the students are facing, improvement of their work area, and interaction with peers from other sectors should encourage 'crosspollination' of knowledge and experience.

SEPT Faculty have been recognized as having one of the highest student ratings in the Faculty of Engineering, which is a clear indication of their ability to engage students and create an engaging working environment.

In addition to the classes, the students will be able to participate in the social activities in SEPT. Remotely located students will be able to interact with their colleagues via social media platforms (e.g. Facebook group for each class is a tradition at SEPT).

To: Certificates and Diplomas Committee, February 6, 2018 Meeting

From: Lorraine Carter, Centre for Continuing Education

Re: **The Art of Seeing: Perception and Resilience through Visual Art**
Certificate of Attendance

Date: January 31, 2018

***

The Centre for Continuing Education is pleased to offer a Certificate of Attendance program called **The Art of Seeing: Perception and Resilience through Visual Art**.

Participants enrolled in this program will learn to look at visual art as a means to better understand ourselves and others. The program develops skills to enhance and support professional and personal growth with an emphasis on wellness, resilience, and humanistic leadership. The program derives from the understanding that art is a way to tell our stories. It helps us understand how we fit into our cultures, communities, and workplaces.

The program involves the following:

- Collaboration with a diverse group of professionals
- Three 3-hour sessions held in Hamilton art galleries and museums

Learning outcomes for the program are as follows:

- To develop skills in critical and creative thinking, wellness and resilience, communication, compassion and innovation
- To develop and nurture a humanistic approach to leadership and professional relationships
- To develop resilient leadership strategies to engage and lead inspiring teams

McMaster University

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- Senate

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REPORT TO UNDERGRADUATE COUNCIL
FROM THE
UNDERGRADUATE COUNCIL CURRICULUM AND ADMISSIONS COMMITTEE

FOR APPROVAL

ADDENDA TO CURRICULUM REVISIONS FOR INCLUSION IN THE 2018-2019 UNDERGRADUATE CALENDAR

At its meeting of February 13, 2018, the Undergraduate Council Curriculum and Admissions Committee approved, for recommendation to Undergraduate Council, curriculum revisions for inclusion in the *2018-2019 Undergraduate Calendar*.

Faculty of Social Sciences	(Attachment I)
Faculty of Humanities	(Attachment II)
Faculty of Business	(Attachment III)

The Curriculum and Admissions Committee now recommends,

that Undergraduate Council approve, for recommendation to Senate, revisions to the entry requirements for *Economics* programs, including moving the point of entry into the programs to Level I (effective September 2019), for inclusion in the *2018-2019 Undergraduate Calendar*, as recommended by the Faculty of Social Sciences and set out in Attachment I.

The Curriculum and Admissions Committee now recommends,

that Undergraduate Council approve, for recommendation to Senate, revisions to the entry requirements for the *Health and Society* program, including moving the point of entry into the programs to Level I (effective September 2019), for inclusion in the *2018-2019 Undergraduate Calendar*, as recommended by the Faculty of Social Sciences and set out in Attachment II.

The Curriculum and Admissions Committee now recommends,

that Undergraduate Council approve addenda to curriculum revisions for inclusion in the *2018-2019 Undergraduate Calendar*, as recommended by the Faculties of Business, Humanities, and Social Sciences, as outlined in Attachments I to III.

Undergraduate Council:
February 27, 2018

Faculty of Social Sciences

Addendum to the

Undergraduate Curriculum Report to

Undergraduate Council

FOR THE 2018 – 19 UNDERGRADUATE CALENDAR

February 5, 2018

REPORT TO SENATE

1.0 NEW PROGRAMS: N/A
2.0 NEW MINORS: N/A
3.0 PROGRAM CLOSURES: N/A
4.0 MAJOR REVISIONS TO EXISTING PROGRAMS:

ECONOMICS

4.1 MAJOR REVISIONS TO EXISTING PROGRAMS:

4.11 Introduction of a new direct entry Level I program, Economics I:

Introduction/Justification: *The April 2017 IQAP report for the Department of Economics made a number of recommendations for the Department of Economics to strengthen and enhance their undergraduate programs. The Review Committee noted that Math is not an admission although Grade 12 Calculus, or the equivalent taken at university, is a pre-requisite for Intermediate Microeconomics I (2GO3) or Intermediate Macroeconomics I (2HO3), which must be taken in second year. The Committee believed that this is insufficient to assure student success. They indicated that to do well in the second-year Macro- and Micro-Economic theory courses, as well as the more advanced Theory courses and Econometrics, more Math preparation is needed. This could be accomplished by introducing a Math requirement for admission, and by strengthening the Math requirements within the Economics programs, as we outline below. The IQAP Review Committee recommended that Grade 12 Calculus should be made an admission requirement for each undergraduate Economics program.*

The Department of Economics believes that one of the best ways to ensure the completion of Grade 12 mathematics courses prior to admission to the program is by requiring these courses for admission from high school applicants. The difficulty with the existing program structures is that the Social Sciences I program (the first year program in the Faculty of Social Sciences) stipulates only one required Grade 12 course, Grade 12 English. Over the years, stating that Grade 12 Calculus is recommended for those students intending to pursue a program in Economics has not been effective in bringing in significant pool of new students who have completed Grade 12 Calculus or even those who have completed Grade 12 Advanced Functions. This has created a situation where these students who lack the Grade 12 Math courses are required to complete the high school equivalent courses in Social Sciences I. This takes space in their Level I course selections of up to 9 units if they are lacking Grade 12 Data Management, Grade 12 Calculus and Grade 12 Advanced Functions. Further if we wish to introduce a requirement for a Level I Calculus course this could result in students taking up to 12 units of Math in their Level I program. This is not a desired outcome.

The best way to ensure that incoming high school students have an adequate background in Grade 12 mathematics is to require these courses at the time of admission to Level I. Therefore the Department of Economics is proposing a new Level I program with entry requirements that require at least two Grade 12 Math courses and

will bring McMaster in line with several Ontario universities that have direct entry Economics programs:

Economics I

The following are the minimum Grade 12 U and M requirements:

1. English U
2. Two of Advanced Functions U, Calculus and Vectors U, and Mathematics of Data Management U
3. Completion of three additional U or M courses to total six courses

Note: *Applicants without Calculus and Vectors 4U will be required to take an equivalent Calculus course in Level 1. Applicants without Data Management U will be required to take an equivalent Stats course in Level 1.*

The new Level I program will have Level I course requirements as follows:

Economics I (Beginning September 2019)

Course List

- ANTHROP 1AA3 - Introduction to Anthropology: Sex, Food and Death
- ANTHROP 1AB3 - Introduction to Anthropology: Race, Religion, and Conflict
- CAYUGA 1Z03 - Introduction to Cayuga Language and Culture
- GEOG 1HA3 - Human Geographies: Society and Culture
- GEOG 1HB3 - Human Geographies: City and Economy
- GLOBALZN 1A03 - Global Citizenship
- HLTHAGE 1AA3 - Introduction to Health Studies
- HLTHAGE 1BB3 - Aging and Society
- HLTHAGE 1CC3 - Introduction to Mental Health and Illness
- INDIGST 1A03 - Introduction to Indigenous Studies
- INDIGST 1AA3 - Introduction to Contemporary Indigenous Studies
- INUKTUT 1Z03 – Introduction to Inuit Language and Culture
- LABRST 1A03 - An Introduction to Labour in Canada
- LABRST 1C03 - The Future of Work
- MOHAWK 1Z03 - Introduction to Mohawk Language and Culture
- OJIBWE 1Z03 - Introduction to Ojibwe Language and Culture
- POLSCI 1AA3 - Government, Politics, and Power
- POLSCI 1AB3 - Politics and Power in a Globalizing World
- PSYCH 1F03 - Survey of Psychology
- PSYCH 1X03 - Introduction to Psychology, Neuroscience & Behaviour
- PSYCH 1XX3 - Foundations of Psychology, Neuroscience & Behaviour
- RECONCIL 1A03 – Reconciling What? Indigenous Relations in Canada
- RELIGST 1AB3 - Archaeology and the Bible
- RELIGST 1B03 - What on Earth is Religion?
- RELIGST 1I03 - Religious Themes in Modern Culture
- RELIGST 1J03 - Great Books in Asian Religions
- RELIGST 1L03 – Abraham in Judaism, Christianity, and Islam
- RELIGST 1R03 – Introduction to Anthropology: Race, Religion, and Conflict

- SOCPSY 1Z03 - An Introduction to Social Psychology
- SOCWORK 1AA3 - So You Think You Can Help? Introduction to Social Work I
- SOCWORK 1BB3 - Re-Imagining Help: Introduction to Social Work II
- SOCIOL 1Z03 - An Introduction to Sociology
- SOCIOL 1C03 - Canadian Society: Social Problems, Social Policy, and the Law
- SOCSCI 1SS3 - Inquiry in the Social Sciences
- SOCSCI 1T03 - Life, the University, and a Bit of Everything
- SOCSCI 1RM3 – How Do We Know?: Doing Social Sciences Research

Requirements: 30 Units

6 units

- ECON 1B03 – Introductory Microeconomics
- ECON 1BB3 – Introductory Macroeconomics

0-3 units
from

- MATH 1F03 – Introduction to Calculus and Analytic Geometry *(if Grade 12 Calculus and Vectors U not completed)*

0-3 units
from

- STATS 1L03 - Probability and Linear Algebra *(if Grade 12 Mathematics of Data Management U not completed)*

3 units
from

- MATH 1M03 – Calculus for Business, Humanities and The Social Sciences
- MATH 1A03 – Calculus for Science 1
- MATH 1LS3 – Calculus for the Life Sciences 1

6-9 units
from

- *Course List*

12 units

Electives, which may include courses from the *Course List* (See the Degrees and Programs: Duration in Years section of this Calendar for a list of elective courses available to Level I students)

4.12 Amendment to Level II admission statements for all Economics programs:

Beginning in September 2020, the Level II Economics programs will continue to permit entry for students who have completed any Level I program including the same required courses as Economics I.

****

HEALTH, AGING AND SOCIETY

4.2 REVISIONS TO EXISTING PROGRAMS:

4.21 Major Revision:

Introduction/Justification: *The Department of Health, Aging and Society wishes to pilot a direct entry Level I program, Honours Health and Society I. Competing programs at other universities in Ontario (including Health and Society at York University; Health Studies at Waterloo, and McMaster's Bachelor of Health Sciences) already allow for direct entry. Introducing a direct entry Health and Society program will allow us to attract higher quality students into the Faculty of Social Sciences. Student will still have the ability to select Level I courses from a variety of departments (as they currently do in Social Sciences I) and students would also have the option to change direction into another program after Level I.*

The department believes that McMaster loses out on attracting high school applicants who do not want to wait a year to get the program that they want by applying to Social Sciences I and then applying again through Level II program selection for a limited enrollment Level II program offered by the department. Also, given that Health and Society is not a traditional, easily identifiable discipline-based program within the social sciences (like political science or sociology), students who would be interested might not be getting sufficient exposure to it. Also, even if they know about it, they might not be able to find it….in other words, if you were interested in sociology, you would know to look for it under the umbrella of the social sciences. However, if a student is interested in the various aspects of health, then they would probably not look for health in the social sciences. In addition, the department believes they will be able to attract higher quality students to the Faculty of Social Sciences, and the Provost has indicated we should be more concerned about quality than growth. Like Economics, it is possible that a direct entry program in Health and Society would be attractive to international students, consistent with university priorities. It is also possible that direct entry into programs where competing universities also have direct entry may lead to an increase in the percentage of offers from the Faculty of Social Sciences being accepted, thereby helping the Faculty of Social Sciences meet its enrolment targets. Meeting targets is very important for the Faculty financially.

While some prospective students will be drawn to Health and Society in the secondary school application process, others who enter McMaster through Social Sciences I will 'discover' it by taking the Department's Level I courses (primarily HLTH AGE 1AA3 – Health & Society and 1CC3 – Introduction to Mental Health & Illness), and that door of entry will remain open. In other words, if a student in any Level I program meets the entry requirements, they will still be eligible for entry into Hons Health and Society in Level II, although priority would be given to those who complete the Honours Health and Society I. The total number of spaces available for the Level II programs will remain the same at 120. Conversely, students who complete Honours Health and Society I and prefer to pursue a different program in Level II will be permitted to apply for entry to Level II in other programs for which they qualify.

The Honours Health and Society I program will not have net new Level I spaces. The spots for this program will be taken from Social Sciences I.

The new Level I program will have high school entry requirements as follows:

Honours Health and Society I

The following are the minimum Grade 12 U and M requirements:

1. English U
2. Completion of five additional U or M courses to total six courses

The new Level I program will have Level I course requirements as follows:

Honours Health and Society I (Beginning September 2019)

Program Note

Enrolment in this program is limited.

1. As places in the Honours Health and Society I program are limited, admission is by selection, and possession of the minimum requirements does not guarantee admission.

Course List

- ANTHROP 1AA3 - Introduction to Anthropology: Sex, Food and Death
- ANTHROP 1AB3 - Introduction to Anthropology: Race, Religion, and Conflict
- CAYUGA 1Z03 - Introduction to Cayuga Language and Culture
- GEOG 1HA3 - Human Geographies: Society and Culture
- GEOG 1HB3 - Human Geographies: City and Economy
- GLOBALZN 1A03 - Global Citizenship
- INDIGST 1A03 - Introduction to Indigenous Studies
- INDIGST 1AA3 - Introduction to Contemporary Indigenous Studies
- INUKTUT 1Z03 – Introduction to Inuit Language and Culture
- LABRST 1A03 - An Introduction to Labour in Canada
- LABRST 1C03 - The Future of Work
- MOHAWK 1Z03 - Introduction to Mohawk Language and Culture
- OJIBWE 1Z03 - Introduction to Ojibwe Language and Culture
- POLSCI 1AA3 - Government, Politics, and Power
- POLSCI 1AB3 - Politics and Power in a Globalizing World
- PSYCH 1F03 - Survey of Psychology
- PSYCH 1X03 - Introduction to Psychology, Neuroscience & Behaviour
- PSYCH 1XX3 - Foundations of Psychology, Neuroscience & Behaviour
- RECONCIL 1A03 – Reconciling What? Indigenous Relations in Canada
- RELIGST 1AB3 - Archaeology and the Bible
- RELIGST 1B03 - What on Earth is Religion?
- RELIGST 1I03 - Religious Themes in Modern Culture
- RELIGST 1J03 - Great Books in Asian Religions
- RELIGST 1L03 – Abraham in Judaism, Christianity, and Islam
- RELIGST 1R03 – Introduction to Anthropology: Race, Religion, and Conflict
- SOCPSY 1Z03 - An Introduction to Social Psychology
- SOCWORK 1AA3 - So You Think You Can Help? Introduction to Social Work I
- SOCWORK 1BB3 - Re-Imagining Help: Introduction to Social Work II
- SOCIOL 1Z03 - An Introduction to Sociology

- SOCIOL 1C03 - Canadian Society: Social Problems, Social Policy, and the Law
- SOCSCI 1SS3 - Inquiry in the Social Sciences
- SOCSCI 1T03 - Life, the University, and a Bit of Everything
- SOCSCI 1RM3 – How Do We Know?: Doing Social Sciences Research

Requirements: 30 Units

9 units

- HLTHAGE 1AA3 - Introduction to Health Studies
- HLTHAGE 1BB3 - Aging and Society
- HLTHAGE 1CC3 - Introduction to Mental Health and Illness

9 units

from

- *Course List*

12 units

Electives, which may include courses from *Course List.* (See the Degrees and Programs: Duration in Years section of this Calendar for a list of elective courses available to Level I students)

Faculty of Social Sciences Addendum to the REPORT TO UNDERGRADUATE COUNCIL SUMMARY OF CURRICULUM CHANGES FOR 2018 - 19

This summary report highlights substantive changes being proposed. The complete set of changes are attached for your reference.

1. Department of Economics

- Introduction of a new direct entry Level I program, Economics I for September 2019 entry.
  - i. High school entry requirements will include a requirement for completion of 2 out of the 3 Grade 12 math courses
  - ii. New Level I program will include a requirement for Level I calculus along with the two Level I ECON courses.

2. Department of Health, Aging & Society

- Introduction of a new direct entry Level I program, Honours Health and Society I for September 2019 entry.
  - i. High school entry requirements will be the same as Social Sciences I
  - ii. New Level I program will include a requirement to take all three Level I HLTHAGE courses.

3. Indigenous Studies Program

- Changes to the Notes for the Combined B.A. programs to no longer permit the substitution of Indigenous language courses for the Level I Indigenous Studies courses for entry.
- Addition of 1 new course (INDIGST 2H03)

4. Department of Political Science

- Change to the Minor in Public Leadership to add POLSCI 3PB3 to one of the course lists.

5. Department of Religious Studies

- Addition of 2 new courses in Arabic language (RELIGST 2AA3, 2AR3).

6. Social Psychology Program

- Change in the Level II Admission statement to require only 6 units of course work (SOCPSY 1Z03 and either one of PSYCH 1F03, 1X03 or one of SOCIOL 1Z03 or 1A06AB) for entry to the programs. The outstanding PSYCH or SOCIOL course must be completed by the end of Level 2.
- Adjustment of the program requirements to account for the completion of the remaining 3 units of the Level I courses (if applicable).

7. Department of Sociology

- Revisions to the prerequisites for 26 existing courses (SOCIOL 2BB3, 2CC3, 2DD3, 2EE3, 2FF3, 2GG3, 2HH3, 2I03, 2JJ3, 2L03, 2PP3,2QQ3, 2R03, 2RR3, 2SS3, 2T03, 2TT3, 2UU3, 3G03, 3HH3, 3J03, 3K03, 3MM3, 3NN3, 3X03, 3Z03) to require enrollment in Level II or above.

8. Faculty of Social Sciences

- Addition of new copy to explain/introduce the new Level I programs in the Admissions section of the UG Calendar and in the Faculty of Social Sciences section of the Calendar.
- Updating of Course List 2 for the Social Sciences 1 program to include SOCSCI 1RM3 – the new course created for the Concurrent Certificate in Applied Social Sciences Research.
- Addition of an additional course option to the new Concurrent Certificate in Applied Social Sciences Research and removal of Social Work courses.

FACULTY OF HUMANITIES

UNDERGRADUATE CURRICULUM REPORT

TO UNDERGRADUATE COUNCIL

FOR THE 2018-19 CALENDAR

FEBRUARY 2018

REPORT TO SENATE
FACULTY OF HUMANITIES
SUMMARY OF MAJOR CURRICULUM CHANGES FOR 2018-19

NEW PROGRAMS

None

MAJOR REVISIONS

None

DELETION OF A PROGRAM

None

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For a complete review of all changes, please refer to the February 2018 Addendum to the Faculty of Humanities Report to Undergraduate Council for changes to the 2018-2019 Undergraduate Calendar, found at http://www.humanities.mcmaster.ca/about/faculty-meetings/

REPORT TO UNDERGRADUATE COUNCIL

FACULTY OF HUMANITIES
SUMMARY OF CURRICULUM CHANGES FOR 2018-19

For a complete review of all changes, please refer to the February 2018 Addendum to the Faculty of Humanities Report to Undergraduate Council for changes to the 2018-2019 Undergraduate Calendar, found at http://www.humanities.mcmaster.ca/about/faculty-meetings/

- Addition of one new course
- Minor revisions to seven existing courses
- Revision to Humanities I requirements
- Inclusion of approved concurrent certificate options

FACULTY OF BUSINESS

UNDERGRADUATE CURRICULUM REPORT TO UNDERGRADUATE COUNCIL

FOR THE 2018-19 UNDERGRADUATE CALENDAR

FEBRUARY 2018 – ADDENDUM

APPROVED BY THE FACULTY OF BUSINESS

FACULTY OF BUSINESS
REPORT TO SENATE
SUMMARY OF MAJOR CURRICULUM CHANGES FOR 2018-19
FEBRUARY 2018 ADDENDUM

This report highlights substantive changes being proposed to the undergraduate curriculum. For a complete review of all changes, please refer to the Faculty of Business Curriculum Report for Changes to the 2017-18 Undergraduate Calendar located electronically at: https://ug.degroote.mcmaster.ca/curriculum-report/

NEW PROGRAMS
N/A

MAJOR MODIFICATIONS
N/A

PROGRAM CLOSURES
N/A

FACULTY OF BUSINESS
REPORT TO UNDERGRADUATE COUNCIL
SUMMARY OF CURRICULUM CHANGES FOR 2018-19
FEBRUARY 2018 ADDENDUM

This report highlights substantive changes being proposed to the undergraduate curriculum. For a complete review of all changes, please refer to the Faculty of Business Curriculum Report for Changes to the 2018-19 Undergraduate Calendar located electronically at: https://ug.degroote.mcmaster.ca/curriculum-report/

NEW COURSES

1 new course

- Commerce 4OT3 – Transportation and Warehousing Management

REVISIONS TO EXISTING COURSES

3 new courses have been revised to include the required lecture course hours.

- Principles of Leadership – Commerce 4BP3
- Introduction to FinTech – Commerce 4FY3
- Marketing Analytics - Commerce 4MI3