New Curriculum Development in Operations Management

John TRIMBLE
Tshwane University of Technology, Tshwane, South Africa
trimbleja@tut.ac.za

Tapiwa MURAMBIWA
Tshwane University of Technology, Tshwane, South Africa
murambiwatm@tut.ac.za

Francisca DU PLESSIS
Tshwane University of Technology, Tshwane, South Africa
duplessisf@tut.ac.za

ABSTRACT

Operations management is growing in importance as an advanced studies discipline in Business and Management Schools and Departments. The structured masters program has particular appeal to working professionals with a business or engineering background. Structured masters programs in different areas of Management will serve as vital training for a young South African population preparing to engage in the 4th industrial revolution. Communication advances, particularly in information technology, have escalated the use of online and blended approaches to curriculum delivery. This research focuses on the design and implementation plan of a structured operations management program at the Masters level. It draws on an analysis of existing taught Masters programs at Tshwane University of Technology as well as an examination of best practices on an international level. This study also considers how the 4th industrial revolution should be addressed through curriculum content and delivery. Alternatives are presented regarding the best approach, considering time and resource restrictions.

Keywords: curriculum development, operations management, blended learning.

BACKGROUND

South Africa is concerned with preparing its workforce for the 4th industrial revolution. This is a natural response to globalization and technological advances that are impacting industry, consumption patterns, job creation, culture and communication. Every university wants to improve the employability and job advancement of its graduates. The expansion of postgraduate studies addressing operations management addresses these concerns.

A postgraduate program designed to produce Masters graduates with added skills in operations management in this era of the 4th industrial revolution is in the best position to expand the management workforce responsible for enhancing industry productivity. This is the milieu where advanced courses are developed and taught and where students engage with academic staff to conduct research. Postgraduate studies are increasing in proportion at universities across South Africa. Globally, universities are being rated based on their research production. The Department of Higher Education and Training (DHET) in South Africa recognizes the importance of postgraduate education allocating funding to Masters and Doctoral students directly and through...
various additional sources including the National Research Foundation (NRF), Department of Trade and Industry (DTI), and the Sector Education and Training Authorities (SETAs). Postgraduate outputs provide universities with additional funds for each graduate and each recognized publication. The intent of these incentives is to provide much needed advanced skills. The added incentive for each university is the potential to improve their international ranking and rating. This in turn will make the university more attractive to top students, lecturers and researchers. The higher quality postgraduate students, lecturers and researchers will be more productive contributing toward further increased quality.

Tshwane University of Technology (TUT) is the largest university of technology in Southern Africa. TUT realizes to advance its status as a highly rated university it must expand its postgraduate opportunities. TUT’s Faculty of Management Science has requested that the Department of Operations Management explore the development of a structured masters program in Operations Management.

In 2018, Tshwane University of Technology offered twenty structured Masters degrees. Each of the seven Faculties offers at least one structured Masters degree. The Faculty of Management Sciences currently offers more than any other Faculty, two in the School of Business, two in the Department of People Management and Development and one in the Department of Management and Entrepreneurship. Most of these masters programs are in the process of transforming from Masters of Technology to Masters of Engineering Technology. The university anticipates expanding its postgraduate offerings to several other structured Masters.

All the TUT structured masters programs, with the exception of the Masters in comparative local development and the MBA have a 90 credit research project /Mini-dissertation. To stay in line with other structured masters at TUT, this new program will have a 90 credit mini-dissertation. TUT has mandated every Faculty to develop online taught courses. However, the operations management program will start as an on campus taught program. The department will take advantage of the latest advances in educational technology, make full use of instructional support software and engage in blended learning.

The new program in Operations Management is based largely on examining comparable programs at highly rated universities, the undergraduate programs in Operations Management at TUT and related Masters programs at TUT such as the Engineering Management and MBA programs.

Several internationally rated programs in Operations and Production Management were examined. These include programs from Stanford University, Purdue University and Massachusetts Institute of Technology (MIT) in the USA and Rotterdam School of Management and HEC Paris in Europe. These programs share a strong emphasis in supply chain management, quantitative skills and a variety of taught electives open to students. In all cases the research project was 25% or less of the credits.

Before investigating different options, a number of questions were raised.

1. Should the Masters program address all three programs in the department: project management, management services and operations management?
2. What prerequisites should be established for entry into the program? 65 or 60 minimum on Honours or Postgraduate diploma. Should certain B Tech courses be required?
3. What should be the balance between taught modules and the research component? Should it be 50% taught modules and 50% mini-dissertation? Or 75% -25% split.
4. Should the program draw on modules from other departments and faculties? Enrol students in modules or take all or part of the content of select modules in other departments?
5. Should the presentation of the taught modules be totally classroom based? Or should blended learning modules or full online modules be considered?
6. Should there be one track of Operations Management for all students? Or should we have multiple tracks, such as a track devoted to operational research?
7. Should students be given options to choose between electives? If so what should be the core material required of all students? What and how many electives should be offered?
8. Who is the primary audience for this program? What is the primary pool for potential students? Is the focus fulltime day students or working students?
9. What is the geographic base of our students? Are we focusing on local students, or will we primarily look to draw from across the country, or across Africa or internationally?
10. How will the class be scheduled? Evenings, Friday evening only, Friday and Saturday, Saturday and Sunday, Saturday only, complete a block in 2-3 weeks, modules to go 6-15 weeks meeting one or two days a week, or other options?
11. What resources should be allocated to implement this structured masters? This would greatly impact the scope and timing of the development of the structured masters.
12. How and at what point should the research component be linked to taught modules? Should the research component meet as a class on a regular basis with fixed assignments?

Defining the context for development

The twelve question above were addressed by considering similar programs at leading universities, as well as a careful examination of the TUT trajectory in developing postgraduate studies. The Operations management department is small and one of the youngest in the University.

| Table 1: Terms of Engagement |
|-----------------------------|
| **Pre-requisites**          | Admission to the program requires Honours or Postgraduate diploma in Operations Management or a closely related field. A student must have an average of 60% or higher overall, with 60% or higher in Operations Management, Research Methods and Operations Research modules. |
| **Student Recruitment**     | The pipeline within TUT will be a primary source of recruitment. A plan to focus on recruitment across all UoTs is key to attracting quality students. However, the recruitment pool for this operations management program is international. |
| **Admission Process**       | Student must submit all document standard to the university postgraduate admissions process. Students will submit an abstract of a minimum of 120 words indicating their research interest. After the abstract is approved, the student can register. |
| **Collaboration with other programs** | This program is only for students pursuing a Masters in Operations Management. However, the synergy with programs Project Management and Engineering Management must be considered. |
| **Format of taught modules** | The focus will be on direct contact taught instruction and will rely on the use of computer-based educational technology, as well as blended learning. In anticipation that most students will be working fulltime and attending TUT on a part time basis, taught modules will meet on Friday afternoon/evening and Saturday. 4-6 taught modules will be required. |
| **Scope of core modules**   | Core modules will cover the fundamentals of operations and supply chain management and prepare students will quantitative methods for conducting research and managing production and service operations. Content will be mindful of the demands of the 4th Industrial Revolution. |
| **Scope of elective modules** | The selection of initial electives will take into account the current human resources in the department, university and country. The structure of certain electives will have a flexibility to adjust to demands of the 4th Industrial |
The research component will consist of a mini-dissertation worth half of the credits to complete the degree. At what stage in the Masters program should a student start the research component?

With the merger of the Technikon Pretoria, Technikon North-West and Technikon Northern Gauteng in 2004 a new entity came about that then became known as the Tshwane University of Technology (TUT). The Department of Industrial Engineering and Operations Management resided in the Faculty of Management Sciences and was also restructured in 2004. The B Tech: Technology Management and all the Industrial Engineering courses were transferred to the Faculty of Engineering and Built Environment (FEBE) in June 2004. The Operations Management department still presented Engineering subjects as a service to the Industrial Engineering department until the end of 2014. The subjects were officially transferred to the Industrial Engineering department because of the Operations Management department’s lack of resources. The Operations Management department still has a lack of resources and this was taken into consideration in the development of the structured masters. The results in Table 1 above define the context for developing the new structured masters in operations management.

**PRE-REQUISITES, RECRUITMENT AND ADMISSION**

Admission to the program requires Honours or Postgraduate diploma in Operations Management or a closely related field. Working students with a B Tech in Operations Management may be admitted with the requirement that the complete 40 credits of postgraduate coursework in operations management as approved by the department. A student must have an average of 60% or higher overall, with 60% or higher in Operations Management, Research Methods and Operations Research modules. However, a limited number of students will be admitted. Students with the highest averages will be considered first. However, a balance in student enrolment is important so gender will be considered and students coming from a disadvantaged community will be given special consideration.

A plan to focus on recruitment across all UoTs is key to attracting quality students. The preparation and intent of students in other UoT programs is most similar to that of TUT students. However, the recruitment pool for this operations management program is international. DHET (2017) has developed guidelines for the South Africa curriculum to align with international standards. The plan to recruit top students from outside South Africa will be multi-phased. As the program advances recruitment outside of the country will expand based on results of the programs and resources devoted to this effort. Success in recruitment is directly linked to funding available to support top students.

Student will be required to submit all documents standard to the university postgraduate admissions process. Students will submit an abstract of 200-400 words indicating their research interest with their application. The abstract should clearly indicate the planned methodology. This methodology should be based on material in one of the three core taught modules. They are encouraged to develop their abstract based on a topic from the list provided by the department. When the abstract is approved by the Departmental Committee for Research and Innovation (DCRI), the new student will be allowed to register. There are three registration time frames (start dates) each year. They correspond to the start date of the three core taught modules. The student should start the program with the core taught module that covers the methodological basis for their research. This allows the earliest collaboration with lecturers teaching the methodology the student has chosen to employ. This arrangement will provide the engagement on methodology at the earliest point of study and facilitate faster development of the student’s proposal.
The Operations Management department has three tracks – operations management, management services and project management. The Diploma in Management Services teaches students how to advise all levels of management on solving their problems in a service environment to achieve their organisational goals, in particular regarding profit, cost-effectiveness, quality, efficiency and productivity. The Diploma in Operations Management, on the other hand, deals with the management of the process of providing the market place with products. It covers the tasks, issues and decisions facing an operations manager responsible for providing essential products to the market effectively and efficiently. The current project management qualification offered in the department, focuses on producing well-rounded project management graduates that are capable of applying project management knowledge, skills, tools and techniques to project activities in projects environments of varying complexities.

In developing this new program the synergy with programs in the School of Business and Project Management in the Faculty of Management Science (FMS) and Engineering Management in the Faculty of Engineering and Built Environment (FEBE) must be considered.

**COURSE DELIVERY TAUGHT MODULES**

The planned delivery of the taught modules for the structured Masters of Operations management follows the terms of engagement listed above. The core modules will cover the fundamentals of operations and supply chain management and prepare students will quantitative methods for conducting research and managing production and service operations. The plan for developing and selecting content of the core modules will be mindful of the demands of the 4th Industrial Revolution. The core modules will build on fundamentals taught in the Bachelor’s, Honours and post-graduate diploma level in Operations management in South Africa.

The selection of core modules also takes into consideration core subject matter at leading universities internationally. The trend is to focus more on quantitative techniques. This is consistent with developments of the 4th Industrial Revolution where IoT, Cloud computing and Knowledge management are combining to generate massive amounts of information on both manufacturing and service operations.

Big data and information analysis is becoming pervasive. To better prepare management, the emphasis on quantitative methods such as mathematical programming, regression analysis and forecasting techniques will only increase (Hillier & Lieberman 2015). Big data and analytics also facilitate the use of simulation and other decision support techniques. Operational Research is a core course at both the diploma and advanced postgraduate diploma level. The core module on advanced operations research and quantitative methods builds on these pre-requisites. This module will provide a range of methodologies for students to engage in quantitative research (Wilson et al 2016).

Supply chain management continues to be a core aspect of operations management (Sarkar 2017). The globalisation process makes supply chain and value chain study even more important. Consumer goods and machinery manufacturing involve suppliers from multiple countries increasing the complexity of their supply chains (Chopra and Meindl 2018). The Africa Free Trade agreement offers opportunities to examine the supply chain and value chain from the primacy of Africa. Small and medium enterprises (SMEs) play an important role in the economy of South Africa. It is important to understand SMEs’ role in the supply chain and to assure their fair share of the value chain. These are considerations that must be addressed in this module to best prepare students to engage in management operations. This core module is the pre-requisite for more in depth study in the service, government and manufacturing sectors.

System dynamics (SD) is a methodology that originated at MIT Sloan School of Business (Forrester 1975, 2013). They have one of the internationally top ranked management programs and offer a Masters and Doctoral degree in system dynamics. Along with system thinking, SD has emerged as
a major approach to addressing a wide range of business problems. The approach taken is to train students in the methodology and the programming tools such as Stella or Vensim (Sterman 2000). Peter Senge, trained at MIT in SD, developed a systems approach, for building learning organisations, that is widely used by business and governments (Senge 2006). Both SD and learning organisations are covered in the Business Dynamics taught module for the Engineering Management structured masters at TUT. It has been well received and a number of students use SD as their methodology for their thesis research. The proposed module for operations management will extend the system thinking content (Jackson, 2019). There is a South Africa SD Society that hosted a national conference offering the opportunity for students and staff to present their research. The decision to provide elective modules is in line with the operation of the most successful and highly rated operations management masters programs internationally. This is designed to assure the program keeps pace with evolving sub-disciplines in operations management, as well as the technological demands on industry and government operations. Giving students options through taught electives makes the program more attractive to students that have distinct interests. The selection of initial electives takes into account the current human resources in the department, university and country. The structure of the electives will have a level of flexibility to adjust to demands of the 4th Industrial Revolution (Xing & Marwala 2017; Canals & Heukamp 2019; Odame & Jubi 2018). Financial management and Project management overlap with operations management (Block, Hirt, & Danielsen, 2019; Kerzner, 2018; Turner, 2019). The core taught material provides the basis for advanced studies in financial, project and service management. The elective module on Special Topic: Advances in operations management is designed to adjust the content based on current developments in operations management.

The range of credits varies indicating the potential range in depth of each of the taught modules. The minimum number of taught modules would be four with three core modules of 30, 20 and 20 credits and one elective of 20 credits. The option detailed below is with three core modules of 20 credits each and two electives of 15 credits each. This provides more time for the core modules that focus on alternative methodologies that the students can select from. The elective modules will be provided based on resource availabilities and may be offered only once every two years.

| Table 2: Taught modules: Core and Elective. |
|-------------------------------------------|
| **CORE TAUGHT MODULES (20 credits each)** |
| Advanced Operations Research & Quantitative Methods |
| Supply Chain Design & Management with Value Chain analysis |
| System Dynamics and System Thinking |
| **ELECTIVE TAUGHT MODULES (15 credits each)** |
| Advanced Operations Management: Engaging the 4th Industrial Revolution |
| Project Management |
| International & Environmental Management |
| Service Management |
| Special Topic: Advances in Operations Management |
| Financial Management |

**COURSE DELIVERY RESEARCH COMPONENT**

In keeping with most structured masters programs at TUT, the research component will consist of a mini-dissertation worth 90 credits, half of the 180 credits required to complete the degree. Every effort will be made in organising this component to assure timely proposal development and dissertation completion. This will require a careful examination of the successes and failures in how current structured masters programs are handling their research component.
The critical question is - At what stage in the Masters program should a student start the research component? Some programs require completion of all the taught modules before beginning the research component. NRF will only fund Masters students that complete their research proposal within six month of the start of the program. Students in the current structured masters for Engineering Management submit their proposal during the 2nd year. This makes them ineligible for NRF funding. The current Policy on Postgraduate Studies states “the student prepares and submits a research proposal preferably within six months (but not later than eight months) to the relevant DCRI, for approval by the FCPS.” The organisation of the research component must take these realities into consideration.

The Policy document on Postgraduate Studies must be revised to clearly indicate the distinction between mini-dissertation and full research dissertation. This may require indicating a recommended page limit or required number of references. It may also address changes to the external review process. External reviewers of mini-dissertations must be advised on the unique nature of the mini-dissertation so their review will be consistent with the intent of the structured masters program.

The recommendation is that all students develop their proposal during the first six months of study. The Faculty Committee of Postgraduate Studies (FCPS) must approve a student’s proposal within this time period. This requires that students have a strong idea of what they will research and the methodology they will employ when they start the program. Students should build on the abstract they submitted as part of the admissions requirement. Students should draw their methodology from one of the three core taught modules. This will allow a student to complete a significant portion of the methodology development while completing these core modules.

Most Masters programs at TUT and other competing universities in South Africa, require a journal publication, conference presentation or journal ready paper. This is not a standard requirement for most mini-dissertations. All of the students in this program should submit a journal ready paper that must first be approved by the student’s supervisor and then must go through an internal department review coordinated by the DCRI.

Given the current timeline for developing the Operations Management Masters program, aspects of the research component may have to be developed as the program approval process progresses. The university is currently considering recommendations for additions or changes to the Policy on Postgraduate Studies. The process for developing this new masters program should consider submissions to the revised policy document that will benefit the proposed structured Masters in Operations Management.

RESULTS: SELECTION OF APPROACH

The approach addresses both course delivery issues and curricula content development, and will be determined by the time and financial constraints and the program goals. Table 3 examines alternatives for different timelines for full-funded program implementation, while Table 4 corresponds to limited funds for the new program. In both cases, a short-range 1-2 year time constraint is compared to a 3-5 year full term program.

| Time Constraint | Program goal | Recommended approach |
|-----------------|--------------|----------------------|
| 1-2 years       | Limited New program | This requires the addition of one full time senior lecturer or professor fully devoted to the postgraduate program to teaching and supervising students. Core modules taught by Operations management staff. Number of students limited to 20 so department staff can handle research projects. Only four elective modules – project management |

Table 3: Full Funded Curriculum Development Options
(handled in department); financial management (handled by Business school); service management (handled by department) and Special Topic: Advances in operations management. Each core and elective module will be taught once a year

3-5 years Full New Program This requires the addition of two full time senior lecturers or professors fully devoted to the postgraduate program to teaching and supervising students. The additional two electives will be added. All electives and core modules will be taught once a year. With limited staff the enrolment will be maintained at 30 students per year

### Table 4: Limited Funds Curriculum Development Options

| Time Constraint | Program goal            | Recommended approach                                                                                                                                                                                                 |
|-----------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1-2 years       | Limited New program     | Core modules taught by current staff. Number of students limited to 20 so current staff can handle research projects. Only three elective modules – project management (handled in department); financial management (handled by Business school) and Special Topic: Advances in operations management (this allows possibly teaching any of the other listed modules such as service management; this may be handled by department or outside partner). Each core and elective module will be taught once a year |
| 3-5 years       | Full New program        | This requires the addition of one full time senior lecturer or professor fully devoted to the postgraduate program to teaching and supervising students. The additional three electives will be added. The most popular 2 electives will be taught each year and the other four will be taught every other year. For example: project management and special topics every year; financial management and International & Environmental Management even years; and service management & Advanced Operations Management: Engaging the 4th Industrial Revolution the odd years. With limited staff the enrolment will be maintained at 25 students per year |

Stanford University, Purdue University, Georgia Institute of Technology and MIT were selected as benchmark institutions for related structured masters in operations management because they are ranked as top postgraduate programs in operations and production management in the USA (US News, 2018).

Module development of both core and elective modules should be organized as a collaborative effort between the project management and operations management programs in the Management Faculty and the Industrial Engineering department in the Engineering and Built Environment Faculty. This will involve an exchange of course materials used by instructors. Discussions on lecture material; student group and individual exercises and assignments; testing regiments; tutorials and audio and video supplements will lead to the development of enhanced modules. This collaboration must identify new materials relevant to the module and new developments in instructional technology that can be used.
CONCLUSIONS

Learning from best practices of the leading examples is essential to this process. “Operations Management (OM) is the functional area of business primarily devoted to the creation, planning, and management of the resource capabilities used by a firm to create products or services” (Scheller, 2019). The concept of the firm can be extended to address public organisations. This definition of operations management by Scheller College of Business is similar to that expressed by competing top universities. The common ground operations management have with engineering management was considered and they also were examined as a source of best practices (GaTech 2019; Gupta 2018). This is the foundation for developing the new program for TUT. The authors also draw on previous experience in curriculum development. In particular the work on developing an engineering management postgraduate program at TUT (Trimble et al. 2018), as well as work on appropriate technology (Trimble 2013) and socially relevant curriculum development (Trimble & Keeling 2014).

A three-step systems approach was used in developing the recommended program. The first step was to identify questions of concern when developing a postgraduate program in operations management. The second step was to address these questions and craft the ‘terms of engagement’. The final step was to address these terms to flesh out the proposed program. Recognising the uncertainties in support and with time, four scenarios were developed for implementing the new program: 1) short range limited funding; 2) mid-range limited funding; 3) short range full funding and 4) mid-range full funding.

Module descriptors for core and elective taught modules are developed. These descriptors address: syllabus overview; pre-requisites; competencies; method of delivery; assessment activities; credits; anticipated contact and student hours and possible textbooks. Detailed descriptors for all core and elective modules can be found in Appendix B. These descriptors are the basis for comprehensive development of course material. This is a major next step in the process of implementing this new postgraduate program on operations management. The other major need is to develop a set of research topics that students can draw from. This is a key element in the recruitment process as well as assuring the timely completion of the program.

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### Appendix A: Structured Masters Programs Offered at TUT

| Faculty & Department                  | Program                                          | Taught Modules Required | Electives |
|--------------------------------------|-------------------------------------------------|-------------------------|-----------|
| Economics and Finance/Economics      | Comparative Local Development                   | 9                       | None      |
| FEBE / Architecture                  | Architecture in Architectural Technology        | 5                       | None      |
| FEBE / Building Sciences             | Building Science                                | 4                       | 2         |
| FEBE / Industrial Engineering        | Engineering Management                          | 7                       | 4         |
| Humanities / Applied Languages       | Language Practice                               | 2                       | None      |
| Humanities / Public Management       | Public Affairs                                  | 5                       | 7         |
| Humanities / Safety & Security       | Policing                                        | 6                       | 9         |
| Management Sciences /Business School | MBA                                             | 12                      | 6         |
| Management Sciences /Business School | Organisational Leadership                      | 6                       | None      |
| Management Sciences /Management and Entrepreneurship | Entrepreneurship | 6                       | None      |
| Management Sciences /People Management and Development | Human Resource Development | 4                       | None      |
| Management Sciences /People Management and Development | Labour Relations Management | 4                       | None      |
| Science / Environmental, Water and Earth Sciences | Environmental Management | 4                       | 4         |
| Science / Mathematics and Statistics | Mathematical Technology                         | 12                      | None      |
| Science / Pharmaceutical Sciences    | Pharmaceutical Sciences                         | 4                       | 5         |
| Arts / Drama and Film                | Drama                                           | 1                       | None      |

*Note: the four Masters programs (not counting the MBA) in the Faculty of Management Sciences each require either 4 or 6 taught modules and offer no electives.*
### Appendix B: Taught modules – Core and Electives

#### B.1 Core Taught Module Descriptors

| Module Name                                      | NQF-Level | Overview of Syllabus                                                                                                                                                                                                                   |
|-------------------------------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advanced Operations Research & Quantitative Methods | 9         | Review of linear, non-linear, dynamic and stochastic programming and discrete simulation; extensive applications of mathematical programming, linear and non-linear regression, forecasting, cost-benefit analysis and advanced statistical analysis applications. |

| Method of delivery | Contact hours | Competencies                                                                                                                                                                                                                     |
|--------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Classroom lectures, lab sessions for software instruction and tutorial sessions | 40 hours over 10 weeks | Demonstrate the ability to construct and solve a range of mathematical programming models for business situations; And to set up and perform regression models, alternative cost-benefit analysis and statistical models. |

| Module Custodian     | Credits | Module pre-requisites                              |
|----------------------|---------|----------------------------------------------------|
| Operations Management | 20      | Operations Research at Honours or Postgraduate diploma level |

| Method of assessment | Student hours | Assessment activities                                                                 |
|----------------------|---------------|----------------------------------------------------------------------------------------|
| Continuous assessment | 300           | Homework problems using Excel solver and Lindo (or other LP/NLP software) to solve mathematical programming and regression models; In class / group assignments formulating mathematical programs and statistical models; 3 Tests and End of term team project or individual research pre-proposal |

| Textbooks                                      | Reference books | Related websites and videos                     |
|------------------------------------------------|-----------------|-------------------------------------------------|
| Regression Analysis: Understanding and Building Business and Economic Models using Excel: JH Wilson et al | Non Linear Programming: D Bertsekas | www.informs.org http://www.orssa.org.za |
| Introduction to Operations Research: FS Hillier et al |                  |                                                 |
| Module Name                                      | NQF-L | Overview of Syllabus                                                                                                                                                                                                 |
|------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supply Chain Design & Management with Value Chain analysis | 9     | Supply Chain Performance: Achieving Strategic Fit and Scope; Supply Chain Drivers and Metrics; Designing Distribution Networks; Network Design in the Supply Chain; Designing Global Supply Chain Networks; Demand Forecasting in a Supply Chain; Aggregate Planning in a Supply Chain; Sales and Operations Planning; Coordination in a Supply Chain; Global Value Chain; Impact of 4th Industrial revolution |

| Method of delivery | Contact hours | Competencies                                                                                                                                                                                                                                                   |
|-------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Classroom lectures, blended learning with online tutorials, lectures and tests with asynchronous access | 20 hours over 8 weeks | Use of software such as Excel solver to construct and solve supply chain problems at strategic, planning and operational levels, Ability to conduct value chain analysis for global problems. |

| Module Custodian | Credits | Module pre-requisites                                                                                                                                   |
|------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operations Management | 20      | Operations Management at Honours or Postgraduate diploma level                                                                                       |

| Method of assessment | Student hours | Assessment activities                                                                                                                                                                                                                     |
|----------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Continuous assessment | 200          | Problems using Excel solver to locate facilities, design distribution, forecast demand and calculate other supply chain measures; Group activities (in class and online) to evaluate case studies on supply chain design and operation 2 Tests End of term project (team or individual) or individual research pre-proposal |

| Textbooks | Reference books | Related websites and videos |
|-----------|----------------|----------------------------|
| Supply Chain Management Strategy, Planning and Operation: S. Chopra & P. Meindl | Global Supply Chains: Evaluating Regions on an EPIC Framework – Economy, Politics, Infrastructure, and Competence: “EPIC” Structure – Economy, Politics, Infrastructure, and Competence – M. Srinivasan | www.pearsonglobal editions.com/chopra |
| Module Name                     | NQF-Level | Overview of Syllabus                                                                                                                                                                                                 |
|--------------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| System Dynamics and System Thinking | 9         | Major concepts of system dynamics including feedback, delay and generic behaviour; Causal loop diagrams; stock & flow diagrams; bulls-eye diagram; constructing aging chains and using co-flows; modelling using Stella, Vensim or similar software; critical thinking, system thinking, mental models and conceptual models as related to business problems |

| Module Custodian | Credits | Module pre-requisites                                                                                                                                                  |
|------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operations Management | 20      | Operations Management at Honours or Postgraduate diploma level                                                                                                         |

| Method of delivery | Contact hours | Competencies                                                                                                                                                      |
|--------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Classroom lectures, lab sessions for software instruction and tutorial sessions. Some online content, including key videos from noted system dynamic practitioners out of MIT | 32 hours over 8 weeks | Application of system dynamics methodology including identification of problems, reference mode, time horizon and construction of stock & flow diagrams, causal loop diagram, time horizon and bulls eye diagram. Ability to conduct validity checks on system dynamics models |

| Method of assessment | Student hours | Assessment activities                                                                                                                                              |
|----------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Continuous assessment | 200           | Problems using system dynamics software; Construct stock & flow diagrams. Group activities addressing team learning, shared vision, mental models system thinking and critical thinking 2 Tests End of term project (team or individual) or individual research pre-proposal |

| Textbooks | Reference books | Related websites and videos |
|-----------|-----------------|-----------------------------|
| Business Dynamics: J. Sterman  
Learn to Think in Systems: A. Rutherford | The Fifth Discipline: P. Senge  
Strategic Modelling and Business Dynamics, A feedback systems approach: J Morecroft | www.systemdynamics.org  
systemdynamics.org.za |
### Project Management

| Module Name       | NQF-Level | Overview of Syllabus                                                                                                                                                                                                                                                                                                                                 |
|-------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | 9         | Organisation structures, staffing, communication and conflict management; Planning & scheduling techniques; Pricing & cost control; Metric, risk and quality management; project specification, review and life cycle; Master PERT/CPM; Risk analysis; Project management maturity models.                                                                                                                                                         |

| Method of delivery      | Contact hours | Competencies                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| lectures, lab sessions  | 30 hours over 6 weeks | Demonstrate knowledge of and engagement in the area of project management techniques, methods and methodologies including competencies in application of tools and techniques relevant to the field of project management.                                                                                                      |

| Module Custodian          | Credits | Module pre-requisites                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operations Management     | 15      | Advanced Operations Research & Quantitative Methods; Supply Chain Design & Management with Value Chain analysis                                                                                                                                                                                                             |

| Method of assessment      | Student hours | Assessment activities                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Continuous assessment     | 150           | Homework problems; In class assignments formulating mathematical and statistical models; 2 Tests and End of term team project                                                                                                                                                                                                                                                                                        |

| Textbooks                  | Reference books | Related websites and videos                                                                                       |
|----------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------|
| Project Management: A      | A Guide to the Project Management Body of Knowledge (PMBOK(R) Guide-Sixth Edition) | www.projectmanagement.org.za www.ipma.world                                                                 |
| Systems Approach to Planning, Scheduling, and Controlling: H Kerzner   |                 |                                                                                                                    |

### Financial Management

| Module Name                   | NQF-Level | Overview of Syllabus                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Financial Management          | 9         | Investment decision criteria; project cash flows; Risk analysis and project evaluation; Financial forecasting & planning; Working capital management; Corporate risk management; International business finance                                                                                                                                                             |

| Method of delivery            | Contact hours | Competencies                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Classroom lectures, and       | 30 hours in 6 weeks | Display an understanding of risk-return trade-off and ability to conduct financial forecasting.                                                                                                                                                                                                                                                       |
| tutorial sessions             |               |                                                                                                                                                                                                                                                                                                                                                               |

| Module Custodian              | Credits | Module pre-requisites                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operations Management or      | 15      | Supply Chain Design & Management with Value Chain analysis and System Dynamics and System Thinking                                                                                                                                                                                                                       |
| Business School               |         |                                                                                                                                                                                                                                                                                                                                                               |

| Method of assessment          | Student hours | Assessment activities                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Continuous assessment         | 150           | Homework problems; 2 Tests and End of term team project                                                                                                                                                                                                                                                                                                                                                             |

| Textbooks                    | Reference books | Related websites and videos                                                                                       |
|-------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------|
| Financial Management: Principles and Applications: S Titman, A Keown, and J Martin | Financial analysis, Planning & Forecasting: theory and Application: JC Lee & CF Lee | www.fma.org                                                                 |

| Textbooks | Reference books | Related websites and videos |
|-----------|-----------------|-----------------------------|
|           |                 |                             |
| Module Name                                | NQF-Level | Overview of Syllabus                                                                 |
|-------------------------------------------|-----------|-------------------------------------------------------------------------------------|
| Service Management                        | 9         | The service concept; customer and supplier relationships; service processes and service people; resource utilisation, information, networks and technology; performance management; service strategy & culture |

| Method of delivery                         | Contact hours | Competencies                                                                            |
|-------------------------------------------|---------------|-----------------------------------------------------------------------------------------|
| Classroom lectures, and tutorial sessions | 30 hours over 6 weeks | Understand 1) technology options in service industries; 2) service strategy formulation and 3) service performance measures |

| Module Custodian                          | Credits     | Module pre-requisites                                                                  |
|-------------------------------------------|-------------|----------------------------------------------------------------------------------------|
| Operations Management                     | 15          | Advanced Operations Research & Quantitative Methods; and Supply Chain Design & Management with Value Chain analysis |

| Method of assessment                      | Student hours | Assessment activities                                                                   |
|-------------------------------------------|---------------|-----------------------------------------------------------------------------------------|
| Continuous assessment                     | 150           | Homework problems; Case studies of service industries; In class / group assignments; 2 Tests and End of term team project |

| Textbooks & Reference books               |             |
|-------------------------------------------|-------------|
| SERVICE MANAGEMENT An Integrated Approach to Supply Chain Management and Operations Haksever & Render | Service Management: Operations, Strategy, Information Technology: J Fitzsimmons Service Operations Management: Johnson & Clark |

| Module Name                                | NQF-Level | Overview of Syllabus                                                                 |
|-------------------------------------------|-----------|-------------------------------------------------------------------------------------|
| Advanced Operations Management: Engaging 4th Industrial Revolution | 9         | Using AI to eliminate waste; the four manufacturing revolutions; data mining and product flow; introduction to deep learning and neural nets with applications in manufacturing; AI lean six sigma, project management/ development |

| Method of delivery                         | Contact hours | Competencies                                                                            |
|-------------------------------------------|---------------|-----------------------------------------------------------------------------------------|
| Classroom lectures, Tutorial sessions, Online videos | 30 hours over 6 weeks | Understanding how 4th Industrial revolution is different from earlier industrial revolutions; applying AI lean six sigma |

| Module Custodian                          | Credits     | Module pre-requisites                                                                  |
|-------------------------------------------|-------------|----------------------------------------------------------------------------------------|
| Operations Management                     | 15          | Advanced Operations Research & Quantitative Methods                                      |

| Method of assessment                      | Student hours | Assessment activities                                                                   |
|-------------------------------------------|---------------|-----------------------------------------------------------------------------------------|
| Continuous assessment                     | 150           | Homework problems; 2 Tests and End of term team project                                 |

| Textbooks & Reference books               |             |
|-------------------------------------------|-------------|
| Lean Six sigma in the age of AI: M George and D Blackwell | Strategy is Digital: How Companies Can Use Big Data in the Value Chain: C. Gordon et al; Handbook of Research on Supply Chain Management for Sustainable Development: U Akkucuk |
| Module Name                                      | NQF-Level | Overview of Syllabus                                                                                                                                 |
|------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Special Topic: Advances in operations management| 9         | Focus on recent developments in operations management. Knowledge transfer in special topics of operations management. This allows for international guest lecturers to provide online sessions. |

| Method of delivery | Contact hours | Competencies |
|--------------------|----------------|--------------|
| Classroom lectures, online, blended and/or tutorials | 20-30 hours in 4-8 weeks | To be determined by the particular subject matter and lecturers. |

| Module Custodian | Credits | Module pre-requisites |
|------------------|---------|-----------------------|
| Operations Management | 15      | Advanced Operations Research & Quantitative Methods; Supply Chain Design & Management with Value Chain analysis; and System Dynamics and System Thinking; and permission of supervisor |

| Method of assessment | Student hours | Assessment activities |
|----------------------|---------------|----------------------|
| Continuous assessment | 150           | To be determined by the particular subject matter and lecturers. |

| Textbooks | Reference books | Related websites and videos |
|-----------|----------------|-----------------------------|
| TBA       | TBA            | TBA                         |

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| Module Name                                      | NQF-Level | Overview of Syllabus                                                                                                                                 |
|------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| International & Environmental Management        | 9         | The role of different global environmental institutions; Issues with maintaining ocean, atmospheric and fresh water commons; Species and biodiversity conservation; Emerging issues and future scenarios. |

| Method of delivery | Contact hours | Competencies |
|--------------------|---------------|--------------|
| Classroom lectures, tutorial sessions          | 30 hours in 6 weeks | Apply System dynamics to environmental and global problems. |

| Module Custodian | Credits | Module pre-requisites |
|------------------|---------|-----------------------|
| Operations Management | 15      | Supply Chain Design & Management with Value Chain analysis; and System Dynamics and System Thinking |

| Method of assessment | Student hours | Assessment activities |
|----------------------|---------------|----------------------|
| Continuous assessment | 150           | In class / group assignments; Case studies; 2 Tests and End of term team project |

| Textbooks | Reference books |
|-----------|----------------|
| TBA       | TBA            |

Global Environmental Institutions: E Desombre Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems: A Ford