QUALIFICATION SPECIFICATION SECTION A							
QUALIFICATION DEVELOPER	Limkokwing University of Creative Technology						
TITLE	MSc Software Engineering				**NCQF LEVEL**	9	
FIELD	Information and Communication Technology		**SUB-FIELD**		Software Engineering		
New qualification	√	Review of existing qualification					
SUB-FRAMEWORK	General Education		TVET		Higher Education	√	
QUALIFICATION TYPE	Certificate		Diploma		Bachelor		
	Bachelor Honours		Master	√	Doctor		
CREDIT VALUE					240		

1.0 RATIONALE AND PURPOSE OF THE QUALIFICATION

1.0 Rationale of the Qualification

Economy and industry is experiencing a transformation towards software and services-based businesses. Modern products and services increasingly embed software, or are customized, optimized or managed using software in sectors such as health, transportation, and utilities. Software has encompassed critical functional areas of human existence and functionality. From a societal point of view, software provides flexibility, intelligence and security to all the complex systems and equipment that support and control the different key infrastructures of our society: transportation, communication, energy, industry, business, government, healthcare, entertainment, etc. From an economic point of view, software is one of the main drivers of the highly and fully driven technological and knowledge based economies. Software increases productivity and competitiveness in all business activities: industry, commerce, services, finance, etc. Software is the key enabler for innovation and as such Botswana needs Software Engineering skills as evidenced from the following national planning strategic documents.

(a) Botswana National Information and Communication Technology Policy: Maitlamo Policy 2007

The Maitlamo policy advocates for skilling ICT graduates with a strong bias towards research in emergent ICT skills like software engineering. Software engineering is a critical skill in the 4th generation industrial technology revolution as it is core to the essence of this technology revolution. Botswana has postulated through its ICT policy to change from the current resource based economy to a knowledge based economy through embracing 4th generation industry technologies. Use of Internet of Things, Artificial Intelligence, Robotics, Business Intelligence and Big Data Analytics are the key 4th generation industry technologies. Application of these technologies to create contextual technologies and solutions will drive country economies to be knowledge based economies. Botswana therefore needs to develop a strong baseline of software engineering talent and skills which have the rigour and tenacity to research and create contextual technology pertinent to Botswana economy, thus transforming and diversifying the country economy to a strong digital and knowledge based economy.

The national ICT policy also calls for creation of a Botswana Information Society, a nation to be well informed and connected with use of information systems through digitisation process. To date Botswana has already made an appreciable development towards creating a whole some information society through the following

infrastructure e-Government, e-Legislation, e-Education, e-Health, e-Commerce, e-Agriculture and e-Tourism. This observation tallies with the overall revelation of the national ICT policy's vision which is: "Botswana will be a globally-competitive, knowledge and information society where lasting improvements in social, economic and cultural development are achieved through effective use of ICT". Underpinned with this colossal development, Botswana needs to strengthen its stance and position by developing software engineering skills which will continue to improve, maintain and incorporate changes that would definitely come, through a well research based approach and applying empirical software engineering skills and talents.

In a nut shell the national ICT policy advocates human skill development in evolving and emergent ICTs and produce local ICT skills-set in software engineering. The local skills would deliver quality and research based native software applications and avoid problems as noted in the ICT policy that some software applications "…being introduced by Ministries are not designed around the needs of clients, have no common standards or "look and feel". The challenge of failing to implement an overarching e-Government strategy is the danger of creating "cyber stovepipes", wasting money, increasing costs and missing opportunities for service improvements through Electronic Service Delivery" (pg7). This problem can be solved by developing native skills in software engineering with capacity to research and develop contextualised software. The research component should address software development which is looking at local issues and how software should be developed in Botswana.

(b) Botswana Consultancy on the Development of the Science and Technology Human Resource Strategy 2009 Report (BNSTR)

Botswana's Science and Technology policy (1998) was created to direct and monitor attainment of sustainable social and economic development through a coordinated and integrated application of science and technology. The BNSTR May (2009) reports explicitly stated that Botswana labour market "…were deemed in short supply of local ICT (software development, hardware development); database administrators, security specialists (ICT), forensic specialists (ICT), software developers, project managers (ICT) and system analysts…" The report further alluded to a global outlook projection of trends in ICT manpower developments on a global scale and intimated that "…Information and Communication Technology will be high on demand as the world moves towards a technology driven state, the primary industries of construction, mining and oil and gas will also see significant demand. Within ICT, software engineers and networking engineers are forecast to be of greatest demand…"Software engineering skills sets are appropriate skills to drive the Botswana government's effort to create Knowledge based economy, Information Society and diversification of the economy. This also calls for development of research skilled software engineers who can articulate and relate to what Botswana software industry needs.

(c) National Development Plan 10 and 11 (2010-2023)

In the NDP10 and NDP 11 have all emphasised the need for Botswana's economic diversification from non-renewable-resource driven economy to a knowledge driven economy. The strategic plans have recommended ICT integration and adoption as a critical component. This is also complemented by the Maitlamo Policy 2007 which calls for e-governance, knowledge based economy and a Botswana information society oriented community. The NDP10 calls for ICT integration in Botswana through development of skills like "… database administrators, security specialists (ICT), forensic specialists (ICT), software developers, project managers (ICT) and system analysts…" and noted as the most critical ICT skills needed in the

Botswana labour market (pg. 34). In addition the report gives a forecast and need for expertise in ICT such as "software engineers and networking engineers" as both the developed and developing countries are moving towards technology driven economies. This forecast coincides with Botswana's embracement of the 4th generation industry revolution technologies as discussed before. The NDP11 emphasised the training of local software engineers who should create content and applications that are relevant to the Botswana's market and also provide maintenance and upgrading of the national information systems architecture: e-Government, e-Health, e-Education and e-Commerce. Software engineering skills are also needed in the development of the information systems architecture that will enable the government to provide E-Services as envisaged in the Botswana E-Government Policy 2011-2016.

This calls for comprehensive skills development which is operational, tactical and executive thus a need for research based software engineers who are not only software developers but engineers with an ability to formulate solutions through research. The Human Resource Development Council 2016 report also listed software developers and software engineers among the top occupations in high demand in Botswana.

(d) Consultations with Stakeholders

Institutional consultations with the ICT industry, former and current students of the qualification identified the hard and soft skills needed in the industry. The industry needs graduates who have advanced programming skills, software testing and reliability skills, advanced use of empirical software engineering skills, software documentation and testing skills, verbal and written communication skills, analytical and problem solving skills, managerial, project management and research based skills, among others. Because software technology evolves rapidly graduates need to be lifelong learners and endowed with research capability. Therefore the graduates should combine technical expertise with context-sensitive soft skills in order to cope with complex situations in real life.

Besides providing a learning pathway for learners with Level 8 qualifications in software engineering this qualification is in line with local, regional and international industry demand as it will equip learners with deeper insight into proficiency in some of the core fields in the software engineering discipline. The qualifications shall also guide in applying acquired research skills and software engineering in creating new knowledge in key and specific contexts. The ever evolving software engineering landscape has led to the huge growth in the current software development at local, regional and international levels. Many companies now recognise generally and professional software engineering skills as highly strategic and driver of any knowledge based economy and information society. Mastering software challenges through advanced software engineering techniques, methods and tools is a must for all software-intensive industry sectors to stay competitive with their products and services.

1.2 Purpose of the Qualification:

Therefore the purpose of this qualification in MSc Software Engineering is to produce graduates with the following competencies, knowledge and skills:

- Practice scientific research and design in software engineering
- Develop techno-entrepreneurial knowledge for managing software development projects.
- Evaluate appropriate software engineering technologies, methodologies and tools for developing complex software.

- Recognize the complexity of eliciting software requirements and solutions.
- Practice intellectual property and ethics in dealing with software development.
- Apply software metrics and measurement techniques for validating software quality.

2.0 ENTRY REQUIREMENTS (including access and inclusion)

2.1 Normal Requirements

NCQF Level 8 Certificate Qualification in Bachelors Honours Degree in Software Engineering or any Information and Communication Technology Related field of study.

2.2 Recognition of Prior Learning (RPL)

Prospective students who attained qualification and awarded recognition shall be evaluated to determine its equivalence within the NCQF through recorded interviews, oral and practical test to determine the level of knowledge and skill attainment for exemptions for this qualification. The Education Training Providers (ETP), general academic entry requirement may be considered through Accreditation of Prior Learning (APL) (both Certified Prior Learning and/or Prior Experiential Learning) as per the ETP's Admissions and Retention Policy.

2.3 Credit Transfer

Credit transfer shall also be recognised as an approach to enrol those who have other Level 8 Certificate Qualification in Bachelors Honours Degree in ICT or Engineering related degrees obtained from other institutions and recognised by BQA for purposes of placing them to an equivalent NCQF level 8.

2.4 Target Population

- Bachelors Honours Degree in ICT related field (NCQF Level 8)
- Bachelors Honours Degree in Engineering related field (NCQF Level 8)
- Post Graduate Diploma (NCQF Level 8) in Software Engineering with research methodology module at 20 credits

3.0 QUALIFICATION SPECIFICATION SECTION B

GRADUATE PROFILE (LEARNING OUTCOMES)	ASSESSMENT CRITERIA
3.1 **Resolve** scientific research and design in software engineering.	3.1.1 Critique software development theories, methodologies and techniques in software engineering. 3.1.2 Decide through research on relevant theories and approaches for software application to be developed 3.1.3 Conducts feasibility of developing a given software application and tradeoffs. 3.1.4 Justify selected software development concepts, ideas and suggestion based on software engineering. 3.1.5 Document a software engineering research report or research.

3.0 QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
3.2 **Develop** techno-entrepreneurial knowledge for managing software development projects.	3.2.1 Distinguish software applications for different business scenarios and applications 3.2.2 Identify appropriate software engineering tools for developing business applications for various business needs on different platforms 3.2.3 Research and incorporate emergent ICT technologies for recent entrepreneurial ventures 3.2.4 Integrate professional, legal and ethical matters during development for business applications 3.2.5 Review existing business applications with view to increase their value or integrate with legacy systems in the business
3.3 **Evaluate** appropriate software engineering technologies, methodologies and tools for developing software.	3.3.1 Investigate techniques for eliciting software functional requirements from domain stakeholders and recommend appropriate and practical approaches in a given context. 3.3.2 Elicit user requirements using appropriate theories of interaction with software users to derive software functional and nonfunctional requirements. 3.3.3 Verify and authenticate both applicable functional and nonfunctional requirements using appropriate quantitative methods 3.3.4 Apply rigorous and specified software requirements verifications models and tools for developing user sensitive software applications 3.3.5 Compile a typical Software Specification Document for purposes of initiating a software application with the sponsor
3.4 **Critic** knowledge and principles required to develop quality software	3.3.1 Construct various software designs based on the architecture of the software to be implemented 3.3.2 Determine various approaches to derivation and specification of software application interaction interfaces 3.3.3 Investigate possible and appropriate third party or middleware software for interfacing various software components during software development. 3.3.4 Compose the software application architectural layout based on the software application functionality 3.3.5 Derive the physical specification for implementing information and data repository for the software application based on the data model defined.

3.0 QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
3.5 **Recognize** the complexity of eliciting software requirements during interaction with software clients.	3.4.1 Investigate techniques for eliciting software functional requirements from domain stakeholders and recommend appropriate and practical approaches in a given context. 3.4.2 Elicit user requirements using appropriate theories of interaction with software users to derive software functional and nonfunctional requirements. 3.4.3 Verify and authenticate both applicable functional and nonfunctional requirements using appropriate quantitative methods 3.4.4 Apply rigorous and specified software requirements verifications models and tools for developing user sensitive software applications 3.4.5 Compile a typical Software Specification Document for purposes of initiating a software application with the sponsor
3.6 **Create** object-oriented and service-based programs to solve presented and situational problems	3.5.1 Assess the importance and value of developing OO software applications using appropriate software engineering techniques 3.5.2 Integrate advanced OO principles in creating appropriate solution for emergent technologies 3.5.3 Adopt various emergent SE technologies in developing contemporary software applications using OO 3.5.4 Generate possible and creative solutions by integrating various software components which include SHELF software and developed software to realize application required in a multipurpose project 3.5.5 Create possible SE technologies in assisting and solving local problems related to industry and socio domain
3.7 **Develop** software using state-of-the-art techniques and technologies.	3.6.1 Investigate techniques for eliciting software functional requirements from domain stakeholders and recommend appropriate and practical approaches in a given context. 3.6.2 Elicit user requirements using appropriate theories of interaction with software users to derive software functional and nonfunctional requirements. 3.6.3 Verify and authenticate both applicable functional and nonfunctional requirements using appropriate quantitative methods

3.0 QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
	3.6.4 Apply rigorous and specified software requirements verifications models and tools for developing user sensitive software applications 3.6.5 Compile a typical Software Specification Document for purposes of initiating a software application with the sponsor
3.8 **Practice** ethics and professional conduct in dealing with software engineering matters.	3.7.1 Conform to country intellectual property statutes in developing software. 3.7.2 Apply principles of IP in software development 3.7.3 Develop upright morals and ethics in developing software applications. 3.7.4 Relate with social engineering issues that happen from global to local issues on areas of collaboration with other stakeholders 3.7.5 Make relevant local decisions that guide the development of software engineering in the community
3.9 **Test** software quality using appropriate techniques and metrics.	3.8.1 Develop appropriate software project cost using appropriate techniques. 3.8.2 Create software metrics that can be used to obtain objective reproducible measurements that can be useful for quality assurance, performance, debugging, management, and estimating costs 3.8.3 Distinguish different types of software metrics and where they can be applied 3.8.4 Apply the Design Structure Quality Index (DSQI) to evaluate Object Oriented Software Packages 3.8.5 Perform general calculations using DSQI
3.10 **Initiate** lifelong and self-directed learning strategies and opportunities when engaged in software engineering issues.	3.10.1 Identify one's areas of weakness which need strengthening through staff development 3.10.2 Participate in software engineering communities through social media platforms blog and present one's reflection and perception of issues related to software engineering 3.10.3 Collaborate with fellow software engineering experts from different organizations to share knowledge 3.10.4 Subscribe to professional bodies of software engineering

3.0 QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
3.11 **Observe professional,** ethical and cultural codes of conduct in developing software based applications	3.11.1 Practice principles and values of empathy in a software engineering community or in user domain 3.11.2 Apply principles of ethical and professional practice in conducting software engineering activities in particularly when dealing with different clients 3.11.3 Sensitize and respect cultural norms of various eco systems related to area of occupation and location 3.11.4 Abide to legal statues to guide the operations and conduct of software engineering duties in any given context. 3.11.5 Respect and honor working relationships of subordinates and superiors to maintain good working relationships in any give working environment

4.0 QUALIFICATION STRUCTURE			SECTION C
	Module Title	**Level**	**Credits**
FUNDAMENTAL COMPONENT Subjects / Units / Modules /Courses	Innovation and Entrepreneurship	9	20
	Internet of Things	9	20
	Mobile & Distributed Computing Systems	9	20
CORE COMPONENT Subjects / Units / Modules /Courses	Empirical Software Engineering	9	20
	Object Oriented Software Engineering	9	20
	Software Metrics	9	20
	Software Maintenance and Configuration Management	9	20
	Software Engineering Thesis	9	80
ELECTIVE COMPONENT Subjects / Units / Modules /Courses	Internet & Intranet Protocol Application	9	20
	Software Agents	9	20
	Artificial Intelligence	9	20
	Project Innovation and Management	9	20
5.0 RULES OF COMBINATIONS, CREDIT DISTRIBUTION (where applicable):			
Rules of the Qualification The qualification rules constitute a combination of: (a) Elective modules			

(b) Core modules which are compulsory
(c) Fundamentals modules which are also compulsory
(d) To graduate a candidate should have completed 240 credits

Qualification Combination Rules Based on Module Status per NCQF designation of: Fundamental, Core & Electives

- Core modules have a total of 160 credits **inclusive** a thesis module with 80 credits
- Fundamental modules have 60 credits
- **One elective module** must be selected and has 20 credits

Qualification Rule of Credit Distribution Based on NCQF Levels from Level 9 is given below.

- NCQF Level 9 Modules: 240 Credits

6.0 ASSESSMENT and MODERATION ARRANGMENTS

6.1 Standard Conditions of Assessment

- ETP assessors accredited with BQA will design assessments with reference to the approved module descriptor.
- ETP assessor working procedures are supposed to be guided by the ETP's assessment policy.
- Assessments categorization and weightage of modules should be specifies as shown in table below. The ETP will classify what constitute the formative and summative assignments.

Type of Assessment	Weight Percentage of the Assessment
Formative	60%
Summative	40%

6.2 MODERATION

- Both internal and external moderation processes will be carried out in accordance with the ETP Moderation Policy
- Both Internal and External moderators should be accredited with BQA.
- Bother Internal and External moderators should have a qualification at least one level above the Qualification MSc Software Engineering i.e. Level 10.
- External moderators should have both academic and industrial exposure with a minimum experience of 3 years for each category.
- The Internal and External Moderation reports should be compiled for purposes of ETP audit and compliance to BQA requirements.

7.0 PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal articulation of the MSc in Software Engineering

- NCQF Level 9 MSc in Information Technology
- NCQF Level 9 MSc in Computer Science
- NCQF Level 9 MSc in Computer Engineering
- NCQF Level 9 MSc in Business Information Technology
- NCQF Level 9 MSc in Business Information Systems
- NCQF Level 9 MSc in Telecommunications

Diagonal articulation in BSc in Software Engineering may also lead to further studies

- NCQF Level 9 MSc in Educational Technology
- NCQF Level 9 MSc in Electrical Engineering
- NCQF Level 9 MSc in Electronics Engineering
- NCQF Level 9 MSc in Project Management

Vertical articulation in BSc in Software Engineering may also lead to further studies

- NCQF Level 10 PhD in Software Engineering
- NCQF Level 10 PhD in Computer Science
- NCQF Level 10 PhD in Electrical Engineering
- NCQF Level 10 PhD in Telecommunications Engineering
- NCQF Level 10 PhD in Electronics Engineering

Employment Pathways

Graduates of the course may find employment in a range of public and private organisations for the following posts:

- Software Engineer
- Software Architect
- Software Project Manager
- Software Analyst
- Web Site Master
- Software Test Engineer
- Mobile App Developer
- Information Security
- Database developer
- Software Quality Assurance Engineer
- Information Technologist Support Specialist
- Research Scientist
- Information Technologist Educator

8.0 RECOGNITION OF PRIOR LEARNING (if applicable)

Prospective students who attained a qualification and were awarded recognition by BQA registered institution shall be evaluated to determine its equivalence within the NQF through recorded interviews, inspection of transcript or oral and practical test to determine the level of knowledge and skills acquisition for exemptions for this qualification and guided by the ETP RPL policy and in conformance to BQA requirements.

9.0 QUALIFICATION AWARD AND CERTIFICATION

To qualify for an award of a Qualification in MSc Software Engineering a learner must

- Successfully complete the research module in a stipulated timeframe specified by the ETP Academic policy
- Has completed all core modules with 160 credits.
- Has completed all fundamental modules with 60 credits
- Has done one elective module worth 20 credits
- The total credits should be a minimum of 240 credits

10.0 INTERNATIONAL AND REGIONAL COMPARABILITY

10.1. Regional Comparability

Similarities

- All qualification emphasizes on professional practice to ensure development of software engineering competencies through a research thesis module or software engineering project.
- Majority of the qualifications offer electives so as to apply SE skills in domains of specialization.
- Majority of qualifications are at level 9 according to the country The National Qualification Framework.
- All qualifications cover almost all knowledge areas in the domain of Software Engineering
- Majority of the qualifications are learning outcome and minor are objective based
- Majority have study period of 2 years and with 1 year for research project of software engineering capstone project

Differences

- Not all software engineering qualification use the notional 10 hour learning
- The total credits awarded at the completion of the qualification are different

10.2. International Comparability

Similarities

- All qualification emphasizes on professional practice to ensure development of competencies.
- All qualifications also offer electives as areas of further specialization in the qualifications, i.e. applied domain.
- Majority of qualifications are at level 9 according to the country national qualification framework.
- All qualifications cover almost all knowledge areas in the domain of Software Engineering
- Majority of qualifications use the learning outcome based approach
- Similar assessment strategies are used amongst all software engineering qualifications from the international universities
- Majority of international universities have allocated more credits to the software engineering domain

Differences

- Not all software engineering qualification use the notional 10 hour learning to calculate credits
- The total credits awarded at the completion of the qualification are different because of the credit framework used

10.3. Comparability and Articulation of The Proposed Qualification with the ones Examined

The qualification MSc SE being developed has similar attributes to all the qualifications in the following: majority of the modules are software engineering, the NQF level of the qualification is at 9, the qualifications offers elective in the areas of challenge Botswana, the qualification offers research module which is a capstone project in Software Engineering, its uses the same title, it is has coursework modules and covers 2 years. Therefore the qualification is portable, generalizable and standard both in the region and international.

REVIEW PERIOD
Every after 5 years

Other information – please add any supplementary information to help the application for this qualification for NCQF Registration.
• Needs Analysis Document • HRDC Document • National Development Plan 10 and 11 • Maitlamo National ICT Policy • Australian National Qualification Document • UK National Qualification Document • Kenya National Qualification Document • South Africa National Qualification Document

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CODE (ID)			
REGISTRATION STATUS	**BQA DECISION NO.**	**REGISTRATION START DATE**	**REGISTRATION END DATE**
LAST DATE FOR ENROLMENT		**LAST DATE FOR ACHIEVEMENT**	