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The IoC Accreditation Standard – Statements of Alignment

Institute of Coding – Workstream 1.1 - Deliverable 1.1.5

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1. Summary

The IoC Accreditation Standards¹ were developed for the Institute of Coding, a collaboration, funded by HEFCE (later the Office for Students), between over 30 Higher Education Institutions in England and more than 100 employers.

The IoC Accreditation Standards are a response to the concerns articulated in the Shadbolt Review². A key concern was that employers were looking for better “work-preparedness” in graduates, underpinned by real experience. That is, employers want graduates to be able to “do” something.

Thus, the IoC Accreditation standards have been developed to focus on real-world competence rather than on academic achievement. The distinction between these are set out in Bowers, Petre and Howson³. Whilst graduates with both academic insight and real-world competence are necessary across the economy as a whole, existing accreditation schemes seem to focus on the latter, almost to the exclusion of the former.

The key requirement of the IoC Accreditation Standards is that students must demonstrate competence in real-world settings, alongside gaining appropriate academic knowledge, rather than having academic knowledge alone. Students’ real-world achievements are mapped against the SFIA competence framework, and must demonstrate competence in at least one SFIA skill.

An accreditation standard for a degree, at Bachelor’s or Master’s level, must align with external benchmarks and frameworks. This document sets out the alignments between the IoC accreditation standards and:

- The Framework for Higher Education Qualifications in England (FHEQ)
- The Framework for Qualifications in Higher Education in Scotland (FQHEIS)
- The Quality Assurance Agency’s (QAA) Subject Benchmark Statements for Computing
- Emerging academic frameworks, such as the ACM Computing Curricula 2020
- The Skills Framework for the Information Age (SFIA)
- International Standards ISO 17024:2012 and ISO 27443-1:2019 for the certification of software and systems engineers
- The registration requirements for RITTech
- The BCS accreditation requirements for degrees providing the educational component of CITP.

These frameworks are summarised in Bowers & Howson, 2019⁴.

The alignment is confirmed in all cases, provided that the knowledge component of the standard is delivered by a Higher Education Institution that itself complies with FHEQ/FQHEIS.

¹ Chris Sharp, David Bowers, 2019-2021. Institute of Coding Accreditation Standard <https://institute-of-coding.github.io/accreditation-standard/standard/standard/>

² Shadbolt Review of Computer Sciences Degree Accreditation and Graduate Employability, Department for Business, Innovation & Skills and Higher Education Funding Council for England, May 2016, available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/518575/ind-16-5-shadbolt-review-computer-science-graduate-employability.pdf (accessed 03 June 2019)

³ David Bowers, Marian Petre and Oli Howson. 2019. Aligning Competence Hierarchies and Bloom’s Taxonomies: Changing the focus for computing education. In Proceedings of 19th Koli Calling International Conference on Computing Education Research. ACM, Koli, Finland. <https://doi.org/10.1145/3364510.3366147>

⁴ David Bowers, Oli Howson (2019), Analysis of Accreditation Approaches, Open University on behalf of the Institute of Coding, <https://tinyurl.com/IoC-D1-1-1>

2. Overview

The IoC standard is a meta-standard, which may be instantiated in a wide range of contexts, reflecting the demonstration of particular SFIA skills. Whatever the context, the generic responsibility characteristics set out in SFIA correspond to “professional” and “transferable” skills within the various frameworks, and the SFIA skills selected will evidence sufficient technical knowledge and skills to complete the alignment with each framework.

The following sections articulate the alignment of the IoC Accreditation Standard with regulatory frameworks (FHEQ / FQHEIS, QAA); PSRB standards (RITTech, CITP), professional frameworks (SFIA, ISO 24773), emerging academic frameworks (ACM CC2020) and the Open Badge Standard.

For reference, the IoC standard is reproduced in [Appendix A](#).

3. Regulatory Frameworks:

3.1. FHEQ / FQHEIS

A fundamental requirement of an IoC degree is that it must satisfy the usual volume and level requirements for a honours degree. For England, the requirement is set out in the Higher Education Credit Framework⁵, which states that an honours degree comprises 360 credits (3600 study hours) (180 ECTS credits) of learning, with at least 90 credits at NQF level 6.

Study at level 6 is characterised, in the Higher Education Credit Framework, as enabling students to:

critically review, consolidate and extend a systematic and coherent body of knowledge, utilising specialised skills across an area of study; critically evaluate concepts and evidence from a range of sources; transfer and apply diagnostic and creative skills and exercise significant judgement in a range of situations; and accept accountability for determining and achieving personal and/or group outcomes⁶

For the IoC Accreditation Standards to be a valid benchmarks against which degrees can be measured, the standards must ensure that graduates meet or exceed the Outcomes Statements for the relevant level of the Framework for Higher Education Qualifications (FHEQ) (for England, Wales and Northern Ireland) and/or the corresponding framework, FQHEIS (for Scotland). The frameworks are outlined in Bowers and Howson (2019), and the outcomes statements are available from the QAA website⁷.

Both FHEQ and FQHEIS are necessarily subject-independent, and are complemented by Subject Benchmark Statements for each discipline. The frameworks themselves are expressed therefore in generic terms. To confirm the validity of the standard, it is necessary first to demonstrate that graduates from an IoC accredited degree would meet the relevant generic outcome statements.

⁵ QAA (2008), Higher education credit framework for England: ISBN 978 1 84482 870 8
<https://www.qaa.ac.uk/docs/qaa/quality-code/academic-credit-framework.pdf> (accessed 12 Dec 20)

⁶ Ibid, Appendix B

⁷ QAA (2014) The Frameworks for HE Qualifications of UK Degree-Awarding Bodies, available from
<https://www.qaa.ac.uk/en/quality-code/qualifications-and-credit-frameworks> (accessed 13 Dec 2020)

Without pre-judging the specific SFIA skills that are developed in a particular programme, it is helpful to map the generic responsibility characteristics for SFIA Level 3 against the generic outcomes descriptors for an honours degree.

3.1.1. FHEQ – Level 6 – Bachelor’s degree with honours (England, Wales & Northern Ireland)

The mapping for an FHEQ honours degree is shown in [Appendix B1](#).

The notation used in the Appendix tables is that a dot in a table indicates that demonstration of that particular SFIA characteristic contributes to the outcome statement. Outcomes that are fully met are flagged green; those that are met at least in part are flagged amber; and those that are not addressed, red. Some outcomes will be met if the generic characteristics are contextualised within an actual skill; these outcomes are flagged blue. The same notations and coloured flags are used for all of the tables in the appendices. *(Although the images are a little small, they are embedded spreadsheet object, and can be made navigable by double clicking.)*

From the table in Appendix B1, it is apparent that two outcomes are not addressed by the generic responsibility characteristics, and one is addressed only partially. Specifically, the generic characteristics do not of themselves address:

- c.ii to describe and comment upon particular aspects of current research, or equivalent advanced scholarship, in the discipline
- d an appreciation of the uncertainty, ambiguity and limits of knowledge

However, given the characterisation, above, of academic study at NQF Level 6, it would seem clear that an honours degree satisfying the IoC standard would include learning at NQF Level 6, which should lead to these two outcomes.

Similarly, study at NQF Level 6 would combine with the generic responsibility characteristics to deliver the partially satisfied outcome:

- g critically evaluate arguments, assumptions, abstract concepts and data (that may be incomplete), to make judgements, and to frame appropriate questions to achieve a solution - or identify a range of solutions - to a problem.

The remainder of the outcomes are flagged either green (fully demonstrated) or blue (demonstrated given a technical context).

Hence, an honours degree meeting the IoC Standard would deliver the FHEQ outcomes, meaning that the IoC standard is fully aligned with FHEQ.

3.1.2. FQHEIS – Level 10 – Bachelor’s degree with honours (Scotland)

The phrasing for Level 10 of the Framework for Qualifications in Higher Education in Scotland is rather different from that for Level 6 of FHEQ. It might be argued that it is a little more demanding academically.

However, the mapping from SFIA Level 3 generic responsibility characteristics is shown in [Appendix B2](#), and it is clear that the pattern of alignment is similar to that for English honours degrees, with

all of the transferable skill requirements satisfied by the generic responsibility characteristics of SFIA Level 3.

As with the English Bachelor's degree, there are several outcomes that should be demonstrated when contextualised within a particular skill.

The two omissions with respect to the Scottish framework are similar, but somewhat more demanding, to those for English honours degrees:

- c A critical understanding of the uncertainty and limits of knowledge and how it is developed, and an ability to deploy established techniques of analysis and enquiry within the subject.
- e Skills in identifying information needs, and in the systematic gathering, analysis and interpretation of ideas, concepts and qualitative and quantitative data and information from a range of evaluated sources including current research, scholarly, and/or professional literature.

However, as with English Honours degrees, a Scottish IoC degree would include teaching appropriate for the final year of an honours degree (i.e., FQHEIS Level 10), and this would ensure the achievement of these two outcomes.

Thus, an IoC degree would, when taught in a Scottish HEI, be fully aligned to FQHEIS Level 10.

As an aside, FQHEIS does specify a Bachelor's degree without honours, at level 9, for which the outcomes are rather more similar to those for FHEQ Level 6; it would follow that an IoC degree should align completely with FQHEIS Level 9.

3.1.3. FHEQ Level 7 / FQHEIS – Level 11 –Master's degree

For Master's degrees, FHEQ and FQHEIS are combined, to give a single statement of outcomes.

An IoC Master's degree requires demonstration of the generic responsibility characteristics at Level 4. The mapping from these Level 4 characteristics to the joint statement of outcomes for FHEQ Level 7 / FQHEIS Level 11 (Master's Degree) is shown in [Appendix B3](#).

Here, the alignment is more straightforward, as there is an expectation that some Master's degrees will be professionally oriented, and this is captured in the phrasing of the outcome statements. The outcomes either fully demonstrated or demonstrated when contextualised in a particular skill.

The two partial satisfactions:

- d.i to evaluate critically current research and advanced scholarship in the discipline
- d.ii to evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses.

both focus on the critical evaluation that is inherent in Master's level learning. It follows that an IoC degree delivered by an HEI, in either England or Scotland, will be fully aligned to the relevant levels of both FHEQ and FQHEIS.

3.2. Computing Subject Benchmark Statement

3.2.1. Undergraduate benchmark

For computing degrees, the Standard must ensure satisfaction of the QAA Subject Benchmark Statements for Computing.

The Subject Benchmark Statement, for honours degrees, comes in two parts: the benchmark itself, and a set of computing-related skills.

The benchmark describes outcomes for three levels: threshold, typical and excellent students. The mapping from the SFIA Level 3 generic responsibility characteristics to the second and third set of outcomes is shown in [Appendix C1](#), using the same notation as in Appendix B.

All but one of the outcomes are shown to be met, given some technical context; the one which is partially met is,

- vi apply appropriate practices within a professional, legal and ethical framework and identify mechanisms for continuing professional development and lifelong learning.

Since demonstration of practices within professional, legal and ethical frameworks is not (currently) explicit in SFIA, and is needed also for BCS recognition, this requirement is an explicit addition to the standard.

CPD and lifelong learning are covered in the SFIA generic responsibility characteristics.

Hence, the IoC standard for an honours degree meets the QAA benchmark statement at “typical” and “exceptional” levels.

The second component of the SBS is the set of computing-related skills. The mapping for these is shown in [Appendix D1](#), with three sections: *computing-related cognitive skills*, *computing related practical skills*, and *generic skills for employability*.

Not surprisingly, the first two sections are not addressed by the SFIA *generic* characteristics: they are delivered by appropriate learning and practical experience. However, the third group is, again, served well by the generic responsibility characteristics, as shown in [Appendix D2](#).

Two employability skills appear not to be addressed by the SFIA generic responsibility characteristics:

- ii Intellectual skills: critical thinking; making a case; numeracy and literacy; information literacy. The ability to construct well argued and grammatically correct documents. The ability to locate and retrieve relevant ideas, and ensure these are correctly and accurately referenced and attributed.

- vii Sustainability: recognising factors in environmental and societal contexts relating to the opportunities and challenges created by computing systems across a range of human activities.

The first of these is met by study at Level 6, as for the FHEQ outcomes; the second, sustainability, is included as an explicit requirement in the IoC standard.

Hence, the IoC standard meets the QAA Subject Benchmark for Computing, and delivers all of the generic skills for employability. The computing-related cognitive and practical skills will be delivered by the selected knowledge and competence SFIA badges.

Thus, the IoC Accreditation standard is fully aligned with the current QAA Subject Benchmark Statement for Computing.

It should be noted that the SBS is due for update in 2021/22.

3.2.2. Master's Benchmark

The 2019 version of the Master's Benchmark for computing provides indicators only for the threshold level of achievement.

By its very nature, Master's degrees tend to be quite specialised, and can be focussed either on academic or professional challenges. The indicators are, therefore, fairly broad, to accommodate the variety of degrees offered.

[Appendix C2](#) shows the mapping from SFIA level 4 generic responsibility characteristics. As with the SBS for honours degrees, there is an apparent shortfall in the area of appropriate professional, legal, social and ethical frameworks. However, IoC Master's graduates are required to demonstrate that they:

- understand and apply the legal, social, ethical and professional principles that are relevant to their chosen skills;

An interesting requirement is the fifth outcome:

the ability to apply the principles and practices of the particular course's domain in tackling a significant domain-related activity; the solution should demonstrate a sound justification for the approach adopted as well as originality (including exploration and investigation) and a self-critical evaluation of effectiveness, but also critical awareness of current problems and new insights, and a sense of vision about the direction of developments in aspects of the domain of the course.

For purely academic Master's degrees, this outcome is normally addressed through a substantial individual project. In the context of an IoC Master's degree, this outcome corresponds most closely to the "complexity" characteristics:

Work includes a broad range of complex technical or professional activities, in a variety of contexts.

Investigates, defines and resolves complex issues.

The key point, of course, is that an IoC graduate, particularly at Master's level, is expected to have *done* something significant and substantial in a real-world environment.

In summary, the IoC Master's standard is fully compliant with the QAA Master's SBS for Computing.

3.3. CC2020

Users of the QAA Subject Benchmark Statements are exhorted to take heed of the set of ACM/IEEE computing curricula, which are updated regularly.

CC2020 – Computing Curricula 2020 – draws together the salient features of the various individual curricula, and seeks to set the direction of their evolution for the next decade.

One of the key innovations of CC2020, compared with the previous, 2005, report, is an explicit refocussing of curricula on competence. CC2020 builds an interesting academic model of competence, identifying a number of “dispositions” or personal characteristics which bridge from knowledge to competence, and develops an elaborate scheme for documenting the presence of these dispositions within a curriculum.

In contrast, the IoC accreditation standard focusses on the demonstration of real competence in a real-world environment.

Hence, although the IoC accreditation standard may not phrase its requirements in the academic language developed in CC2020, it is completely aligned with the *intent* of that project – the incorporation of the development of real competence into the curriculum. Indeed, the dispositions identified in CC2020 correspond to several of the generic responsibility characteristics.

Hence, the IoC standard is aligned with the intention of the CC2020 model.

4. SFIA – Skills Framework for the Information Age – V7

The proficiency/competency level for the Bachelor's standard is set at SFIA level 3, with some knowledge required at the level to underpin SFIA Level 4.

SFIA level 3, the “apply” level, is appropriate for an initially trained practitioner such as a new graduate.

The Master's standard requires evidence of proficiency or competency at SFIA level 4 (“Enable”), corresponding to a senior practitioner or team leader.

For context, to achieve Chartered status through BCS, the Chartered Institute for IT, evidence is required of a significant period of work at SFIA Level 5 (“Ensure”/ “Advise”).

The threshold for demonstrating proficiency in a skill at a given level is repeated successful application of the majority of the components of the skill over a significant period of time. This is consistent with established practice for assessment against SFIA, and corresponds to being “broadly

competent” in the skill. It is likely that graduates at this level of competence would be “consciously competent” – that is, reliable, but needing to think carefully about what they are doing. This level of competency corresponds to demonstration of several “skills” in the context of ISO 24773, and is consistent with the approach that the SFIA Foundation is developing.

Importantly, to cater for some safety-critical activities, proficiency may be demonstrated in a professionally-simulated realistic environment.

4.1. International Standards: ISO 17024:2012 and ISO 24773-1:2019

These ISO standards^{8,9} sets out the requirements for certification of software and systems engineering professionals. Whilst not strictly applicable to degree accreditation, ISO 17024 is concerned with the reproducibility of any certification scheme, and ISO 24773-1 requires demonstration of *competency* over and above academic capability.

The Accreditation Panel’s agreed mapping processes for competence are sufficient to satisfy ISO 17024, but It is appropriate to align the competence definitions with those in ISO 24773-1.

One of the key distinctions introduced in ISO 24773 is a three-level hierarchy of Knowledge, skill and competency. However, it is important to note that, in ISO 24773 terms, “skill” corresponds to the successful performance of a single activity or task, rather than to a subset of a collection of activities as would be found in a SFIA Skill description.

Knowledge corresponds directly to “academic competence” – or capability: knowing how to do something. “skill” aligns approximately with “conscious competence”, where an individual has mastered a task, and can perform it consciously, but has not yet internalised it, alongside others, to achieve “unconscious competence”. The ISO standard refers to this last level as “competency”.

The threshold competence level required by the IoC standard is “proficiency” in a SFIA skill at level 3. In contrast with the use of “skill” in ISO 24773, proficiency corresponds to successful completion of a subset of the activities specified in a SFIA skill definition, rather than just one activity, and in a realistic environment.

Excellent students may well demonstrate (unconscious) competence.

5. Professional Standards

5.1. RITTech (and advanced RITTech)

The Bachelor’s standard is aligned explicitly with RITTech.

The RITTech competencies are virtually identical to the SFIA Level 3 generic responsibility characteristics, as shown in [Appendix E1](#). The technical requirement is more than satisfied by the competence requirement in the Standard.

⁸ ISO/IEC 17024:2012 Conformity assessment — General requirements for bodies operating certification of persons available from <https://www.iso.org/standard/52993.html>

⁹ ISO/IEC 24773-1:2019 Software and systems engineering — Certification of software and systems engineering professionals — Part 1: General requirements available from <https://www.iso.org/standard/69724.html>

The Accreditation Panel agreed that the IoC standard should use the RITTech assessment approach for the generic responsibilities.

In addition to the competencies in Appendix E1, there are also RITTech requirements for demonstration of personal and professional responsibility, and of a commitment to CPD. The reflection component of the technical assessment has been adapted to ensure that these two RITTech criteria would be satisfied by an IoC graduate.

Hence, the alignment is explicit.

It should be noted that the SFIA framework is updated every three years. Although major changes are not anticipated for the generic responsibility characteristics, ensuring currency of alignment between RITTech, the IoC standard and SFIA may prove challenging.

It is hoped that a similar approach can be taken for the Masters' standard, when it is published.

5.2. CITP *Educational* Requirement

It must be emphasised that this alignment is with the accreditation awarded to undergraduate degrees, for education to underpin chartered status. There is no intention that an IoC degree should be deemed sufficient on its own for Chartered Status; there will still be an additional experience requirement.

The accreditation requirements for a degree to provide the educational component of CITP is in two sections. The first part, mapped in [Appendix E2](#). Nearly all of the requirements are addressed by the SFIA generic responsibility characteristics either on their own or contextualised by at least one skill.

There is one major omission against the core requirements:

- 2.1.6 Recognise the legal, social, ethical and professional issues involved in the exploitation of computer technology and be guided by the adoption of appropriate professional, ethical and legal practices

This is similar to the shortfall against the Subject Benchmark statement above, and is addressed by the inclusion in the IoC standard of a specific requirement to demonstrate an understanding of the legal, social, ethical and professional issues.

The additional BCS requirements for CITP, shown in [Appendix E3](#), will be satisfied by the knowledge and competence achievements required by the IoC standard.

Hence, the IoC standard is aligned with the requirements for academic accreditation for the educational component of CITP.

There is one major proviso, however. The IoC standard does **not** stipulate a significant individual (academic) project, which is essential for BCS accreditation. It follows that, for a programme that

does not include an individual project, IoC accreditation is not currently completely equivalent to CITP accreditation.

6. Open Badge Standard

The IoC standard has been described in terms of the accumulation of IoC/SFIA badges for “knowledge” and “competence”. Given the alignment with ISO 24773, it will be necessary also to provide “skill” badges.

All IoC badges are compliant with the Open Badge Standard. This satisfies requirements set out by the SFIA Foundation for endorsement of badges by the SFIA Foundation.

The concept of combining open badges into a portfolio is relevant to describing an individual’s achievements within an IoC degree.

Furthermore, since the IoC standard is agnostic about how knowledge and experience are acquired, the possibility to stack micro-credentials equating to a SFIA Knowledge – or possibly Skill – badge should also be explored.

7. Conclusion

The IoC accreditation standards are agnostic about which skills from SFIA are demonstrated. Given the number of skills available (102 in SFIA version 7), it follows that alignment with the various external benchmarks and standards that an accreditation standard must achieve can be demonstrated by aligning the generic responsibility characteristics against the benchmark requirements.

For the “employability” or “transferable” skill outcomes, these are often satisfied by demonstration of the generic responsibility characteristics alone; the bulk of the remaining “technical” outcomes are demonstrate by the application of the generic responsibility characteristics in the context of any given SFIA skill.

Having applied this approach, we have confirmed that the IoC Accreditation Standards, based on the SFIA Skills framework, for Bachelor’s degrees with Honours and Master’s degrees align with:

- The relevant FHEQ/FQHEIS outcomes statements
- The appropriate QAA Subject Benchmark Statements
- International standards ISO 17024:2012 and ISO 24773-1:2019
- BCS Professional standards – RITTech, and the educational component of CITP.

subject, in certain cases, to the knowledge requirements being delivered by a Higher Education Institution which itself conforms to the expectations of FHEQ/FQHEIS.

Appendix A: The IoC Degree Accreditation Standards.

From <https://institute-of-coding.github.io/accreditation-standard/standard/standard/>

Bachelor's degree with honours

Graduates should:

- have demonstrated the responsibility characteristics (Autonomy, Influence, Complexity, Knowledge, Business Skills) for SFIA level 3;
- have demonstrated proficiency or competency in one or more relevant SFIA skills at level 3 (the p/c skill(s));
- have underpinning knowledge for a total of four SFIA skills at levels 3 or 4, including the p/c skill(s), and with at least one at SFIA level 4;
- understand and apply the legal, social, ethical and professional principles that are relevant to their chosen skills;
- demonstrate an understanding of the need for sustainable computing in the context of their chosen skills.

Master's degree

Graduates should:

- have demonstrated the responsibility characteristics (Autonomy, Influence, Complexity, Knowledge, Business Skills) for SFIA level 4;
- have demonstrated proficiency or competency in at least one relevant SFIA skills at level 4 (the p/c skill(s));
- have underpinning knowledge for a total of three SFIA skills at levels 4 or 5, including the p/c skills, and with at least one at SFIA level 5;
- understand and apply the legal, social, ethical and professional principles that are relevant to their chosen skills;
- demonstrate an understanding of the need for sustainable computing in the context of their chosen skills.

Notes

Knowledge: The graduate has demonstrated that they can explain and discuss the knowledge relevant to a SFIA skill description.

Proficiency: the graduate has applied relevant knowledge to demonstrate in a realistic* environment that they can perform most of the activities defined in a SFIA skill description.

Competency: The graduate has demonstrated, in a working environment, that they have consistently and reliably achieved the expected outcomes for a SFIA skill description at a professional level.

** Whilst proficiency must be demonstrated in a working context, a workplace supervisor may make a case to justify the use of a professional simulated environment for specific safety-critical tasks.*

The minimum level of achievement required – proficiency – must be demonstrated by repeated successful application of the components of the relevant skill, in a real-world (or realistic simulated) context, over a period of time. This corresponds at least to conscious competence, to “skill” in the terminology of the SFIA professional assessment scheme, and to demonstration of a set of “skills” in ISO 24773:2019 - 1 terms.

Appendix B1: FHEQ outcomes descriptors

FHEQ - Level 6 Outcomes Descriptors		<div>Autonomy</div> <div>Work under general direction. Uses discretion in identifying and responding to complex issues and assignments. Receives specific direction, accepts guidance and has work reviewed at agreed milestones. Determines when issues should be escalated to a higher level. Influence</div> <div>Interacts with and influences colleagues. Has working level contact with customers, suppliers and partners. May supervise others or make decisions which impact the work assigned to individuals or phases of projects. Understands and collaborates on the analysis of user/customer needs and represents this in their work. Complexity</div> <div>Performs a range of work, sometimes complex and non-routine, in a variety of environments. Applies methodical approach to issue definition and resolution. Knowledge</div> <div>Has a sound generic, domain and specialist knowledge necessary to perform effectively in the organisation typically gained from recognised bodies of knowledge and organisational information. Demonstrates effective application of knowledge. Takes action to develop own knowledge. Business skills</div> <div>Demonstrates effective communication skills. Plans, schedules and monitors own work (and that of others where applicable) competently within limited deadline and according to relevant legislation, standards and procedures. Contributes fully to the work of teams, employer or client. Demonstrates an analytical and systematic approach to issue resolution. Takes the initiative in identifying and negotiating appropriate personal development opportunities. Understands how own role impacts security and demonstrates routine security practice and knowledge required for own work.</div>																			
•	o																				
Bachelor's degree with honours are awarded to students who have demonstrated:																					
a	a systematic understanding of key aspects of their field of study, including acquisition of coherent and detailed knowledge, at least some of which is at, or informed by, the forefront of defined aspects of a discipline																				
b	an ability to deploy accurately established techniques of analysis and enquiry within a discipline																				
c	conceptual understanding that enables the student:																				
c.i	- to devise and sustain arguments, and/or to solve problems, using ideas and techniques, some of which are at the forefront of a discipline																				
c.ii	- to describe and comment upon particular aspects of current research, or equivalent advanced scholarship, in the discipline																				
d	an appreciation of the uncertainty, ambiguity and limits of knowledge																				
e	the ability to manage their own learning, and to make use of scholarly reviews and primary sources (for example, refereed research articles and/or original materials appropriate to the discipline).																				
Typically, holders of the qualification will be able to:																					
f	apply the methods and techniques that they have learned to review, consolidate, extend and apply their knowledge and understanding, and to initiate and carry out projects																				
g	critically evaluate arguments, assumptions, abstract concepts and data (that may be incomplete), to make judgements, and to frame appropriate questions to achieve a solution - or identify a range of solutions - to a problem																				
h	communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.																				
And holders will have:																					
i	the qualities and transferable skills necessary for employment requiring:																				
i.i	- the exercise of initiative and personal responsibility																				
i.ii	- decision-making in complex and unpredictable contexts																				
i.iii	- the learning ability needed to undertake appropriate further training of a professional or equivalent nature.																				
Key																					
Satisfied in full																					
Satisfied in part																					
Satisfied, given appropriate technical context																					
Not addressed																					

Appendix B2: FQHEIS Outcome Descriptors

FQHEIS - Level 10 Outcomes Descriptors		<div>Autonomy</div> <div>Works under general direction. Reserves discretion in identifying and responding to complex issues and assignments. Receives specific direction, accepts guidance and has work reviewed at agreed milestones. Determines when issues should be escalated to a higher level. Interacts with and influences colleagues. May supervise others or make decisions which impact the work assigned to individuals or phases of projects. Understands and collaborates on the analysis of user/customer needs and of environments. Performs a range of work, sometimes complex and non-routine, in a variety of environments. Applies methodical approach to issue definition and resolution. Has a sound generic, domain and specialist knowledge necessary to perform effectively in the organisation typically gained from recognised bodies of knowledge and organisational information. Demonstrates effective application of knowledge. Has an appreciation of the wider business context. Takes action to develop own knowledge. Business Skills</div> <div>Demonstrates effective communication skills. Plans, schedules and monitors own work (and that of others) where applicable) competency within limited deadlines and according to relevant legislation, standards and procedures. Contributes fully to the work of teams. Appreciates how own role relates to other roles and to the business of the employer or client. Demonstrates an analytical and systematic approach to issue resolution. Takes the initiative in identifying and negotiating appropriate personal development opportunities. Understands how own role impacts security and demonstrates personal security practice and knowledge required for own work.</div>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Appendix B3: Master's Outcome Descriptors

FHEQ Level 7 - FQHEIS - Level 11 Outcomes Descriptors		<div>Autonomy Works under general direction within a clear framework of accountability. Exercises substantial personal responsibility and autonomy. Plans own work to meet given objectives and processes. Influence: Influences customer's, suppliers and partners at account level. May have some responsibility for the work of others and for the allocation of resources. Participates in external activities related to own specialism. Makes decisions which influence the success of projects and team objectives. Collaborates regularly with team members, users and customers. Engages to ensure that user needs are being met throughout. Complexity: Work includes a broad range of complex technical or professional activities in a variety of contexts. Investigates, defines and resolves complex issues. Knowledge: Has a thorough understanding of recognised generic industry bodies of knowledge and specialist bodies of knowledge as necessary. Is able to apply the knowledge effectively in unfamiliar situations and actively maintains own knowledge and contributes to the development of others. Rapidly absorbs new information and applies it effectively. Maintains an awareness of developing practices and their application and information to both technical and non-technical audiences. Communicates fluently, orally and in writing, and can present complex information to both technical and non-technical audiences. Plans, schedules and monitors work to meet time and quality targets. Facilitates collaboration between stakeholders who share common objectives. Selects appropriately from applicable standards, methods, tools and applications. Fully understands the importance of security to own work and the operation of the organisation. Seeks specialist security knowledge or advice when required to support own work or work of immediate colleagues.</div>																			
•	o																				
Master's degrees are awarded to students who have demonstrated:																					
a	a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their academic discipline, field of study or area of professional practice																				
b	a comprehensive understanding of techniques applicable to their own research or advanced scholarship																				
c	originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline																				
d	conceptual understanding that enables the student:																				
d.i	- to evaluate critically current research and advanced scholarship in the discipline																				
d.ii	- to evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses.																				
Typically, holders of the qualification will be able to:																					
e	deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences																				
f	demonstrate self-direction and originality in tackling and solving problems, and act autonomously in planning and implementing tasks at a professional or equivalent level																				
g	continue to advance their knowledge and understanding, and to develop new skills to a high level.																				
And holders will have:																					
h	the qualities and transferable skills necessary for employment requiring:																				
h.i	- the exercise of initiative and personal responsibility																				
h.ii	- decision-making in complex and unpredictable situations																				
h.iii	- the independent learning ability required for continuing professional development.																				
Key																					
	Satisfied in full																				
	Satisfied in part																				
	Satisfied, given appropriate technical context																				
	Not addressed																				

Appendix C1: QAA SBS – Benchmark

QAA Computing Subject Benchmark Statement - Benchmark		<p>Autonomy: Works under general direction. Uses discretion in identifying and responding to complex issues and assignments. Determines specific direction, accepts guidance and has work reviewed at agreed milestones.</p> <p>Influence: Interacts with and influences colleagues. May supervise others or make decisions which impact the work assigned to individuals or teams of projects. Understands and collaborates on the analysis of user/customer needs and represents this in their work.</p> <p>Complexity: Performs a range of work, sometimes complex and non-routine, in a variety of environments. Applies methodical approach to issue definition and resolution. Has a sound generic domain and specialist knowledge necessary to perform effectively in the organisation typically gained from recognised bodies of knowledge and demonstrates effective application of knowledge.</p> <p>Knowledge: Has an appreciation of the wider business context. Takes action to develop own knowledge. Demonstrates effective communication skills. Plans, schedules and monitors own work (and that of others where applicable) and procedures. Coordinates with limited deadlines and according to relevant legislation, standards and knowledge required for own work.</p>																			
•	o																				
Threshold																					
i	demonstrate a requisite understanding of the main body of knowledge for their programme of study																				
ii	understand and apply essential concepts, principles and practices of the subject in the context of well-defined scenarios, showing judgement in the selection and application of tools and techniques																				
iii	produce work involving problem identification, the analysis, design and development of a system with accompanying documentation, recognising the important relationships between these stages and showing problem solving and evaluation skills drawing on supporting evidence																				
iv	produce small well-constructed programmes to solve well-specified problems																				
v	demonstrate generic skills, an ability to work under guidance and as a team member.																				
vi	identify appropriate practices within a professional, legal and ethical framework and understand the need for continuing professional development.																				
Typical																					
i	demonstrate a sound understanding of the main areas of the body of knowledge within their programme of study, with an ability to exercise critical judgement																				
ii	critically analyse and apply essential concepts, principles and practices of the subject in the context of loosely defined scenarios, showing effective judgement in the selection and use of tools and techniques																				
iii	produce work involving problem identification, the analysis, the design or the development of a system, with appropriate documentation, recognising the important relationships between these																				
iv	the work will show problem solving and evaluation skills, draw upon supporting evidence and demonstrate a good understanding of the need for a high quality solution																				
v	demonstrate generic skills with an ability to show organised work both as an individual and as a team member and with minimum guidance																				
vi	apply appropriate practices within a professional, legal and ethical framework and identify mechanisms for continuing professional development and lifelong learning.																				
Excellent students:																					
i	will be able to contribute significantly to the analysis, design or the development of systems that are complex, recognising the important relationships between these																				
ii	will be creative and innovative in their application of the principles covered in the curriculum																				
iii	will be able to exercise critical evaluation and review of both their own work and the work of others.																				
iv	will be able to demonstrate team leadership skills.																				
Key																					
Satisfied in full																					
Satisfied in part																					
Satisfied, given appropriate technical context																					
Not addressed																					

QAA Computing Master's SBS		<div>Autonomy: Works under general direction with a clear framework of accountability. Exercises substantial personal responsibility and autonomy. Plans own work to meet given objectives and processes. Influence: Influences customers, suppliers and partners at account level. May have some responsibility for the work of others and for the allocation of resources. Participates in external activities related to own specialism. Makes decisions which influence the success of projects and team objectives. Collaborates regularly with team members, users and customers. Complexity: Work includes a broad range of complex technical or professional activities in a variety of contexts. Knowledge: Investigates, defines and resolves complex issues. Has a thorough understanding of recognised generic industry bodies of knowledge and specialist bodies of knowledge as necessary. Is able to apply the knowledge effectively in unfamiliar situations and actively maintains own knowledge and contributes to the development of others. Rapidly absorbs new information and applies it effectively. Maintains an awareness of developing practices and their application and takes responsibility for driving own development. Business skills: Communicates fluently, orally and in writing, and can present complex information to both technical and non-technical audiences. Plans, schedules and monitors work to meet time and quality targets. Facilitates collaboration between stakeholders who share common objectives. Selects appropriately from applicable standards, methods, tools and applications. Fully understands the importance of security to own work and the operation of the organisation. Seek specialist security knowledge or advice when required to support own work or work of immediate colleagues.</div>																			
	•	o																			
All students graduating with a master's degree in computing are expected to have demonstrated:																					
a	a systematic understanding of the knowledge of the domain of their course of study, with depth being achieved in particular areas, including both foundations and issues at the forefront of the discipline and/or professional practice in the discipline; this should include an understanding of the role of these in contributing to the effective design, implementation and usability of relevant computer-based systems																				
b	a comprehensive understanding, and a critical awareness of the essential principles and practices of the domain of the course of study as well as current research and/or advanced scholarship; current standards, processes, principles of quality and the most appropriate software technologies to support the specialism; the relevance of these to the discipline and/or professional practice in the discipline; and an ability to apply these																				
c	consistently produced work which applies to and is informed by research and/or practice at the forefront of the developments in the domain of the course of study; this should demonstrate critical evaluation of aspects of the domain, including appropriate software support, issues of security and data integrity, the ability to recognise opportunities for software or hardware tools as well as possible tool improvement, an understanding of the importance of usability and effectiveness in computer systems development, and generally the acquisition of well-developed concepts																				
d	understanding of the professional, legal, social and ethical framework within which they would have to operate as professionals in their area of study; this includes being familiar with and being able to explain significant applications associated with their course of study and being able to undertake continuing professional development as a self-directed lifelong learner across the elements of the discipline																				
e	the ability to apply the principles and practices of the particular course's domain in tackling a significant domain-related activity; the solution should demonstrate a sound justification for the approach adopted as well as originality (including exploration and investigation) and a self-critical evaluation of effectiveness, but also critical awareness of current problems and new insights, and a sense of vision about the direction of developments in aspects of the domain of the course.																				
Key																					
Satisfied in full																					
Satisfied in part																					
Satisfied, given appropriate technical context																					
Not addressed																					

Appendix D1 – QAA SBS – Computing-related Skills

QAA Computing Subject Benchmark Statement - Skills		<div>Autonomy: Works under general direction. Uses discretion in identifying assignments. Recreates specific direction, agreed milestones. Determines when issues should be escalated to a higher level.</div> <div>Influence: Interacts with and influences colleagues. May supervise others or make decisions which impact the work assigned to individuals or pieces of projects. Understands and collaborates on the analysis of user/customer needs and represents this in their work.</div> <div>Complexity: Performs a range of work, sometimes complex and non-routine, in a variety of environments. Applies methodical approach to issue definition and resolution.</div> <div>Knowledge: Has a sound generic, domain and specialist knowledge necessary to perform effectively in the organisation typically gained from recognised bodies of knowledge and organisational information. Demonstrates effective application of knowledge. Takes action to develop own knowledge.</div> <div>Business skills: Demonstrates effective communication skills. Plans, schedules and monitors own work (and that of others where applicable) competently within limited deadlines and according to relevant employer or client. Demonstrates an analytical and systematic approach to issue resolution. Takes the initiative in identifying and negotiating appropriate personal development opportunities. Understands how own role impacts security and demonstrates routine security practices and knowledge required for own work.</div>																			
•	o																				
Computing-related cognitive skills:																					
i	Computational thinking including its relevance to everyday life.																				
ii	An understanding of the scientific method and its applications to problem solving in this area.																				
iii	Knowledge and understanding: demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to Computing and computer applications as appropriate to the programme of study.																				
iv	Modelling: use such knowledge and understanding in the modelling and design of computer-based systems for the purposes of comprehension, communication, prediction and the understanding of trade-offs.																				
v	Requirements, practical constraints and computer-based systems (and this includes computer systems, information, security, embedded, and distributed systems) in their context: recognise and analyse criteria and specifications appropriate to specific problems, and plan strategies for their solutions.																				
vi	Critical evaluation and testing: analyse the extent to which a computer-based system meets the criteria defined for its current use and future development.																				
vii	Methods and tools: deploy appropriate theory, practices and tools for the specification, design, implementation and evaluation of computer-based systems.																				
viii	Professional considerations: recognise the professional, economic, social, environmental, moral and ethical issues involved in the sustainable exploitation of computer technology and be guided by the adoption of appropriate professional, ethical and legal practices.																				
Computing-related practical skills:																					
i	The ability to specify, design and construct reliable, secure and usable computer-based systems.																				
ii	The ability to evaluate systems in terms of quality attributes and possible trade-offs presented within the given problem.																				
iii	The ability to plan and manage projects to deliver computing systems within constraints of requirements, timescale and budget.																				
iv	The ability to recognise any risks and safety aspects that may be involved in the deployment of computing systems within a given context.																				
v	The ability to deploy effectively the tools used for the construction and documentation of computer applications, with particular emphasis on understanding the whole process involved in the effective deployment of computers to solve practical problems.																				
vi	The ability to critically evaluate and analyse complex problems, including those with incomplete information, and devise appropriate solutions, within the constraints of a budget.																				
Generic skills for employability:																					

Appendix D2 - QAA SBS – generic skills for employability

QAA Computing Subject Benchmark Statement - Skills		Autonomy: Works under general direction. Uses discretion in identifying and responding to complex issues and assignments. Receives specific direction, accepts guidance and has work reviewed at agreed milestones. Influence: Determines when issues should be escalated to a higher level. Interacts with and influences colleagues. Has working level contact with customers, suppliers and partners. May supervise others or make decisions which impact the work assigned to individuals or phases of projects. Understands and collaborates on the analysis of user/customer needs and represents this in their work. Complexity: Performs a range of work, sometimes complex and non-routine, in a variety of environments. Applies methodical approach to issue definition and resolution. Knowledge: Has a sound generic, domain and specialist knowledge necessary to perform effectively in the organisation typically gained from recognised bodies of knowledge and/or additional information. Demonstrates effective application of knowledge. Has an appreciation of the wider business context. Business skills: Takes action to develop own knowledge. Demonstrates effective communication skills. Plans, schedules and monitors own work (and that of others where applicable) competently within limited deadlines and according to relevant legislation, standards and procedures. Contributes fully to the work of teams. Appreciates how own role relates to other roles and to the business of the employer or client. Demonstrates an analytical and systematic approach to issue resolution. Takes the initiative in identifying and negotiating appropriate personal development opportunities. Understands how own role impacts security and demonstrates routine security practice and knowledge required for own work.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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i	Students are expected to develop a wide range of generic skills to ensure they become effective in the workplace, to the benefit of themselves, their employer and the wider economy. Students who develop generic skills, and are able to evidence and demonstrate such skills, will gain significant advantage when seeking employment. It is the responsibility of higher education providers to provide every student the opportunity to acquire and evidence generic skills; it is the responsibility of the student to make the most of that opportunity.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									</

Appendix E1 – BCS RITTech competencies

RITTech Competencies		IoC - SFIA L3 generic responsibility characteristics	
Autonomy: How you work		Autonomy	
A1	Works under general direction. Uses discretion in identifying and resolving complex problems and assignments.		Works under general direction.
			Uses discretion in identifying and resolving complex problems and assignments.
			Receives specific direction, accepts guidance and has work reviewed at agreed milestones.
A2	Determines when issues should be escalated to a higher level.		Determines when issues should be escalated to a higher level.
Influence: How have you contributed to the outcome of the work/tasks you have been involved with		Influence	
B1	Interacts with and influences department/project team members.		Interacts with and influences colleagues.
B2	Has working level contact with customers and suppliers.		Has working level contact with customers, suppliers and partners.
			Understands and collaborates on the analysis of user/customer needs and represents this in their work.
B3	In predictable and structured areas may supervise others.		May supervise others or make decisions which impact the work assigned to individuals or phases of projects.
B4	Makes decisions which may impact on the work assigned to individuals or phases of projects.		
Complexity: What did the project / work involve?		Complexity	
C1	Performs a broad range of work, sometimes complex and non routine, in a variety of environments.		Performs a broad range of work, sometimes complex and non routine, in a variety of environments.
C2	Applies methodical approach to problem definition and resolution.		Applies methodical approach to problem definition and resolution.
Business Skills: Communication and interpersonal skills		Business Skills: Communication and interpersonal skills	
D4	Demonstrates effective communication skills.		Demonstrates effective communication skills.
D6	Plans, schedules and monitors own work (and that of others where applicable) competently within limited deadlines and according to relevant legislation and procedures.		Plans, schedules and monitors own work (and that of others where applicable) competently within limited deadlines and according to relevant legislation and procedures.
D1	Understands and uses appropriate methods, tools and applications.		<i>not in SFIA V7</i>
D2	Demonstrates an analytical and systematic approach to problem solving.		Demonstrates an analytical and systematic approach to problem solving.
D3	Takes the initiative in identifying and negotiating appropriate personal development opportunities.		Takes the initiative in identifying and negotiating appropriate personal development opportunities.
D5	Contributes fully to the work of teams.		Contributes fully to the work of teams.
D7	Absorbs and applies technical information.		<i>not in SFIA v7</i>
D8	Appreciates how own role relates to other roles and to the business of the employer or client.		Appreciates how own role relates to other roles and to the business of the employer or client.
D9	Understands how own role impacts security and demonstrates routine security practice and knowledge required for own work		Understands how own role impacts security and demonstrates routine security practice and knowledge required for own work

[illegible]

[illegible]