

# **EDUCATING FUTURE ACTUARIES TASK FORCE–FINAL REPORT FOR THE IAA EDUCATION COMMITTEE**

## **EXECUTIVE SUMMARY**

At the Singapore meeting, the Education Committee agreed to form a Task Force to look at the core competencies of the actuary in a changing global environment, prompted by some internal and external changes experienced by some member societies of the IAA. The intention was to provide a framework for educating the future actuary in a way that responds to these changes, specifically as input to the next review of the Core IAA Syllabus.

After some very useful and thought-provoking discussions, the Task Force developed two alternative frameworks for the core competencies of the future actuary, both using the Revised Bloom's Taxonomy (RBT), a model for learning objectives that reflects two dimensions: the knowledge dimension and the cognitive process dimension. RBT is a useful framework to more clearly define these competencies. In developing these competencies, the Task Force believes change is needed for the future actuary to be equipped to address the environmental factors set out in the task force's terms of reference and the changing world of work.

While the basic technical toolkit of the actuary is still very useful and forms the core of the profession, this needs to adapt to changes such as the big data revolution. The Task Force believes that as a professional risk manager, a strong set of practical non-technical skills, including communication and strategic thinking, as well as an understanding of information delivery alternatives are also very critical for the future actuary. The actuary's toolkit should be as generic as possible, allowing a wide range of applications, including areas such as banking where it is believed the actuary could add much value worldwide. This should be accompanied by the actuary having a good understanding of the broader financial services environment and framework. This will provide a strong basis for the actuary to play a leading role in a variety of financial services and other areas.

The Task Force believes this core competency framework consists of generic skills which would form the basis of competency required by any actuary. The Task Force believes that these generic skills could be usefully accompanied by further specialist actuarial studies in a specific field of actuarial practice. The Task Force therefore defined the Specialist Actuary as someone who has achieved the core competencies in a specialist field, and this person could then play a leading role in these fields, including reserved roles. However, the Task Force believes it is not essential for the education system of a full member association to provide this specialist education, and that a system could consist only of generic education.

The Task Force believes that their core competency frameworks should form the basis of the next Core Syllabus review of the IAA, where the frameworks can be adapted into the key learning areas as a start to the Core Syllabus review process. The syllabus review process should commence immediately after the London meetings, with some continuity in the people involved in this Task Force and the syllabus review group. On completion of the syllabus review, an appropriate time period should be given for associations to make the required changes to meet the updated syllabus requirements. Careful thought will need to be given to supporting associations in meeting the updated requirements, and in reviewing compliance with the updated syllabus.

All of the members of the task force strongly support the content of this report and the need for change in actuarial education to ensure the profession remains relevant and proactive.

Respectfully submitted

Educating Future Actuaries Task Force

26 August 2014

## **1) Background**

At the Singapore meeting, the Education Committee agreed to form a Task Force to look at the core competencies of the actuary in a changing global environment, prompted by some internal and external changes experienced by some member societies of the IAA. The intention was to provide a framework for educating the future actuary in a way that responds to these changes, specifically as input to the next review of the Core IAA Syllabus.

While the specific drivers of change were mentioned in the input paper at Singapore and are encapsulated in the Task Force's Terms of Reference (see below), the Task Force specifically noted an Economist article, which came out in January, referring to the future world of work. This article, at <http://www.economist.com/news/leaders/21594298-effect-todays-technology-tomorrows-jobs-will-be-immenseand-no-country-ready>, particularly noted that changes in technology will change the future world of work, just as it has done in recent history. The article suggests that education is critical in this future change and suggests that future education should "foster the creativity that humans will need to set them apart from computers. There should be less rote-learning and more critical thinking."

### **1) Composition and meetings**

After the Singapore meetings, members of the Education Committee were invited to join the Task Force or nominate others from their Associations to join. The core group consisted of 15 people, with a fairly good geographical spread of membership, although with little representation from smaller associations. A number of other people served as interested persons. The detailed membership of the Task Force is set out in Appendix B.

The Task Force had sixteen meetings by teleconference, seven prior to Washington D.C. meetings and nine after those meetings. The Task Force would like to thank Christian Levac and Karla Zuniga for providing extensive support for the group which was much appreciated.

### **2) Methodology**

The Task Force initially focused on agreeing to Terms of Reference as well as building a base of input material for members to read. This resource base of input material included the output of the IAA Task Force on the Role Of The Actuary, as well as material from many of the actuarial associations represented.

Members of the Task Force were then invited to submit a list of the core competencies that the future actuary should possess at the time of qualification for membership in a full member association. These were then discussed, and there was a fair degree of consensus around these competencies, including those which may be regarded as practical/non-technical skills. At the Washington D.C. meetings, the interim report of the Task Force was discussed, and there was general support for the direction that the Task Force was taking. There was limited feedback from the meetings, but this was taken into account in the Task Force's work subsequent to the Washington meetings.

The Task Force focussed on three specific areas in the months after the Washington D.C. meetings

- (i) To refine and agree to the basic core competencies for a fully-qualified actuary
- (ii) To suggest additional competencies that may be required for the actuary who has an expertise in a special field.

- (iii) To suggest the way forward, including how the next syllabus review may be conducted in the light of the core competencies suggested, and any other work that the Education Committee could be doing

As a framework for the core competencies, the task force agreed to use a revised version of Bloom's Taxonomy. More detail is provided on this taxonomy in Section 5 in this report. In setting out the detail of the core competencies, two differing presentations of essentially the same core competencies that were developed by the entire Task Force have been set out in the Appendices, one by Steve Eadie and one by Marjon Tjia. The Task Force believes that these presentations provide useful alternative perspectives and detail on the critical question around the core competencies of the actuary of the future.

### **3) Terms of Reference**

A draft Terms Of Reference was prepared by the Chairperson of the Task Force, using the original paper submitted at Singapore as a framework. This was discussed and edited by the Task Force, with an agreed version sent to the Education Committee. After some wording changes suggested by the Committee, a final version was placed on the IAA website. This version is included as Appendix A of this report.

### **4) A Model for Future Actuarial Education Objectives**

Our task force used the Model of Learning Objectives, created by Rex Heer, Iowa State University, to support our work. The model is based on Bloom's Taxonomy of Education Objectives (1956) and Anderson and Krathwohl's 2001 revision. The model reflects two dimensions; the knowledge dimension and the cognitive process dimension. It allowed the Task Force to establish a set of Learning Objectives, based on the competencies desired of the new fully qualified actuary. It is expected that actuaries will achieve more extensive knowledge or higher cognitive process levels as their careers progress.

New fully qualified actuaries who meet these Learning Objectives will have the desired competencies.

Adopting this model allowed us to define not only the areas of learning achievement expected of future actuaries but also the specific level and type of knowledge required of them. This framework is widely used and respected by educators worldwide and will give member associations a way of linking the required learning objectives with appropriate learning activities and assessments. We acknowledge that to be successful some member associations may require assistance in translating our work based on Bloom's Taxonomy into their local languages.

Our purpose is not to create the next version of the International Actuarial Association's core education syllabus but to describe in general terms the competencies that must be covered in a complete set of learning objectives and to provide examples of learning objectives that we would include in the next version of the International Actuarial Association's (IAA) core education syllabus. Our work is intended to provide the Education Committee of the IAA with a framework to assist them in their next syllabus review.

Competencies (knowledge, skills, attributes) identify the type of knowledge required and the cognitive level to be achieved. Competencies are normally written to include a group of related Learning Objectives. The group of related Learning Objectives or even a single Learning Objective may cover more than one type of knowledge or skill and more than one cognitive process category.

The model of learning objectives uses both a knowledge dimension and a cognitive process dimension as demonstrated in the graphic below.

		Revised Bloom's Taxonomy (RBT)					
		Cognitive Process Dimension					
Knowledge Dimension	Verbs	1. REMEMBER Recognize, Recall	2. UNDERSTAND Interpret, Exemplify, Classify, Summarize, Infer, Compare, Explain	3. APPLY Execute, Implement	4. ANALYZE Differentiate, Organize, Attribute	5. EVALUATE Check, Critique	6. CREATE Generate, Plan, Produce
	Objects						
	A. Factual Knowledge	A1	A2	A3	A4	A5	A6
	B. Conceptual Knowledge	B1	B2	B3	B4	B5	B6
	C. Procedural Knowledge	C1	C2	C3	C4	C5	C6
	D. Metacognitive Knowledge	D1	D2	D3	D4	D5	D6

There are six cognitive processes - Remember, Understand, Apply, Analyze, Evaluate and Create – and four types of knowledge - factual, conceptual, procedural and metacognitive.

For our purposes:

1. Factual knowledge generally involves terminology associated with actuarial work and specific details with respect to financial security systems, actuarial models, actuarial methods and the external forces important to actuarial work. Factual knowledge also includes specific details with respect to membership in the actuarial profession.
2. Conceptual knowledge generally involves the interrelationships among current or potential future financial security systems, common actuarial models, common actuarial methods, external forces and the actuary.
3. Procedural knowledge involves how an actuary actually does something. To demonstrate Procedural Knowledge often requires both Factual and Conceptual knowledge. Many normative or practical skills require Procedural knowledge.
4. Metacognitive knowledge involves an actuary's awareness of his strengths and weaknesses, including when the actuary is not qualified to do specific work. This knowledge will also include an actuary's awareness of personal learning needs and lifetime learning strategy. Some normative skills involve acquiring metacognitive knowledge (e.g. self-knowledge).

The six categories of the cognitive process include nineteen specific cognitive processes that clarify the scope of the six categories. There is a natural order for cognitive processes from the lowest order thinking skills "Remember", through "Understand", "Apply", "Analyze" and "Evaluate" to the highest cognitive order "Create". The order does not mean to imply difficulty in succeeding at the cognitive level but rather that the lower cognitive process will be subsumed by another higher cognitive

process. For example, you often need to Remember to Create but seldom need to Create to Remember.

The distinctions between the cognitive categories are not always clear cut. We use verbs associated with each category when necessary to clarify our meaning.

We begin by describing the necessary competencies that a new fully qualified actuary should achieve in general terms (i.e. Apply mathematics that is core to the actuarial profession) but will ultimately need to provide a more detailed set of learning objectives as described below. Our goal is to provide a set of learning objectives for each cognitive level.

Each learning objective involves a verb that refers to the intended cognitive process and an object that describes the knowledge students are expected to have acquired or constructed. For example, “students will be able to explain the results of a mortality study”. In order to successfully complete this learning objective a student will have to Understand the Factual, Conceptual and potentially the Procedural knowledge surrounding mortality and, more generally, experience studies.

Many of the learning objectives should be understood to include related learning objectives and subsume other learning objectives. For example, we often describe a learning objective that requires the student to Analyze particular knowledge. To do this it is implicit that the student will have already been asked to Remember, Understand and Apply related or subsumed knowledge as part of the student’s learning.

## **5) Core Competencies**

As part of the Task Force discussions leading up to the Washington D.C. meetings, the group discussed whether there were competencies unique to actuaries. The agreed view was that there is no single competency/technical skill unique to actuaries. However the combination of a person with a deep technical understanding and ability to model risk, with the professionalism component, particularly adhering to standards of professional conduct and practice, is distinctive and extremely powerful, and therefore the actuary as a professional risk manager *should* be able to make a unique and significant contribution to society.

In setting out the detail of the core competencies of an actuary, the Task Force focussed on refining the list of core competencies set out by Steve Eadie in the interim report presented at the Washington D.C. meetings using the Revised Bloom’s Taxonomy as an indication of the depth of each competency. In addition, an alternative framework was worked on, based on the work of Marjon Tjia. These frameworks are set out in Appendices C and D, respectively, and should be considered carefully.

While the detail is important, the following points may be useful in summarising these core competency frameworks and understanding how the future actuary may be somewhat different from the actuary of today.

- Fairly universal agreement that understanding/modelling/managing risk is at the core of the profession.
- Technical competencies are generally close to what is being taught now, with the possible exception of data analytics, which a number of people have suggested is an area which should become an actuarial competency. In addition, there are suggestions that a greater

understanding of Enterprise Risk Management concepts and non-financial risk should be required to ensure that understanding/modelling/managing risk is a key competency.

- An understanding of, and adherence to, standards of professional conduct and practice is considered an important competency.
- General view is that a wider range of “practical” skills (often known as “normative” skills) should be part of the actuarial competency set. In addition to professionalism and communication, strategic thinking, business skills, decision-making, seeing the big picture, leadership, and teamwork are all suggested as important.
- An understanding of the practical context in which actuaries operate (i.e. economics, operation of financial services) is widely seen as important. The suggestion is that this context should be expanded to areas such as banking.
- The future actuary must be adaptable to rapid change in technology and in the models available to complete actuarial tasks.

The view of an actuary as a professional risk manager able to operate in a wide variety of fields, and the detailed competency frameworks should provide a useful basis to set out the key learning areas for the next syllabus review of the IAA, and ultimately, the detailed syllabuses.

## **6) The Specialist Actuary**

The Task Force spent some time considering whether a specialist actuary (i.e. someone who had studied extensively in a specific field of actuarial practice) might have a set of core competencies additional to the generic set common to any actuary. After some consideration, the view of the Task Force was that the specialist competencies were indeed almost identical, and came up with the following description of a Specialist Actuary.

The Specialist Actuary can be defined as an actuary with the following key attributes

- Has demonstrated all the core competencies required of any actuary
- Has successfully applied these core competencies to design, price or value risk management systems in a specific field of actuarial practice.

The specialist field may be a traditional area of actuarial practice, such as life insurance, general insurance or pensions, or a newer field such as health or banking. The Task Force believes that there may be a wide range of potential fields that actuaries could specialize in, due to the wide applicability of their core competencies and skills. However, the specialization should involve formal study in the specific field, with assessment that the Specialist Actuary has acquired and can apply these competencies and skills.

The education requirements for the Specialist Actuary should include in-depth coverage of the technical tools, environment and practice for the specialist field, including best international practice as well as relevant detail of the local environment in which the actuary practices.

To be successful in the specialist field, it is particularly important that the Specialist Actuary be able to effectively apply the core competencies related to professionalism, communication, and strategic thinking, and promote learning and new ideas in the specialist area.

The newly qualified Specialist Actuary will need to gain experience of applying the competencies listed above but will have a sufficient grounding to be in a position to play a valuable role in the industries and institutions which require their specialist skills. The Specialist Actuary should also be in a position, after appropriate practical experience, to fulfill any reserved roles in the specialist field.

The implication of this is that an education system could have differing levels of qualification for the generic actuary who has the basic core competencies and can be seen as generalist, and for a specialist actuary. A number of education systems currently have this structure. However, it would also be possible to have a single level of qualification incorporating both the generic and specialist elements, or just the generic elements without specialisation.

## **7) The Way Forward**

The Task Force believes our set of core competencies should be used as a framework for the next IAA Core Syllabus review. This section discusses suggestions for the next syllabus review and the overall strategy for the Education Committee in the short and medium term.

A new syllabus providing for development of the competencies needed by a future actuary will not require significantly more knowledge content - possibly less - than the existing one. It will, however, take a different form, perhaps based on one of the frameworks in the task force's report. The next syllabus review will be much more comprehensive than previous reviews and will provide greater clarity on what a newly qualified actuary will be expected to be able to do. There will also be additional practical non-technical requirements that will need to be clearly set out.

Careful thought should therefore be given to the composition of the syllabus review team, the process to be followed and the timeframes. Given the importance of the work, it is suggested that some work may need to be done on a contractual paid basis to ensure quality and timely delivery. This will require explicit budget to be set aside by the IAA for the Education Committee.

The other area that needs to be carefully considered is the implementation of the syllabus changes. Given the more explicit objectives, and additional competencies, an appropriate timeframe should be established for actuarial associations to establish a syllabus meeting the updated requirements. The review process to ensure that individual association programs meet the syllabus requirements will need to change significantly. Given the emphasis on competencies, the new review process should focus on what students are asked to show they can do in the course of qualifying as actuaries.



The following timeframes and process are therefore suggested

<b>Timing</b>	<b>Activity</b>
September 2014 meetings in London	Education Committee to approve report of the Educating Future Actuaries Task Force and establish Syllabus Review Task Force. It is recommended that the Syllabus Task Force is a small group (possibly maximum 7 people) to allow for an effective process. Ideally, the membership of the Syllabus Review group should reflect continuity from the current Task Force. The membership of the Syllabus Task Force should be proposed by the leadership of the Education Committee.
Between London and Zurich meetings	Syllabus Task Force to come up with work plans, and establish initial syllabus structure and proposals. Feedback to be sought from Education Committee, full member associations and the Actuarial Educators Network (AEN) based on London recommendations.
April 2015 meetings in Zurich	It is suggested that an education conference is held in conjunction with the IAA meetings (the last education conference was in Tallinn in 2009), and that the focus is on the initial syllabus proposals, and ensuring a wide range of input and discussion into the final syllabus proposals.
Between Zurich and Vancouver meetings	Syllabus Task Force finalises detailed syllabus requirements for presentation at Vancouver.
September 2015 meetings in Vancouver	Education Committee discusses and approves updated syllabuses.
Between Vancouver and St. Petersburg meetings	The approved syllabuses are discussed by national associations, with any feedback being incorporated in a final syllabus document presented to Council at the St. Petersburg meetings.
Q2 2016 meetings in St. Petersburg	New syllabuses are approved by Council.
Post St. Petersburg implementation	It is suggested that a period of two-and-a-half years is given for associations to adapt their syllabuses. This would mean that the syllabus recommendations would apply to a student commencing actuarial studies in 2019 with any full member association.

As noted above, budget may be required in 2015 to ensure professional and expeditious delivery of the updated syllabuses by allowing for some work to be contracted out. Once the syllabus review is complete, some funding may be required in terms of the work required to support actuarial associations in implementing the changes, and then in reviewing whether associations have met the updated requirements.

Consideration should also be given to the support that larger associations or educational collaborations of associations may be able to give to smaller associations (e.g. making their courses available to them). There may be an option to use certain universities to provide this support as well. Existing structures such as CERA and the Actuarial Association of Europe should also be taken into account to ensure that review processes are not duplicated. New methods of delivery of education should be considered, given recent technological advances. However, given the importance of higher-order skills in the competency frameworks, there will be a critical role for quality actuarial educators.

## **8) Conclusion**

The Task Force believes that change is needed for the future actuary to be equipped to address the environmental factors set out in the task force's terms of reference and the changing world of work. While the basic technical toolkit of the actuary is still very useful and forms the core of the profession, this needs to adapt to changes such as the big data revolution. The Task Force believes that as a professional risk manager, a strong set of practical non-technical skills, including communication and strategic thinking, as well as an understanding of information delivery alternatives are also very critical for the future actuary. The actuary's toolkit should be as generic as possible, allowing a wide range of applications, including areas such as banking where it is believed the actuary could add much value worldwide. This should be accompanied by the actuary having a good understanding of the broader financial services environment and framework, which will provide a strong basis for the actuary to play a leading role in a variety of financial services and other areas, possibly accompanied by further specialist actuarial studies.

Respectfully submitted

Educating Future Actuaries Task Force

26 August 2014

## **APPENDIX A: TERMS OF REFERENCE**

Under the general direction of the Education Committee, the Educating Future Actuaries Task Force will review the fundamental nature of actuarial education and will identify and define the core competencies that should be attained and exemplified by actuaries of the future, and the resulting learning objectives for the International Actuarial Association's core education syllabus. These will then be compared to the current IAA core education syllabus and will be considered during the next IAA core education syllabus review.

The goal is to ensure that at the point of qualification, members of the actuarial profession are equipped to make an important and valuable contribution to society and to the organizations they serve.

The key drivers for establishing this Task Force are

- Significant changes in the demand for actuaries, with some diminished demand in traditional fields for actuaries such as life insurance and pensions, and increased demand in non-traditional practice areas in some regions, such as in broader financial services.
- Some countries are reviewing their actuarial syllabuses and considering which fundamental concepts should be covered in the core actuarial training. The Task Force will assist these reviews by facilitating international collaboration.
- Feedback from IAA Full Member Associations requesting refinements to the IAA core education syllabus.
- With a common understanding of the core competencies of the actuary, the international profession will be in a better position to promote and support appropriate education for the actuary of the future, and ensure relevance in a constantly changing environment.

Membership of the Task Force will include one representative from each full member association represented on the Education Committee, should that association choose to nominate a representative. Additional people can be involved in the Task Force as interested parties. All members of the Task Force are expected to be actively engaged and complete work assigned to them within the timeframes requested.

The Task Force will present provisional findings to the IAA meetings in Washington DC in March 2014, with a final report for the London meetings in September 2014.

## APPENDIX B: TASK FORCE MEMBERS

<b>Chairperson</b>	Andrew Gladwin (South Africa)
<b>Members</b>	Carla Angela (Italy) Stephen Eadie (Canada) Bozena Hinton (Australia) Paul King (United Kingdom) Isabelle Larouche (Canada) Warren Luckner (USA) Mary Frances Miller (USA) Rafael Moreno Ruiz (Spain) Tomio Murata (Japan) Kyle Martin Rudden (Trinidad & Tobago) John Shepherd (Australia) Marjon Tjia (Netherlands) Henning Wergen (Germany)
<b>ex officio</b>	Klaus Mattar (Chairperson, Education Committee)
<b>Staff Liaison</b>	Karla Zuniga Christian Levac
<b>Interested Persons</b>	John Evans (Australia) Ron Hersmis (Netherlands) Luis Maria Sáez de Jáuregui Sanz (Spain) Martha Sikaras (USA) Mark Anthony Stocker (United Kingdom)

## **APPENDIX C: CORE COMPETENCY FRAMEWORK BASED ON REVISED BLOOM'S TAXONOMY – PRIMARY AUTHOR: STEVE EADIE**

### **REMEMBER AND UNDERSTAND - *Factual and Conceptual Knowledge (A1, A2, B1, B2)***

- The mathematics that is core to the actuarial profession: calculus, linear algebra, differential equations, general probability, probability distributions, financial mathematics, numerical methods, statistics (including applied statistics), credibility theory, parametric and semi-parametric models (including extreme value models), the mathematics of contingencies, stochastic modelling and generalised linear models?
- Characteristics of private and public financial security systems including insurance systems, retirement systems, risk management systems
- Characteristics of social insurance systems and elements of existing social insurance systems.
- Elements of the actuarial control cycle.
- Concepts in areas of study related to management of financial security systems: economics (including financial economics), demography, investment theory, corporate finance, basic accounting, basic law, governance structures and regulatory systems
- Concepts in area of risk management including financial, operational and strategic risks and the aggregation of risks, and including elements of risk management frameworks.
- Common methods used for data collection, maintenance and storage, including data structures.
- Concepts associated with estimating and selecting assumptions common to actuarial problems.
- Concepts associated with assets used to support financial security system products including asset classes, and particular asset products including derivative products.
- Common products used in key practice areas: life insurance, general insurance, health, retirement benefits, and banking.
- External forces that are relevant to common actuarial work: legislation, regulations, investment practices, demographic trends and financial security system structures.
- Common methods used in accounting for financial security systems, including international accounting standards.
- Common information technology systems and tools used by actuaries.
- Common techniques for effective communication.
- Professional standards, standards of practice and professional ethics.

### **REMEMBER AND UNDERSTAND - *Procedural Knowledge (C1, C2)***

- Common techniques used to analyze particular data considering the characteristics of the data set, including its size.
- Common techniques used to measure, understand and model risk in all common practice areas (life insurance, general insurance, health, retirement benefits, and banking).
- Common techniques used in the aggregation of risks.
- How to apply the actuarial control cycle appropriately.
- Effective communication: oral, written and listening.
- Effective use of social media in actuarial applications (e.g. big data, social physics)
- Effective role as a professional: professional standards, standards of practice and professional ethics.
- Effective procedures for documenting work

### **REMEMBER AND UNDERSTAND - *Metacognitive Knowledge (D1, D2)***

- Importance of documenting work.
- Importance of maintaining actuarial skills in a changing environment.
- Elements of a lifetime learning plan.
- Role of individual in supporting the public interest.

### **APPLY AND ANALYZE - *Factual and Conceptual Knowledge (A3, A4, B3, B4)***

- Use mathematical output to manage practical risk-based problems.
- Respond to frequently asked question from non-actuarial co-workers.
- Provide instructions to coworkers on completing routine actuarial tasks.
- Select appropriate communication delivery systems to communicate work results to peers, managers, clients and the public.
- Determine whether communication delivery systems effectively communicate work results to peers, managers, clients and the public were used.
- Determine whether all relevant standards of practice were considered in preparing work.
- Determine whether individual assumptions are necessary and a set of assumptions are sufficient for a given problem.
- Differentiate material external forces from other external forces.
- Determine whether all material external forces have been considered for a particular solution.

### **APPLY AND ANALYZE - *Procedural Knowledge (C3, C4)***

- Apply the actuarial control cycle appropriately.
- Apply core mathematics in order to appropriately calculate risk-based amounts and determine risk metrics for financial, operational and strategic risks
- Analyze a given data set using modern statistical methods.
- Apply appropriate algorithmic trading strategies.
- Apply appropriate data mining strategies.
- Analyze the results of an experience study including applying statistical methods to validate results.
- Establish appropriate model parameters
- Confirm that model output is reliable.
- Apply common actuarial models to determine appropriate prices, reserves or funding values.
- Determine appropriate capital allocations for an enterprise.
- Analyze experience for an existing actuarial solution.
- Monitor the results of an actuarial process appropriately.

**APPLY AND ANALYZE - *Metacognitive Knowledge (D3, D4)***

- Consider whether current actuarial skills are sufficient for a work assignment.
- Seek and use help from coworkers when appropriate.
- Seek and use help from other actuaries when appropriate.
- Use methods that recognize own limitations with respect to work required.
- Use peer review and checking of work product by qualified others.
- Choose professional responsibilities over personal gain as they relate to work projects.
- Prioritize obligation to the public when completing any work assignment.



### **EVALUATE AND CREATE - *Factual and Conceptual Knowledge (A5, A6, B5, B6)***

- Check that an experience study (or other work product) is complete.
- Determine the relevance of a work product.
- Generate a list of external forces to consider for a particular project.
- Assemble an appropriate team for a work assignment.
- Check work prepared by non-actuaries that is related to actuarial work.

### **EVALUATE AND CREATE - *Procedural Knowledge (C5, C6)***

- Design a work plan for an experience study (or other work product).
- Select an appropriate set of assumptions for a given problem, using the results of an experience studies where appropriate.
- Judge the results of an experience study (or other work product).
- Judge the appropriateness of a model and the model output.
- Judge the reasonableness of output from common actuarial models used to determine appropriate prices, reserves or funding values.
- Provide a business orientation to a work project to add value to a financial security system.

### **EVALUATE AND CREATE - *Metacognitive Knowledge (D5, D6)***

- Create a lifetime learning plan.
- Reflect on success of one's working relationships.
- Monitor whether professional obligations are being met.
- Reflect on role in actuarial profession.

## **APPENDIX D: ALTERNATIVE PRESENTATION OF CORE COMPETENCIES –PRIMARY AUTHOR: MARJON TJIA**

### **Alternate presentation of Core Competencies for Every New Fully Qualified Actuary using Revised Bloom's Taxonomy**

The general view coming from previous discussions was that the *traditional actuary as a professional risk manager* is a powerful combination and should be able to make the difference in the future. In this alternate presentation of core competencies (see table below) a connection has been made between the key tasks that are expected from the (future) actuary and the relevant core competencies/ learning objectives. Two key tasks and three generic key tasks in the professional profile of the (future) actuary have been distinguished: key tasks is a consistent set of activities which constitutes a characteristic and significant part of actuarial professional practice. Key generic tasks are activities that are inseparably linked to an entire range of professional actuarial practice.

The two key tasks are:

- Valuation/determining and allocating capital which represent the core of the work field of the (traditional) actuary
- Risk management which will become the key aspect of the work field of the future actuary.

The three key generic key tasks are:

- Professionalism/quality assurance
- Communication
- Project Management

Furthermore, the core competencies/ learning objectives are described at the desired final cognitive level as following the Bloom's Taxonomy lower cognitive processes are usually subsumed by another higher cognitive process. The column 'Knowledge Domain' provides an overview of the basic (technical) knowledge which is needed to perform at the desired final cognitive level.

## Summary of Core Competencies for Every New Fully Qualified Actuary using Revised Bloom's Taxonomy

Key task: Valuation/determining and allocating capital	Core Competencies/Learning objectives	Knowledge domain
<i>Actuaries determine value of uncertain future cash flows in relation to insurance (portfolios), pension risks, companies and investment projects and determine the cost of capital necessary for the institution</i>	Select an appropriate set of assumptions for a given problem, using the results of an experience studies where appropriate (C5 C6)	- The mathematics that is core to the actuarial profession: general probability, probability distributions, financial mathematics, numerical methods, statistics (including applied statistics), credibility theory, parametric and semi-parametric models (including extreme value models), the mathematics of contingencies, and stochastic modelling
	Judge the appropriateness of a model and the model output (C5 C6)	- characteristics of private and public financial security systems including insurance systems, retirement systems, risk management systems
	Judge the reasonableness of output from common actuarial models used to determine appropriate prices, reserves or funding values (C5 C6)	- Characteristics of social insurance systems and elements of existing social insurance systems
	Determine appropriate capital allocations for an enterprise (C3 C4)	- Common methods used for data collection, maintenance and storage, including data structures
	Analyze a given data set using modern statistical methods (C3 C4)	- Concepts associated with estimating and selecting assumptions common to actuarial problems
	Apply appropriate data mining strategies (C3 C4)	- Concepts associated with assets used to support financial security system products including asset classes, and particular asset products including derivative products
	Apply common actuarial models to determine appropriate reserves (C3 C4)	- Common methods used in actuarial work: actuarial control cycle, insurance systems (including reinsurance), data maintenance and analysis (including selecting appropriate techniques for analyzing a particular data set given its "size"), setting assumptions, experience studies, reserving methods, capital allocation methods and risk management frameworks
		- Common products used in key practice areas (life insurance, general insurance, health, retirement benefits, and banking)
		- Common information technology systems, tools used by actuaries and models available to complete actuarial tasks
		- Common techniques used to analyze particular data considering the characteristics of the dataset including its size

Key task: Risk Management	Core Competencies/ Learning objectives	Knowledge domain
<i>Actuaries identify, quantify, analyze, manage various risks in the company</i>	Generate a list of external forces to consider for a particular project (A5 A6)	<ul style="list-style-type: none"> <li>- External forces that are relevant to common actuarial work: legislation, regulations, investment practices, demographic trends and financial security system structures.</li> <li>- Concepts in area of risk management including financial, operational and strategic risks and the aggregation of risks, and including elements of risk management frameworks</li> <li>- Common techniques used to measure, understand and model risk in all common practice areas (life insurance, general insurance, health, retirement benefits, and banking)</li> <li>- Common techniques used in the aggregation of risks</li> <li>- Elements of the actuarial control cycle</li> <li>- Concepts in areas of study related to management of financial security systems: economics(including financial economics), demography, investment theory, corporate finance, basic accounting, basic law, governance structures and regulatory systems</li> <li>- Common products used in key practice areas (life insurance, general insurance, health, retirement benefits, and banking)</li> <li>- Common methods used in accounting for financial security systems, including international accounting standards</li> <li>- Common pricing methods and funding methods</li> <li>- Common information technology systems, tools used by actuaries and models available to complete actuarial tasks</li> </ul>
	Apply core mathematics in order to appropriately calculate risk-based amounts and determine risk metrics for financial, operational and strategic risks (C3 C4)	
	Use mathematical output to manage practical risk-based problems (A3 A4.	
	Provide a business orientation to a work project to add value to a financial security system (C5 C6)	
	Apply the actuarial control cycle appropriately (C3 C4)	
	Apply appropriate algorithmic trading strategies (C3 C4)	
	Judge the results of an experience study (or other work product) including applying statistical methods to validate results (C5 C6)	
	Analyze experience for an existing actuarial solution (C3 C4)	
	Determine the relevance of a work product (A5 A6)	
	Apply common actuarial models to determine appropriate prices or funding values (C3 C4)	

Generic key task: Professionalism/quality assurance	Core Competencies/ Learning objectives	Knowledge domain
<i>Actuaries carry out their activities in a professional manner and their professional conduct is based on the code of conduct of the Actuarial Society ....</i>	Choose professional responsibilities over personal gain as they relate to work projects (D3 D4)	<ul style="list-style-type: none"> <li>- Professional standards, standards of practice and professional ethics</li> <li>- Elements of a lifetime learning plan.</li> <li>- Role of individual in supporting the public interest</li> </ul>
	Consider whether current actuarial skills are sufficient for a work assignment. (D3 D4)	
	Use peer review and checking of work product by qualified others (D3 D4)	
	Check work prepared by non-actuaries that is related to actuarial work (A5 A6..)	
	Create a lifetime learning plan and maintain (actuarial) skills in a changing environment (D5 D6)	
	Determine whether all relevant standards of practice were considered in preparing work (A3..)	
	Prioritize obligation to the public when completing any work assignment (D3 D4)	
	Monitor whether professional obligations are being met (D5 D6)	
	Reflect on role in actuarial profession (D5 D6)	
Generic key task: Communication	Core Competencies/Learning objectives	Knowledge domain
<i>Actuaries carry out research, formulate opinions, report and give advice</i>	Select appropriate communication delivery systems effectively to communicate work results to peers, managers, clients, and the public (A3..)	<ul style="list-style-type: none"> <li>- Common techniques for effective communication: oral, written and listening</li> <li>- Effective use of social media in actuarial applications (e.g. big data, social physics)</li> </ul>
	Provide instructions to coworkers on completing routine actuarial tasks (A3..)	
	Respond to frequently asked question from non-actuarial co-workers (A3..)	

Generic key task: Project management	Core Competencies/Learning objectives	Knowledge domain
<i>Actuaries manage substantive working processes and are responsible for the results of these processes and ensure that they meet quality criteria determined in advance</i>	Assemble an appropriate team for a work assignment (A5 A6..)	<ul style="list-style-type: none"> <li>- Effective procedures for documenting work</li> <li>- Concepts of project management</li> </ul>
	Design a work plan for an experience study (or other work product) (C5 C6)	
	Reflect on success of one's working relationships (D5 D6)	
	Monitor the results of an actuarial process appropriately (C3 C4)	