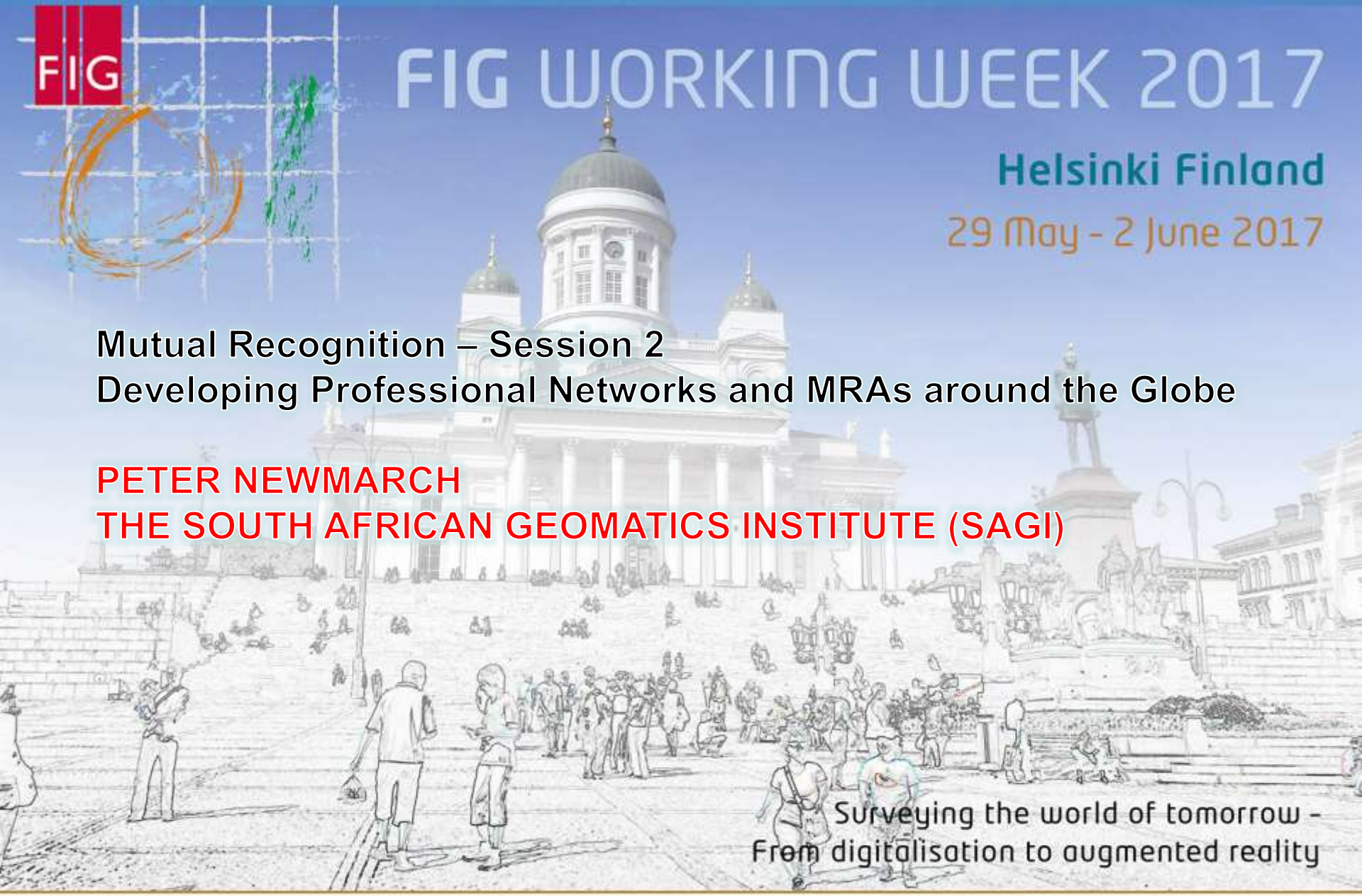

Mutual Recognition – Session 2
Developing Professional Networks and MRAs around the Globe

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THE SOUTH AFRICAN GEOMATICS INSTITUTE (SAGI)

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Academic Model in South Africa – Some Background

- 6 Professional models. (Land, Hydro, Engineering, Photo, GISc)
- 4 Technologist Models. (Engineering, Mining, Photo, GISc)
- 4 Technician Models. (Engineering, Mining, Photo, GISc)
- Plus Older Models.
- Models are reached by discussions between Council, Universities and Industry (Institutes).
- 5 Year accreditation cycle of Universities by Council.
  - Power to suspend course.
  - Power ot impose conditions and criteria.
- Non accredited degrees are submitted to a review committee.

Academic Model in South Africa – Some Background

- Absolutely no criteria to have a completed degree – we rather look at ”modules”.
- Council sets the model by way of ;-
  - The Knowledge Area – eg ”*Geodesy and Satellite Surveying*”, then
  - The Outcome – eg ” *Understanding of geodetic and GNSS concepts and theory and ability to carry out and analyse GNSS surveys*.”, then
  - The Topics / Themes to be taught – eg “*Earth gravity field, earth rotation dynamics and reference systems, geocentric coordinate systems, gravity observations, geoidal studies, tidal effects, datum and datum shifts, geodetic surveying, global navigation satellite systems, satellite orbits and orbital parameters, time systems, 3-D positioning*.”

Academic Model in South Africa – Some Background

- Each Knowledge Area is assigned Credits – the example just given for a Professional Land Surveyor requires 24 Credits in that particular Knowledge area.
- 1 Credit = 10 Notional Hours of Study.
- The whole Land Survey Model requires a minimum of 480 Credits = 4800 Notional Hours – a 4 year Degree.
- SADC countries largely follow the same credit system. Eg 1 SA Credit = 1 Zim Credit

		Technician		Technologist		Eng. Surveyor		Land Surveyor	
		NQF LEVEL 6		NQF LEVEL 7		NQF LEVEL 8		NQF LEVEL 8	
	SUBJECT AREA	Credits	**%**	Credits	**%**	Credits	**%**	Credits	**%**
	Common Subject Areas								
1	Mathematics, Applied Mathematics and Statistics	**36**	**15**	**48**	**13**	**60**	**13**	**60**	**13**
2	Physics	**12**	**5**	**12**	**3**	**24**	**5**	**24**	**5**
3	Surveying	**54**	**23**	**60**	**17**	**60**	**13**	**60**	**13**
4	Information Technology	**18**	**8**	**24**	**7**	**30**	**6**	**30**	**6**
5	Geo-spatial Information Science	**18**	**8**	**18**	**5**	**24**	**5**	**24**	**5**
6	Photogrammetry and Remote Sensing	**18**	**8**	**24**	**7**	**36**	**8**	**36**	**8**
7	Coordinate Systems and Map Projections	**12**	**5**	**18**	**5**	**18**	**4**	**18**	**4**
8	Adjustments and Error Theory	**12**	**5**	**24**	**7**	**36**	**8**	**30**	**6**
9	Earth and Environmental Science	**12**	**5**	**18**	**5**	**24**	**5**	**24**	**5**
10	Business and Project Management	**6**	**3**	**12**	**3**	**12**	**3**	**12**	**3**
11	Professional Practiceand Ethics	**6**	**3**	**12**	**3**	**12**	**3**	**12**	**3**
12	Category Specific Project / Research	**30**	**13**	**36**	**10**	**36**	**8**	**36**	**8**
13	Cadastral Studies and Land Tenure	**6**	**3**	**12**	**3**	**12**	**3**	**36**	**8**
14	Satellite Surveying and Geodesy			**12**	**3**	**24**	**5**	**24**	**5**
15	Land Management and Planning					**12**	**3**	**18**	**4**
16	Precise Engineering Surveying			**24**	**7**	**48**	**10**	**24**	**5**
17	3D Modelling /Cartography/visualisation			**6**	**2**	**12**	**3**	**12**	**3**
	Total	**240**	**100**	**360**	**100**	**480**	**100**	**480**	**100**

		PLS			PES			PS(PH)			PGP			PMS	
	SUBJECT AREA	**Lect.**	**%**		**Lect.**	**%**		**Lect.**	**%**		**Lect.**	**%**		**Lect.**	**%**
		PLS			**PES**			**PPS**			**PGP**			**PMS**	
		Lect.	%		Lect.	%		Lect.	%		Lect.	%		Lect.	%
	Common Subject Areas														
1	Mathematics and Applied Mathematics	**175**	**14**		**175**	**14**		**175**	**14**		**100**	**8**		**175**	**14**
2	Physics	**75**	**6**		**75**	**6**		**75**	**6**		**25**	**2**		**75**	**6**
3	Basic Surveying and Engineering Surveying	**150**	**12**		**150**	**12**		**50**	**4**			**0**		**150**	**12**
4	Information Technology	**50**	**4**		**50**	**4**		**50**	**4**		**75**	**6**		**50**	**4**
5	Geo-spatial Information Science	**50**	**4**		**25**	**2**		**50**	**4**		**175**	**15**		**25**	**2**
6	Photogrammetry and Remote Sensing	**50**	**4**		**50**	**4**		**125**	**10**		**75**	**6**		**25**	**2**
7	Coordinate Systems and Map Projections	**50**	**4**		**50**	**4**		**50**	**4**		**50**	**4**		**50**	**4**
8	Adjustments, Error Theory and Statistics	**75**	**6**		**100**	**8**		**75**	**6**			**0**		**75**	**6**
9	Earth and Environmental Science	**50**	**4**		**50**	**4**		**50**	**4**			**0**		**50**	**4**
10	Business and Project Management	**25**	**2**		**25**	**2**		**25**	**2**		**25**	**2**		**50**	**4**
11	Professional Practiceand Ethics	**25**	**2**		**25**	**2**		**25**	**2**		**25**	**2**		**25**	**2**
12	Category Specific Research Project	**50**	**4**		**50**	**4**		**50**	**4**		**75**	**6**		**50**	**4**
	Subtotal Common Subject Areas	**825**	**66**		**825**	**66**		**800**	**64**		**625**	**52**		**800**	**64**

continued on page 2

		PLS			PES			PS(PH)			PGP			PMS	
	SUBJECT AREA	**Lect.**	**%**		**Lect.**	**%**		**Lect.**	**%**		**Lect.**	**%**		**Lect.**	**%**
		PLS			**PES**			**PPS**			**PGP**			**PMS**	
		Lect.	%		Lect.	%		Lect.	%		Lect.	%		Lect.	%
		continued from page 1													
	Category specific Subject Areas														
13	Cadastral Studies and Land Tenure	**120**	**10**											**25**	**2**
14	Geodesy and Satellite Surveying	**50**	**4**		**50**	**4**		**25**	**2**						
15	Land Management and Planning	**75**	**6**					**25**	**2**						
16	Precise Engineering Surveying				**50**	**4**								**75**	**6**
17	3D Modelling /Cartography/visualisation	**25**	**2**		**50**	**4**		**50**	**4**		**75**	**6**		**50**	**4**
18	Mineral Management													**50**	**4**
19	Mineral Valuation/evaluation/statistics													**150**	**12**
20	Mining Geology													**50**	**4**
21	Rock Mechanics													**50**	**4**
22	Data Aquisition (From Primary and Secondary Sources inc Surveying, GPS etc.										**65**	**5**			
23	Geographic Science										**50**	**4**			
24	Selected Core Themesand electives										**210**	**18**			
	Subtotal not-common core	**270**	**22**		**150**	**12**		**100**	**8**		**400**	**33**		**450**	**36**
	Further time for electives	**155**	**12**		**275**	**22**		**350**	**28**		**175**	**15**		**0**	**0**
	Total	**1250**	**100**		**1250**	**100**		**1250**	**100**		**1200**	**100**		**1250**	**100**

Land Surveyors Model

	Knowledge Area	Outcome	Topic / Themes	Credits	%
1	**Mathematics and Applied Mathematics**	Ability to apply mathematics and statistics in solving geomatics problems at a professional level	Differential and integral calculus of functions of one variable, differential equations, partial derivatives, Taylor series, mean value theorem, solving systems of linear and non-linear equations, trigonometric functions, hyperbolic functions, conic sections, complex numbers, vector geometry, matrix algebra, eigen vectors and values, linear transformations, space curves and surfaces, differential geometry. Series and polynomials. Intersections of 3D lines and planes, distances from points to 3D line and planes. Series an polynomials. Statistics: distributions and probability density functions, other than those forming part of adjustment of observation courses, error theory, correlation, sampling and statistical testing. including sets, probability, permutations and combinations.	**60**	**13**
2	**Physics**	Understanding of the principles of physics as in geomatics practice, instrumentation and technology	Kinematics, Newton's laws of motion, work, energy, power, rotational dynamics, torque, angular momentum, gravity, periodic motion, simple harmonic motion, interference, wave motion, diffraction, refraction and reflection of waves, Doppler effect, electric charge and field, electric potential, capacitance, resistance, electric current, electromagnetic induction, magnetic field, electromagnetic spectrum. Optics	**24**	**5**
3	**Surveying**	Competency in survey theory and its practical applications as required at a professional level	Measurement science, distance measurement (optical, mechanical and electro- optical), angular measurement, surveying equipment (distance and angular, including sources and management of instrument errors, calibration); position determination using observed angles/directions, distances, or combinations of these, (intersection, resection, trilateration and triangulateration) ,heighting; control surveys; setting out of pre-calculated positions and heights; Areas, volumes, interpretation of maps/plans, design and setting out of horizontal and vertical curves, cross and longitudinal sections, cut and fill calculations ,mass-haul diagram, Topographic surveying and creation of maps/plans, 2-D coordinate transformations. Mobile mapping and Data fusion. Inertial navigation systems. Mobile mapping (gyroscopes , accelerometers) Interpreting specifications and technical communication. The history of surveying in SA and internationally.	**60**	**13**
4	**Information Technology**	Ability to apply Information technology to solving advanced geomatics problems	Introduction to computer hardware, operating systems~~, data communications (local and wide area cover networks), word processing, spread sheets, internet, software development (scientific/engineering) in a current programming language, systems development (including systems analysis and design), databases and database management systems, use of information technology in surveying, 2-D CAD, security of systems and information.~~	**30**	**6**

	Knowledge Area	Outcome	Topic / Themes	Credits	%
5	**Geographic Information Systems (GIS)**	Ability to apply Geo Spatial Information Systems (GIS) in solving survey related problems	Nature of geo-spatial information, geo-spatial information in planning and decision- making, components of a GIS, data acquisition and manipulation, data structures (including vector, raster, hybrid), data modelling, geo-spatial databases and DBMS, applications of geo-spatial data using spatial analysis, spatial modelling and spatial statistics, visualisation and representation of geo-spatial information (including digital cartography).	**24**	**5**
6	**Photogrammetry and Remote Sensing**	Understanding of the theory and principles of photogrammetry and remote sensing and its practical applications as required at a professional level	Earth radiation model and electro-magnetic spectrum, satellite orbits and orbital parameters, geometry of sensors and sensor systems (airborne, space borne and terrestrial), camera calibration , acquisition of images (including flight planning), image media and formats incl. image compression, principles of analogue and digital photography, photogrammetric measurement and data processing including geometry of images, relative and absolute orientation, 3D resection, 3D intersection, bundle adjustment and aero triangulation, ortho-rectification, mosaicing and georeferencing, digital elevation models . Determination of 3-D coordinates in close- range photogrammetry. Accuracy and reliability assessment of photogrammetrically derived data, image (photo) interpretation , image processing (including image enhancement, image feature extraction, classification, PC analysis,). creation of 3D computer model of landscapes settlements and buildings. Virtual globes. UAV photogrammetry and related applications. Planning and design of photogrammetry and remote sensing projects. Application of terrestrial and aerial laser scanning	**36**	**8**
7	**Coordinate Systems and Map Projections**	Understanding of the principles and theory of co-ordinate systems and map projections and their practical application at a professional level.	Two- and three-dimensional coordinate systems, grid reference systems, shape of the Earth, Geoid, mathematical representations of the Earth, (including datums and reference ellipsoids) geographical coordinates, map projections, Including mathematical models and projection characteristics) reprojections,transformations, SA Survey co-ordinate system and UTM system. Spherical trigonometry.	**18**	**4**
8	**Error Theory and Adjustments**	Ability to determine best fit solutions for standard and complex surveys and understanding of advanced error theory and analysis	The nature of observations and data acquisition, types of errors, means, norms ,accuracy, precision, reliability, probability, confidence intervals, distributions and probability density functions, auto- and cross-correlation, hypothesis testing, least squares theory, simple and multiple regression, distribution functions, law of error propagation, least squares adjustments of survey observations(parametric and condition equation case), network adjustment (including free networks), adjustment of coordinate transformations, design of survey networks, statistical analysis of results and interpretation of data.	**30**	**6**

	Knowledge Area	Outcome	Topic / Themes	Credits	%
9	**Earth and Environmental Science**	Understanding the relevance of geomatics with respect to the environment	A combination of any of the following: Climatology, Geomorphology, structural geology, engineering geology, interpretation of geological maps, integrated environmental management, environmental impact assessment, development science and theory, urban systems and human settlement, sustainable development, natural environmental systems (water, atmospheric, oceanographic, fauna/flora etc.), conservation (natural or heritage).	**24**	**5**
10	**Business and Project Management**	Understanding of general and financial management principles, including related legislation, and their application in the Geomatics Industry	Management functions (planning, controlling, organising, decision-making), human resource management, financial management and management accounting, marketing and client relations, taxation, project planning, costing, resource allocation, project control and reporting, business communication, report writing, contract law.	**12**	**3**
11	**Professional Practice**	Understanding of practice management, professionalism, professional ethics and related legislation	Professionalism, professional ethics, different types of professional practices, partnerships and partnership law, labour law, structuring a practice, client relationships, SA survey profession and SA Geomatics Council (including legislation and rules), social responsibility. Access to Information Act, Spatial Data Infrastructures, role of national and international associations and societies in geomatics. Intellectual property rights and copyright, privacy rights, information economics.	**12**	**3**
12	**Research project**	Proficiency in independently completing a geomatics project and reporting thereon	Engagement with a geomatics-related problem to demonstrate the ability to design, execute and report on a project in a written and oral presentation format	**36**	**8**
13	**Cadastral Studies and Land Tenure**	Understanding property and cadastral survey law and its application at a professional level	Land law. Land tenure. Registration systems. Land information management. Fundamentals of Roman-Dutch and statute law, immovable property and real rights; land parcels, boundaries, rights and tenure; rights diagrams and deeds (servitudes, leases, sectional titles, 3D rights, off-shore rights, communal rights and rights to mineral and petroleum resources); curvilinear and ambulatory boundaries; the cadastral boundaries in the coastal zone including the HWM; consolidation and subdivision of land; historical development; cadastral case law; cadastral reform. Principles and practice of cadastral boundary surveying, key legislation including Land Survey Act, Sectional Titles Act and Regulations. International legislation, law of the sea.	**36**	**8**
14	**Geodesy and Satellite Surveying**	Understanding of geodetic and GNSS concepts and theory and ability to carry out and analyse GNSS surveys.,	Earth gravity field, earth rotation dynamics and reference systems, geocentric coordinate systems, gravity observations, geoidal studies, tidal effects, datum and datum shifts, geodetic surveying, global navigation satellite systems, satellite orbits and orbital parameters, time systems, 3-D positioning.	**24**	**5**

	Knowledge Area	Outcome	Topic / Themes	Credits	%
15	**Land Management and Planning**	Understanding of land management paradigms, challenges and solutions; understanding of planning principles and applications at a professional level	Urban dynamics and development, land use systems and types, land use planning and control, socio-economic influences, environmental and physical influences, planning legislation and constraints on township development, community dynamics, social compacts, layout design, engineering considerations for services, integrated environmental management, environmental impact analysis, land development objectives of local government, land management and administration, land valuation.	**18**	**4**
16	**Precise Engineering Surveying**	Ability to plan and execute precise surveying projects at a non-specialist level	Specialised instrumentation (including sources of errors, calibration and expected precision), precise engineering surveying methods, precise heighting methods, design and optimisation of networks, precision surveys for construction and industrial applications (including precision alignment), interpretation and, presentation of precise engineering survey results.	**24**	**5**
17	**3D modelling/digital cartography**	Ability to visualise spatial data and differing formats derived from captured survey information	Cartographic communication (including information sense-making, information use and information-knowledge transformation), graphic space, symbology (point, line, area, pictorial, 3-D), colour, cartographic design, typology, generalisation, map use, general purpose maps, relief representation, thematic maps (including statistical mapping), map printing. Presentation an manipulation of point clouds	**12**	**3**
			Total	**480**	**100**

Academic Model in South Africa – Articles

- Generally 270 days articles
  - Spread over a range of subject areas (Field and Office)
- 6 Different Examinations
- 61 different laws

Self Assesment Tool - http://www.sagc.org.za/sat/

- Holds no legal weight – just assists the candidate to see where they are short as well as our EAC in recording those courses / degrees and year.
- Candidate creates a profile on the system.
- Adds the Academic programme
- Adds the Modules with credits
- Matches the entered modules to the fixed model framework
- Generates various report.

Self Assesment Tool - Current uses

- System used in two ways;-
  - Candidate – to check if they meet Councils Model
  - University Assesment – Although not ideal, if does assist in validating a universities degree against the framework.

MR Assesment Tool

- Need to have each Councils Academic models loaded
- Need to have university programmes, knowledge areas, outcome, topics and credits loaded.
- Need to have reporting for;-
  - Under / Over Credits
  - Credit equivalincy
  - Frequency of assesment