Roles Landscape Study
final report

Tom Franklin
Franklin Consulting

Hilary Dexter
Roland Ukor
University of Manchester

Margaret Dale
Sandra Walton
ECC

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Introduction

The Roles Landscape Study was a joint project between Franklin Consulting (FC), the University of Manchester (UoM) and the Educational Competences Consortium Limited (ECC). The aims of the project were:

- To extend the High Level Domain Architecture (HILDA) (now the underpinning model for the Innovation Base) to include role information,
- To enhance the interface of the system in order to enable users to work with it effectively,
- To include a representative set of roles in the model, and
- To present the ideas to the human resources community to determine what their needs are, and how they may be met using a modelling approach and a knowledgebase tool.

The project built on previous work undertaken by each of the partners. In particular, the development of the High Level Domain Architecture (HILDA) project by FC and UoM and the development of the Higher Education Roles Analysis (HERA) by ECC.

The report first discusses what HILDA is, with some example scenarios of how it might be used to support understanding and decision making. This is followed by a discussion of HERA, and then we report on the methods used during the report, and how the resulting information can be visualised. A discussion on role analysis is followed by one on how HILDA can support organisational development and its use in process improvement. Finally, we discuss the technical reasons that currently make it difficult and unhelpful to integrate HERA with HILDA but show how they can be used in conjunction, and a discussion of the transition from HILDA to the Innovation Base.

High Level Domain Architecture

What is a Domain Map?

In brief, a map is a tool which can be used to support navigation. Thus, a domain map is a tool which supports navigation through a representation and abstraction of the domain, which in this case is a model of higher education. The model comprises a number of different types of element which can usefully be grouped together as "Domains", "Work", "Roles" , “Motivations” and "Organisations" and also (but not relevant to this report) "Life-cycles", "Services", "Applications" and "Control" (see below and The HILDA model and its enhancement for organisational development for a full discussion).

It is worth noting at this stage that the vast majority of functions (‘Work’ includes business functions) are generic across institutions, being things like "admit student", "develop learning and teaching strategy". Further, many of the functions will be implemented in remarkably similar ways despite superficial differences. In part, this is because many functions are strongly influenced by external requirements. For instance, student applications are strongly influenced by the need to interface with UCAS in the way that UCAS defines and requires.

There are many ways in which the model can be viewed, depending on the needs of the user. It is possible to start from any of the main concepts in the model (Work, Roles, Domains, Organisations and Motivations), and from there drill down to find relevant information. See Data visualisation for an example of how this can be done.

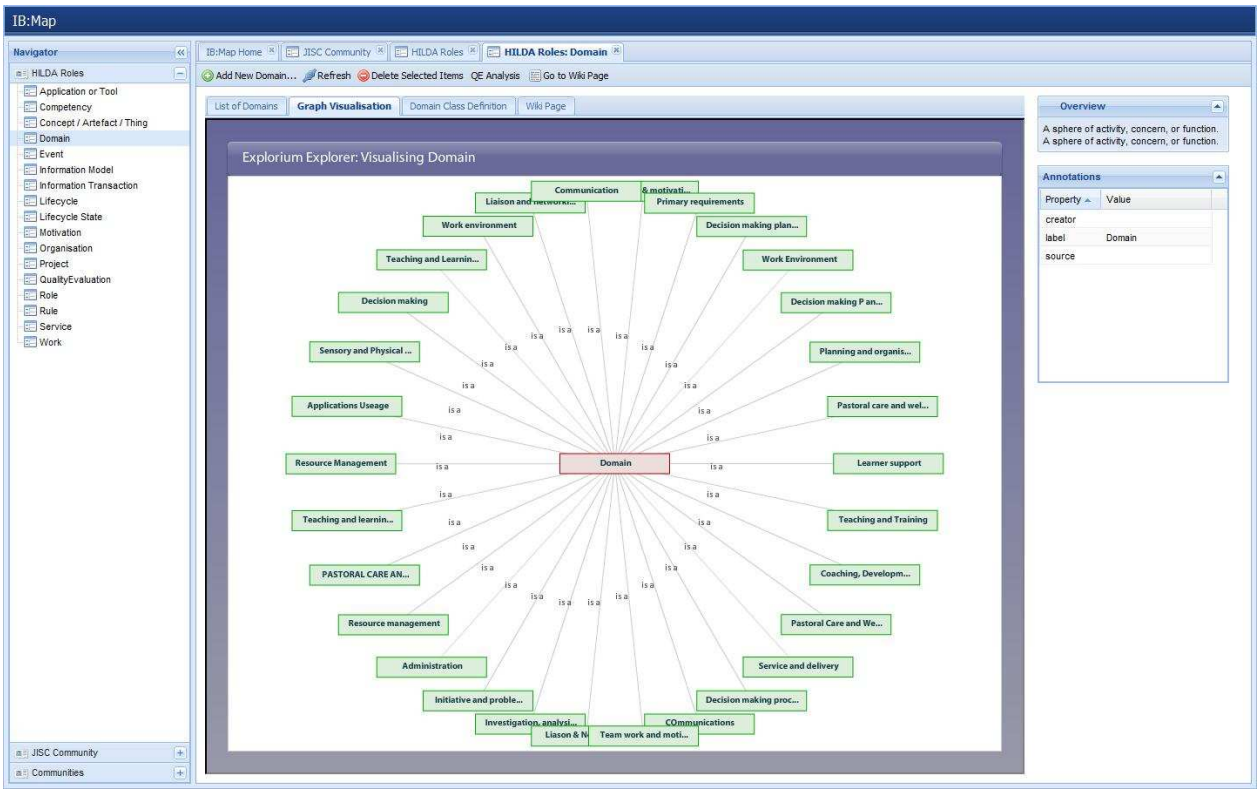

Figure 1: Top level domain view of HILDA

Scenarios

Before proceeding further it is worth looking at a couple of ways in which the system might be used. The following are two example scenarios, one from the point of view of a business analyst and the second from the perspective of a JISC manager/planner:

A Business analyst - replacing the Student Record System

The University of Wigan is a medium sized university that recently merged with Warrington College of Higher Education and needs to unify the various systems found in the two institutions in order to fully merge the universities and achieve economies of scale. Both of the institutions had well established systems that, over the years, had been customised to handle local practices. As part of the merger process it was recognised that processes would have to change and that a new student record system (SRS) would have to be acquired and implemented across the joint institution. In order to achieve the greatest benefit it was agreed to undertake a detailed requirements analysis across both the old institutions looking at existing processes and how they could be improved, and the functionality that would have to be provided by the new SRS.

In order to do this the University appointed a business analyst with a brief to:

1. Investigate existing processes,
2. Propose improvements to the processes,
3. Recommend the scope of the new system,

4. Outline key concerns in the development or implementation of the new system.

This would then be followed by a more detailed specification of requirements which would be incorporated into an invitation to tender to supply the new system.

The first task for the business analyst is to talk with a variety of stakeholders about their interest in the system, what they are doing, why they are doing it, how the current system supports their workflow and ways in which they believe the workflow could be improved.

In order to support this, the business analyst first needs to brief him or herself on the scope of student record systems and secondly devise some aids to support his discussions with stakeholders. To gain an overview of student record systems they go to the domain map, and using 'applications' as his or her entry point selects the student record system. This immediately gives him an overview of the application by showing which work areas it is used in, the life-cycles that it supports and the functions that it needs to support once deployed, and the external organisations from which it will receive information, or to which it will send information. On the details screen they can also see which other applications at the University of Wigan the SRS will have to interact with.

This high-level overview will form a useful starting point for some of his discussions, so they print the view, together with a more detailed one which prints the description for each item with that item.

One of the first people they are able to talk to is the head of admissions. For this they think that it might be appropriate consider the admissions process from the learners' point of view, and thus to use the "aspiring learner" and "admissions" phases of the learner life-cycle and approach the discussions from there. They might therefore look at life-cycles which shows the applications that support the learner life-cycle, and the various states and transitions within the life-cycle.

They can see the functions, processes and external agents (organisations) that are involved, and prints the view (both summary and detailed) for use in discussion with the Head of Admissions.

As an aside it may be worth saying that 'functions' describe what people or systems do to achieve their goals. How a function is carried out is shown in its processes. Each possible process for a function comprises flows of activities that show how the function is undertaken. The work areas, applications, life-cycles and external organisations are then ways in which these functions can be grouped together to facilitate understanding.

Our business analyst can also drill down and look at the functions that support each life-cycle state and the processes that implement them.

Each function and process can be viewed in this way, and form the basis of a discussion about practice in the university, and what is needed in order to either support or enhance current practice.

This can be repeated for the various people that the business analyst needs to see. The use of the domain map will give a greater coherence to their analysis because much of the analysis has already been done (albeit in a generic or archetypal manner) for them to build on and because they will have a framework in which all the discussions and analysis can take place, and a variety of ways in which the ideas and relationships can be discussed. Different views may be appropriate for different people. For instance, when discussing applications with IT staff it might be appropriate to use the application view, and to be considering the relationships between the various applications and the data flows between them and the standards that are needed to support this.

Using the model, our business analyst can understand the flows of data between the various systems, the relationships with external organisations (for instance UCAS for admissions and HESA for reporting) and the standards that are needed to support those communications.

From there they would be able to look at the functions that the student record system needs to support and the interactions and data flows between them. For instance, taking the admissions process, they can see that data has to be taken from UCAS in particular ways and passed to particular groups of people for processing within the university before returning information to UCAS for processing by them.

Once the business analyst has determined the scope of the application, they can begin to explore the functions that it needs to support in greater detail. Some of these may be common across the sector and be specified in the domain map already; others may be specific to the University of Wigan and may need to be recorded as such. We envisage that the University of Wigan could take a local copy of the domain map and record in it the results of analysis, and local variations from the model; they could also feed back into the generic model results that are of wider interest, or where the model is incomplete.

Processes can then point to service usage models (SUMs) within the e-framework.

JISC programme manager developing an Invitation To Tender

JISC produces invitations to tender (ITT) to address issues for which requirements have been recognised by community consultation or external triggers, including the development of services and demonstrators to, amongst other things, prove the e-framework. To date, the work in populating and proving the value of the e-Framework has not been systematic, with the first call simply asking for reference models without making clear exactly what a reference model might be. This resulted in an eclectic group of projects working in different domains, in different ways, producing different artefacts at differing levels of abstraction.

For this use case I am going to suppose that Sam has been asked to draft an ITT for their committee (JISC E-Framework Committee or JEF) that will have significant impact on getting the e-framework taken up by universities.

Sam realises that to determine where the greatest impact can be had it is necessary to review what they have already got (either through JISC or international funding) and look for some area(s) that are likely to be valuable to decision makers in universities, and particularly to IT directors.

Consequently, Sam goes to the domain map and begins to explore the various domains in it in a fairly haphazard way, looking at the domains and life-cycles for inspiration and looking at what services have been developed and rolled out. For this Sam finds being able to move freely around the map moving between the different domains and life-cycles and drill down to see what services have been implemented very useful.

After a while, and a strong cup of coffee, Sam decides that e-administration is most likely to grab the attention of IT directors. Sam goes back to the domain map and goes to the e-administration domain, and then to the asset life-cycle on the grounds that all managers have some interest in the assets in their domain. Sam looks at the life-cycle and sees that there are already services that implement large parts of the life-cycle including acquisition, management, maintenance and disposal. Sam realises that there are no services that support project management for major acquisition projects (such as major computer installations or buildings). Sam looks at the reference models in the area, which are reasonably complete and uses these as the basis for defining a set of services that the JISC could fund. Since the domain map only shows completed work Sam emails DEST, SURF and New Zealand to ask if they are working in the area.

Key elements in HILDA

To be useful a domain map needs to contain detailed information on the domain in question, in this case, higher education. The model needs to contain a number of different types of information and show the relationships between them.

The key elements of HILDA are:

- **Function** - The function describes what the people or systems do to achieve their goals. The function will contain processes that show how value is obtained from that function for the business actors.

- **Processes and sub-processes -** A process is a set of linked activities that creates value by transforming an input into a more valuable output. Both input and output can be artefacts and/or information and the transformation can be performed by human actors, machines, or both. A business process can be decomposed into several sub-processes, which have their own attributes, but also contribute to achieving the goal of the super-process

- **Application** - Computer software that employs the capabilities of a computer directly on a task that the user wishes to perform.

- **Life-cycles and life-cycle states -** The description of the distinct phases through which an object passes during its life. This includes phases such as requirements definition, concept design, production, operation, maintenance, etc. It is a series of states, connected by allowable transitions.

- **External organisation** - Organisation outside the boundary of the university that interact with it. The interactions generally involve exchange of information. This information specification contribute to the domain information model.

- **Work areas (domains) -** In general, a domain is an area of control or a sphere of knowledge, identified by a name. It is an area that defines a set of common requirements, terminology and functionality..

- **Roles -** A role defines the behaviour and responsibilities of an individual, or a set of individuals working together as a team, within the context of an organisation.

- **Artefacts -** An artefact is a work product of the process: roles use artefacts to perform activities, and produce artefacts in the course of performing activities. The collection of artefacts contributes to the domain information model. The detailed domain information model should evolve alongside the functions and processes as they are detailed.

- **Motivation -** this may be positive (to achieve a goal), or negative (to avoid a problem), but is the reason for undertaking a piece of work. Motivations may come from policies and strategies, regulations (such as compliance with legislation). We are concerned with the motivations that drive the business, not those that might drive the individual (pay, recognition, job security etc).

Higher Education Roles Analysis

Higher Education Role Analysis (HERA) was developed for the higher education sector by a consortium of universities and colleges of higher education representing three quarters of the

sector. Its copyright is owned by the consortium which is a not-for-profit company limited by guarantee. The consortium is governed by a board of directors, drawn from member institutions.

HERA's design was underpinned by extensive field research carried out in over 60 institutions. A wide range of stakeholders, including member institutions, trade unions and academic advisers were involved during the development phase. The objectives of the scheme are to support the design, implementation and maintenance of new pay and grading structures and a range of other HR functions.

The scheme has been widely used to support the implementation of the new pay and grading structures and has gained extensive acceptance where the scheme has been applied. A recent independent review of the scheme against its original objectives concluded that these had been achieved.

Following expressions of interest from Colleges of Further Education in Scotland, the scheme was tested for suitability. This revealed that, apart from some minor modifications in terminology, the scheme was capable of producing recognisable definitions of role requirements. The most significant change was to alter *"Analysis and Research"* to "*Investigation and Analysis".* A separate name, Further Education Development and Role Analysis (FEDRA) was given to the product to reflect the differences in organisations and the nature of some of the roles

Both schemes can be used to analyse existing roles and design new roles. The structured approach to analysis allows for consistent definition of roles using terminology and values relevant to the organisation and has been found to be widely acceptable to staff.

The output from the scheme and associated software produces profiles that can support recruitment, and selection, the identification of training and development needs and career planning. The profiles define what is required by the role in terms of responsibilities, level of demands and behaviours expected from a competent and experienced role holder.

Scheme contents

The field research involved the detailed examination of the contents of an extensive range of roles to identify the important and differentiating features.

The result was a structure made up of fourteen heading (elements) broken down into a number of levels representing the different demands or skills required under each heading. The number of levels varies depending on the element and ranges from three to six.

Each element is carefully defined to avoid ambiguity and each level has a statement, setting out the practical activities expected at that level of demand.

The elements are:

- Communication
- Team work and motivation
- Liaison and networking
- Service delivery
- Decision making processes and outcomes
- Planning and organising resources
- Imitative and problem solving
- Analysis and research (Investigation and analysis in FEDRA)

- Sensory and physical demands
- Work environment
- Pastoral care and welfare
- Team development
- Teaching and learning support
- Knowledge and experience

The definition for Decision Making Processes and Outcomes is:

> "Covers the impact of decisions within the institution and externally. This may include decisions which impact on one's own work or team; decisions which impact across the institution; and decisions which could have significant impact in the longer term within or outside the institution."

An example of a level statement for *"Initiative and Problem Solving*" is:

> "The role holder is required to resolve problems where there is a mass of information or diverse, partial and conflicting data, with a range of potential options available; apply creativity to devise varied solutions, approaching the problem from different perspectives."

The schemes also contain a competency framework which sits alongside the elements and questions. This supports the creation of career development routes, and recruitment, selection and promotion. It also enables an individual to identify development needs and plan career futures using the employee career mapping functionality.

Process for analysing roles

Examples of the activities carried out by the role holder as part of his or her normal duties are gathered, using a questionnaire containing the elements and questions, from the role holder, a sample of role holders (n the case of roles with a number of occupants) or from the role's manager. The questionnaire can be completed in paper form, on-line or during a meeting with a trained role analyst.

The examples should be:

- Typical
- Normal
- Representative of the range of activities
- Accurate

The examples should be verified by someone who knows the role well and is authorised to do so. Any differences of opinion about the role requirements need to be resolved before the role is finally scored.

Scoring the evidence

The evidence is scored by the trained role analyst who decides which statement best reflects the level of demand or skill needed to perform the activities.

Each statement has a number of possible responses which represent a measure of importance and magnitude, or a level of responsibility. The response letters are converted into numbers and

the score for each element is cumulated into a total points score. It is possible to make this calculation manually but the web based software is quicker and more accurate.

Great care is needed to ensure that scoring is carried out in a consistent and equitable manner. Notes for Guidance have been produced to help interpretation and each institution will have developed its own version to reflect its context and local circumstances.

The scheme should only be used by those who are trained and able to use the scheme to the standard required. Training and continued development of role analysts is key to achieving consistency and equity and to maintaining the integrity of the institution's pay and grading structure.

The HERA tool software produces a number of outputs:

- **Total points score** which enables roles to be placed in a rank order
- **Role description** which is a narrative outlining the role requirements using the question terminology
- **Role profile** which is a graphical portrayal of the role, element by element
- **Role specification** for use in recruitment, selection, promotion and career development
- **Employee specification** which summarises the results of an individual's career mapping
- **Role to employee comparison** reports to identify development needs and support career planning.

The software also produces a number of reports which aid role modelling by enabling the comparison of roles and provide insight into role requirements. They also support quality and consistency checks.

Each member organisation has its own secure database which contains details of the roles found in that organisation and carries out the calculation of role score.

The database enables role modelling and supports the production of reports which show the relationships and differences between roles. Other outputs include role description reports, role profiles and specification reports.

Using the outputs

Pay and grading

The total points scores report gives a rank order which indicates which is the largest, most valuable role at the top and the least demanding role at the bottom.

The rank order of roles is used in the design of pay and grading structures and informs the allocation of roles into grades. It is usual to band together point scores into a range that fits against a grade e.g. point 365-415 equate to Grade 4. How this is done is for each institution to decide when designing its own pay and grading structure.

Understanding differences

The points scores differentiate between roles and allow for comparison. The position of the role in the rank order is determined by the evidence provided and agreed by role holders and managers. The use of the software reports makes it possible to see, in great detail, why roles

achieve different or similar points score. Thus, decisions can be seen to have been made on grounds that are clear, explicable and justifiable.

Recruitment, selection and promotion

The role specification and description reports set out the behaviours required by an effective role occupant, using the competency framework and element statements to define the level of responsibilities and required activities. These can help to target recruitment activities and assess candidates using criteria relevant to the role in question.

Career path and development planning

The ability to link related roles across a grade or up the hierarchy enables the development of career paths. These enable individuals understand the differences between roles at higher levels and identify what action is needed to help them develop and progress their careers.

It also enables institutions to consider their future staffing requirements and plan accordingly.

Appraisal and the identification of further development needs.

The ability to map individuals against the requirements of the role they occupy will contribute positively to the appraisal process. It will ensure that development action is targeted at areas that will make a difference.

The software also allows an individual to be assessed against any other role in the database. This helps career development as outlined above. It also helps individuals to consider their options in terms of sideways or diagonal career development.

This functionality also helps organisations manage change and, by being able to recognise talents not currently being used, can ensure the effective deployment of the workforce.

Design of new roles and restructuring

Change in processes and roles is a constant feature of institutional life. The benefit provided by using HERA to model roles is that the effect of these changes can be charted and their impact on processes, role shape and the competencies required for effective performance can be assessed. Its use can be applied equally to incremental change just as much as the reconfiguration of significant parts of an institution.

HILDA can be used to identify the activities required in a new area of work. HERA provides a structure that enables these to be fitted together to construct roles that make sense. As HERA is in widespread use in the HE sector, many people, staff and managers alike are familiar with the terminology of the scheme and have been involved in some way with its use.

Continuing its use to map changes to existing roles, linked with the process modelling facility provided by HILDA, makes good use of the HERA database created by institutions as part of the work done to implement new pay and grading structures. It also draws on current understandings and the fact that the scheme has been widely accepted as a means of capturing the diverse and wide ranging aspects of work carried out in institutions.

For managers charged with keeping work processes and roles up to date, HERA provides a tool to test the continued validity and effectiveness of the work being carried out to achieve the unit's business objectives. This consideration will contribute to the identification of work that is no longer effective, work that is effective and gaps in coverage. Comparing the results of this

appraisal with the definitions or descriptions of the current roles, it will be possible to identify where changes to the allocation of responsibility and nature of tasks are required.

HERA can then be used to assess the effect of these changes on the way in which roles in the unit are constructed and relate to each other. As they are grounded on activities and HERA uses evidence of role requirements, it will be possible to discuss what these changes will mean, in practice, to the individuals concerned.

The structure given by HERA's fourteen elements and the questions will enable role holders to see what they need to continue to do, do differently or stop doing. It follows that changes to activity can alter a role's level of responsibility. HERA is designed to size roles according to level of demand or complexity. Therefore, using it to map the effect of changes, before they are put into effect, allows a manager to assess the impact they might have on the hierarchical relationships within the team and the position of each role in the grading structure.

The role profiling ability and reporting functions of the software can also be used to identify reporting and working relationships and design organisational hierarchies in relation to the grading structure. It allows the identification of duplications, overlaps and gaps, all of which are typical features of a dysfunctional organisation. It can also identify relativities and enable more responsible roles to be differentiated using concrete examples of responsibility and levels of demand.

Method

The project had three major strands to its work; generating useful data in a suitable format, extending the model and enhancing the proof of concept application. We will briefly look at each of these in turn, with further discussion of the issues below.

The first thing to say about roles is that they do vary between institutions for a variety of reasons including the size and mission of the institution. For instance, small institutions may combine roles that are split in a larger institution which may have more specialised roles. This is especially true in the support and administrative role, where, for instance, some large libraries have a role of "shelf filler" which may be part of a more general librarian role elsewhere. There are also roles which exist in some institutions, but not in others, for instance not all universities have international research officers or alumni fund raising officers. The increasing diversification of the sector and introduction of new areas of work are likely to result in a greater variety of roles and differences in their make-up.

With some caution we have therefore selected a number of exemplar roles. These have been drawn from the work done by ECC when creating HERA profiles for its members. There is no one "HERA database", as such. Each institution has its own secure data base which is populated with data unique to that institution. As each institution is its own legal entity with its own distinct mission, there is no wish in the sector to create cross-institutional role profiles. However, there is interest in comparing and contrasting the shape and size of different types of role.

The web-based software that supports HERA is developed by Tower Perrins and provided to ECC's members on license. This is a closed system in that it has no published APIs. Data is held securely since it is confidential to each individual member institution and can only be accessed with permission. It is possible to download data and transfer it to other applications using CSV files but for the purposes of using it in conjunction with HILDA, the data was transferred manually. This has implications for how HILDA and the HERA software can be integrated, which are discussed below.

The HERA roles data has been cross-referenced against other data that is readily available to us including job details advertised on jobs.ac.uk, National Occupational Standards (http://www.ukstandards.org/Find_Occupational_Standards.aspx?NosFindID=2) and Skills for the Information Age (http://www.e-skills.com/).

The version of HILDA available at the start of the project had not been tested with role information in any meaningful way at that time. The aim of the project was therefore to extend the model to enable role information to be recorded in more detail along with other pertinent elements such as competencies, role holders and actors to be included.

The extended model has been demonstrated to be robust and has the elements needed to cover the information about roles most likely to be needed for modelling this area (organisational development) in a manageable and scalable way. We are not attempting to hold all the possible available information about roles in HILDA. Other information such as that relating to grade and role holders, that is not relevant for the kind of modelling that we have been doing, can be held elsewhere, including in HERA and human resource management systems.

Data entry

We have developed two methods of data entry into HILDA. There is a batch method, whereby Microsoft Excel tables can be loaded into the knowledge base, and an interactive interface that supports direct data entry.

The batch method is most effective when there are large amounts of data to be entered that are already in machine readable form and can be quickly and easily moved into tables (if they are not already in tables); while the interactive method is most appropriate for small amounts of data, or where there are lots of different entities or relationships so that creating tables is not as effective.

We have mostly used the Excel tables since the data from HERA can be converted through CSV files into this form. This makes adding the information to tables quick and easy. The tables are available as a separate appendix (because of their size), with just a small sample included here.

Note that the second row of the table is used to determine how the data is added to the Innovation Base application database. Full details are in the appendix.

Role	**Work**	**Work-description**	**Motivation**	**Domain**	**Source**	**Author**
I [Role]	*R [Role] executes Work*	*A [Work] description*	*R [Work] has Motivation*	*R [Work] [Motivation] ownedBy Domain*	*A [Work] [Motivation] source*	*A [Work] [Motivation] author*
Lecturer/Senior Lecturer	Acts as personal tutor	Act as a personal tutor to 8 tutees for each year and one post graduate student. Discusses personal problems, gives advice where appropriate and suggests other sources of help		Pastoral care and welfare	ECC - Lecturer/Senior Lecturer	Daniel Franklin
Lecturer/Senior Lecturer	Solves admin problems	Admin problems e.g. trying to obtain permits.		Initiative and problem solving	ECC - Lecturer/Senior Lecturer	Daniel Franklin
Lecturer/Senior Lecturer	Administers projects	administering a number of projects alone without cover		Initiative and problem solving	ECC - Lecturer/Senior Lecturer	Daniel Franklin

Table 1: Sample data for entry into HILDA

The interactive method enables the user to enter the data freely, and see which existing entities they would like to relate an item to.

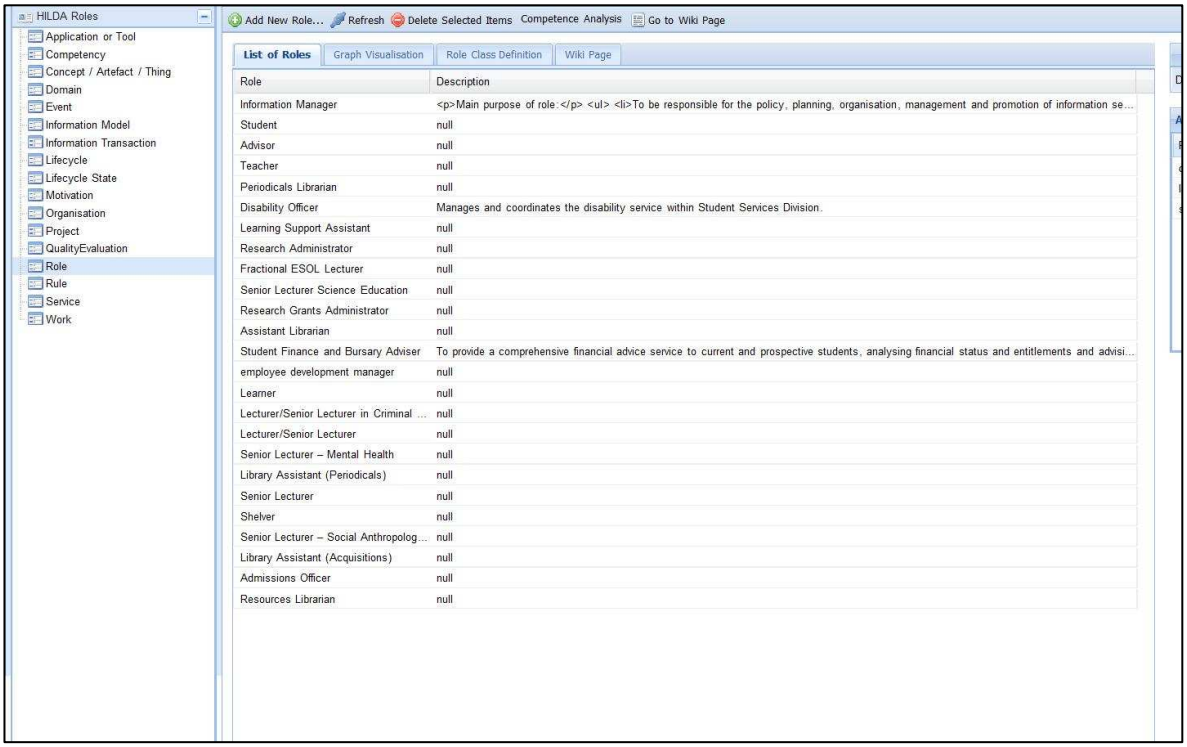

Figure 2: Role screen in HILDA

Selecting "Add New Role" brings up a pop up window into which the core information can be added:

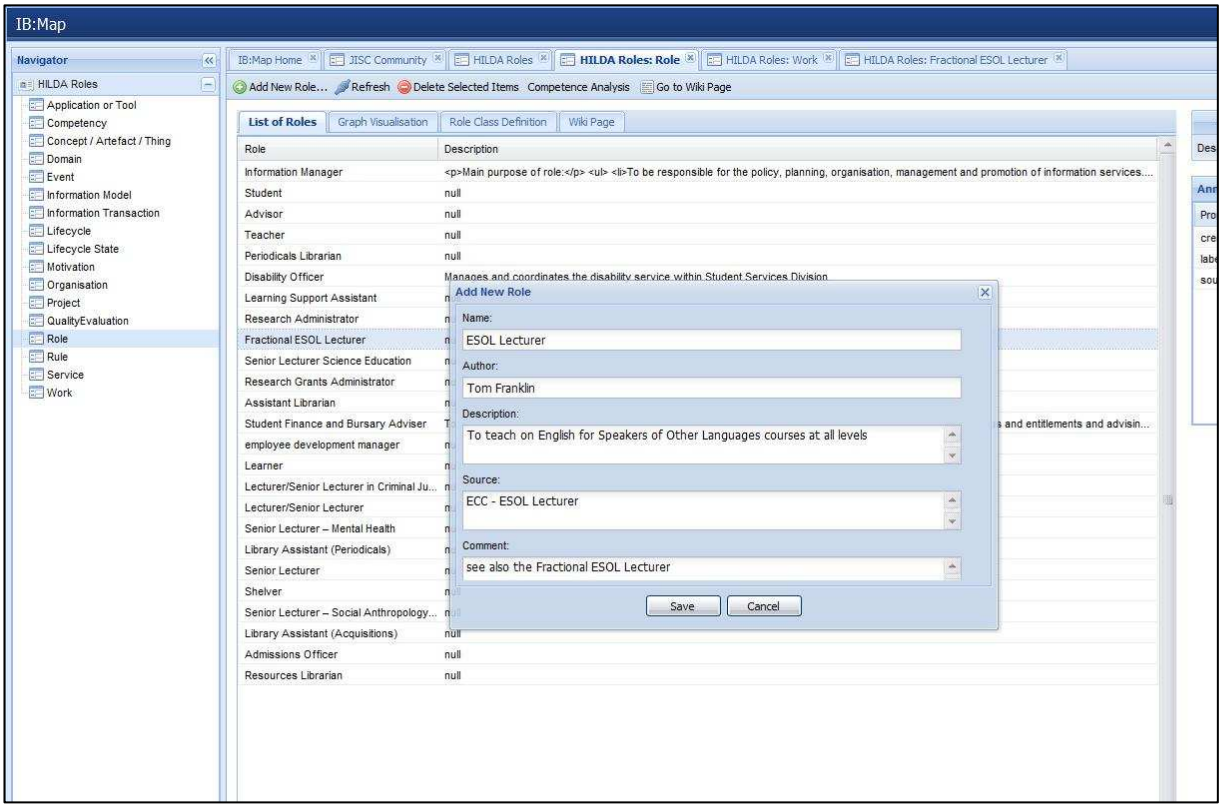

Figure 3: Role screen with "pop up" to add a new Role.

Once the role has been added further details can be added by selecting "Add property"

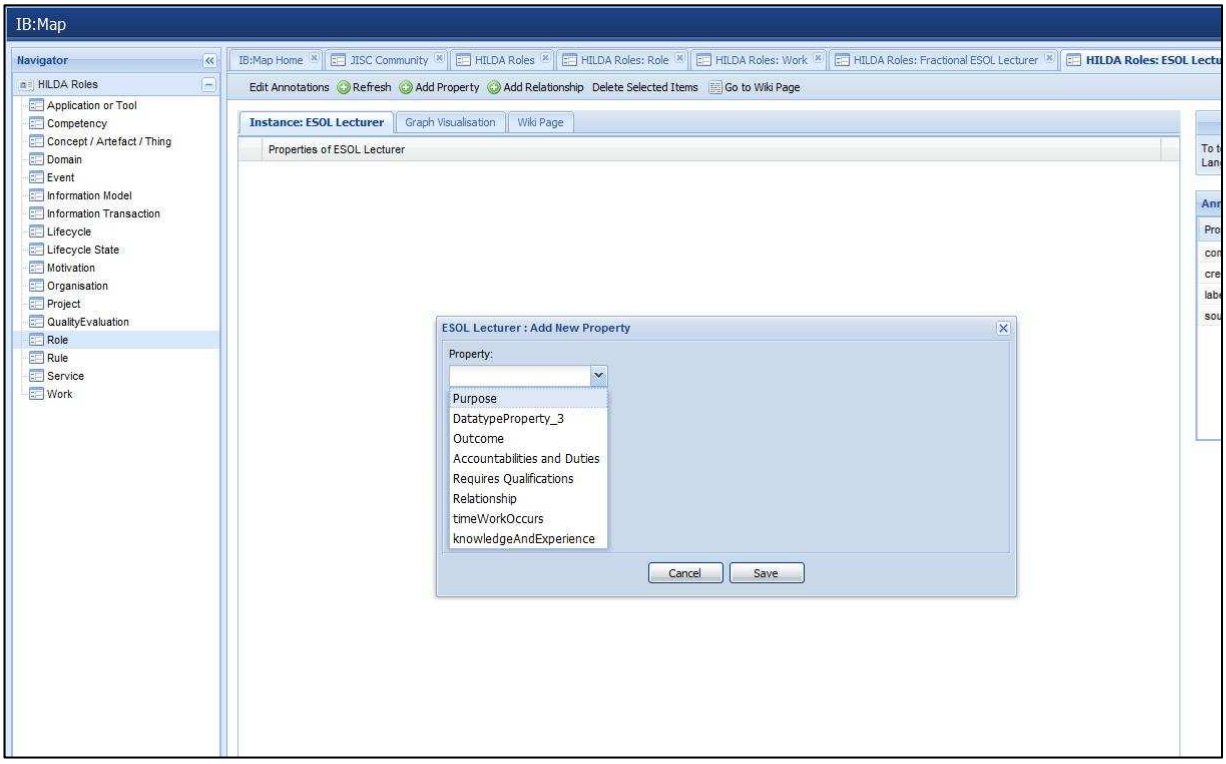

Figure 4: Adding properties to Roles - select a property

Once a property has been selected information can be added.

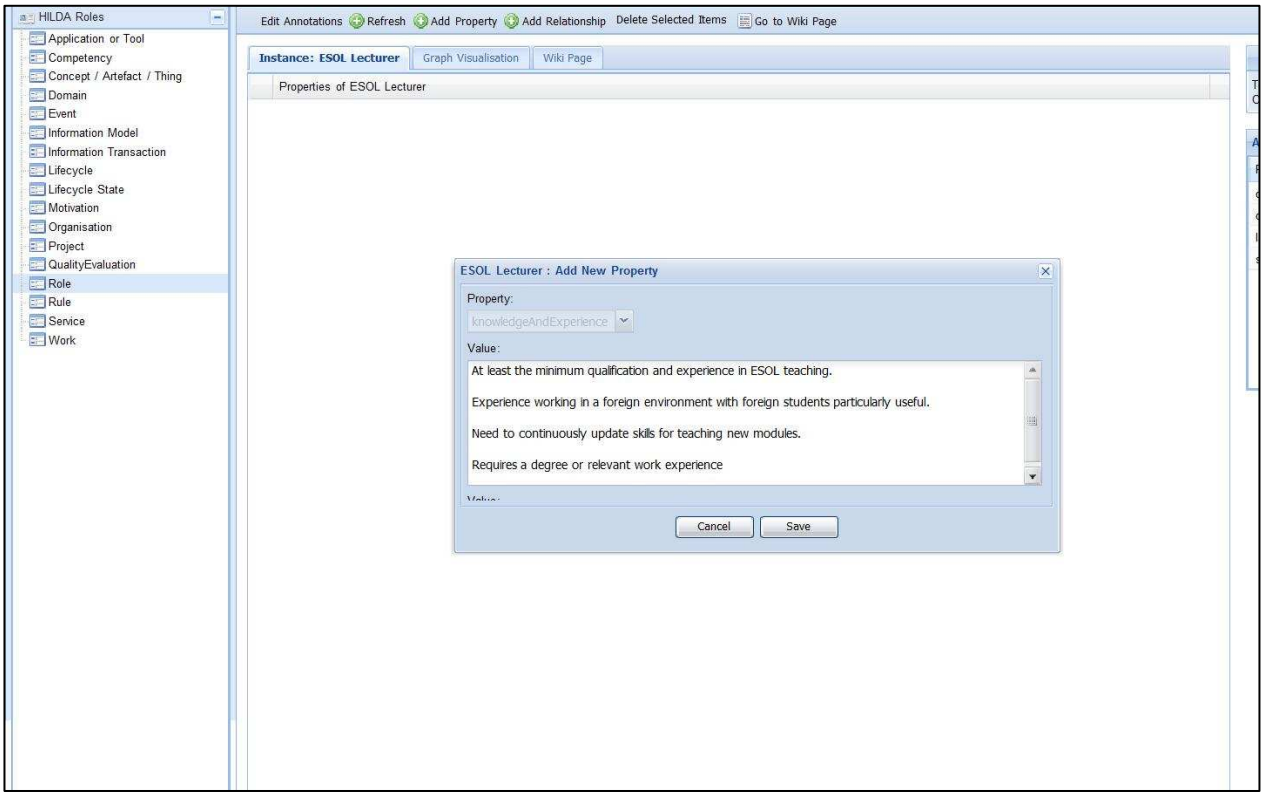

Figure 5: Role with knowledge and experience required being added

Several different properties can be added.

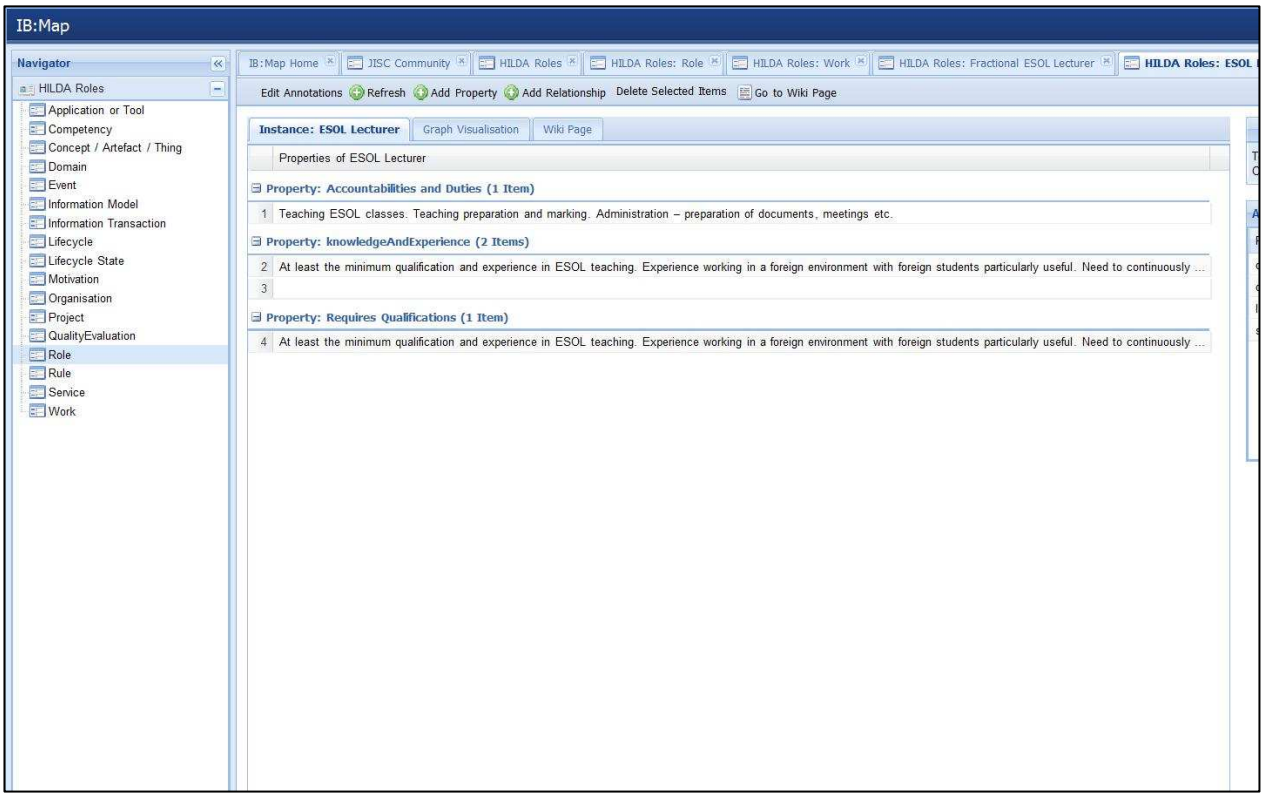

Figure 6: Role with several properties added

It is also possible to add relationships

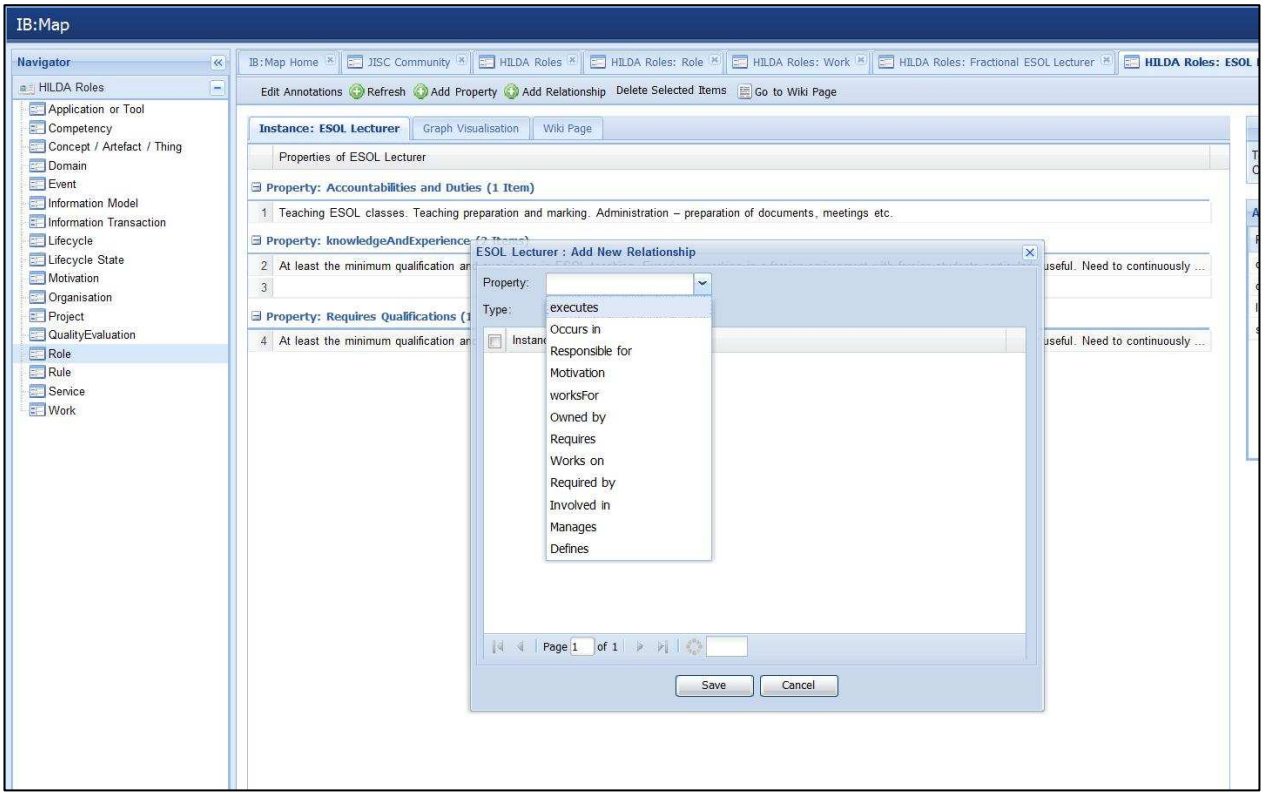

Figure 7: Selecting a relationship to add to a Role

And then choose the relevant work from the list of all the relevant work items

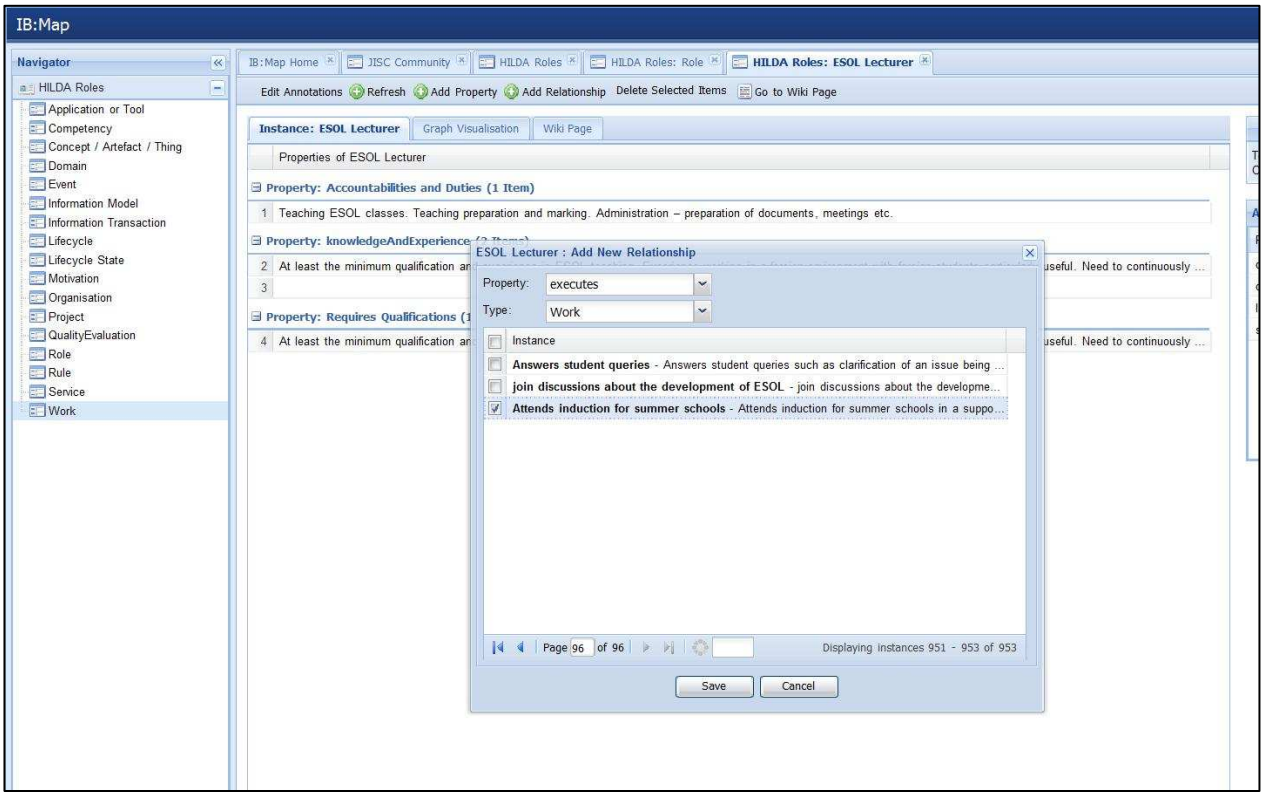

Figure 8: Selecting Work items relating to a role

This can be added for other relationships, such as:

- Role Occurs in Domain
- Role Occurs in Project
- Role Is responsible for Work
- Role Is responsible for Rule.

Once the information has been added it can then be viewed in relation to the other information, and additional entries made or additional comments made on all the content, including through a wiki type interface.

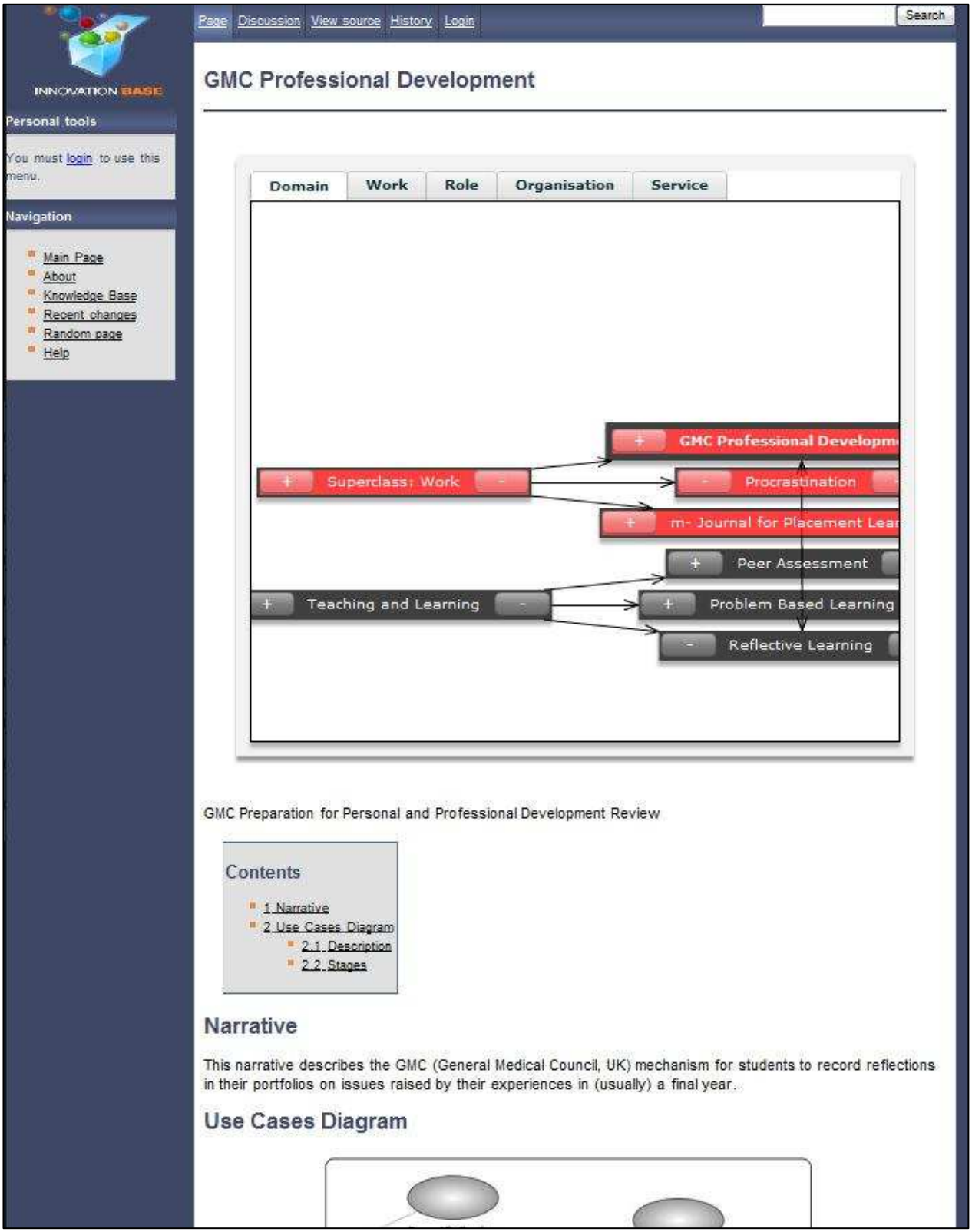

Figure 9: Original wiki interface for HILDA

Data visualisation

There are several ways in which the data can be visualised, and many ways in which it can be used. Here we will first demonstrate the variety of different ways that it can be visualised, and then give a single example of how it might be used to help to understand some issue related to roles.

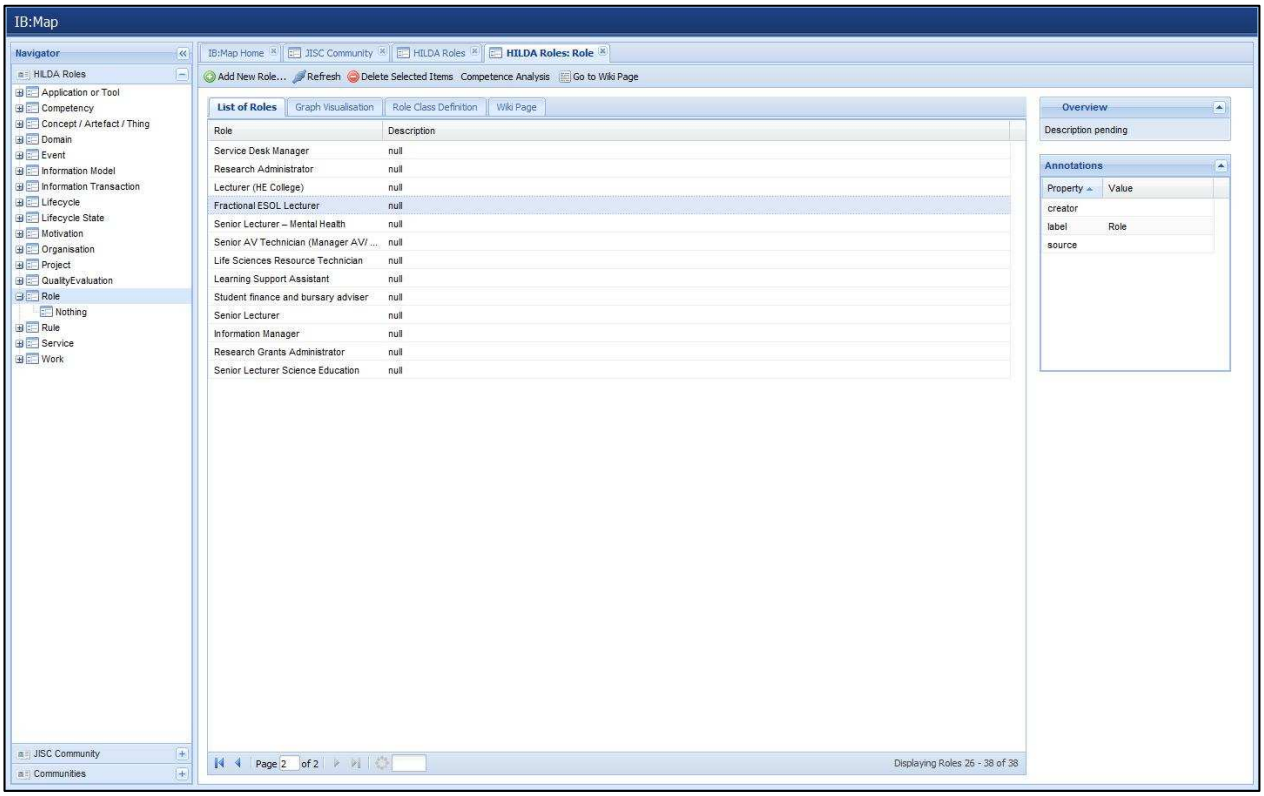

Figure 10: List of Roles

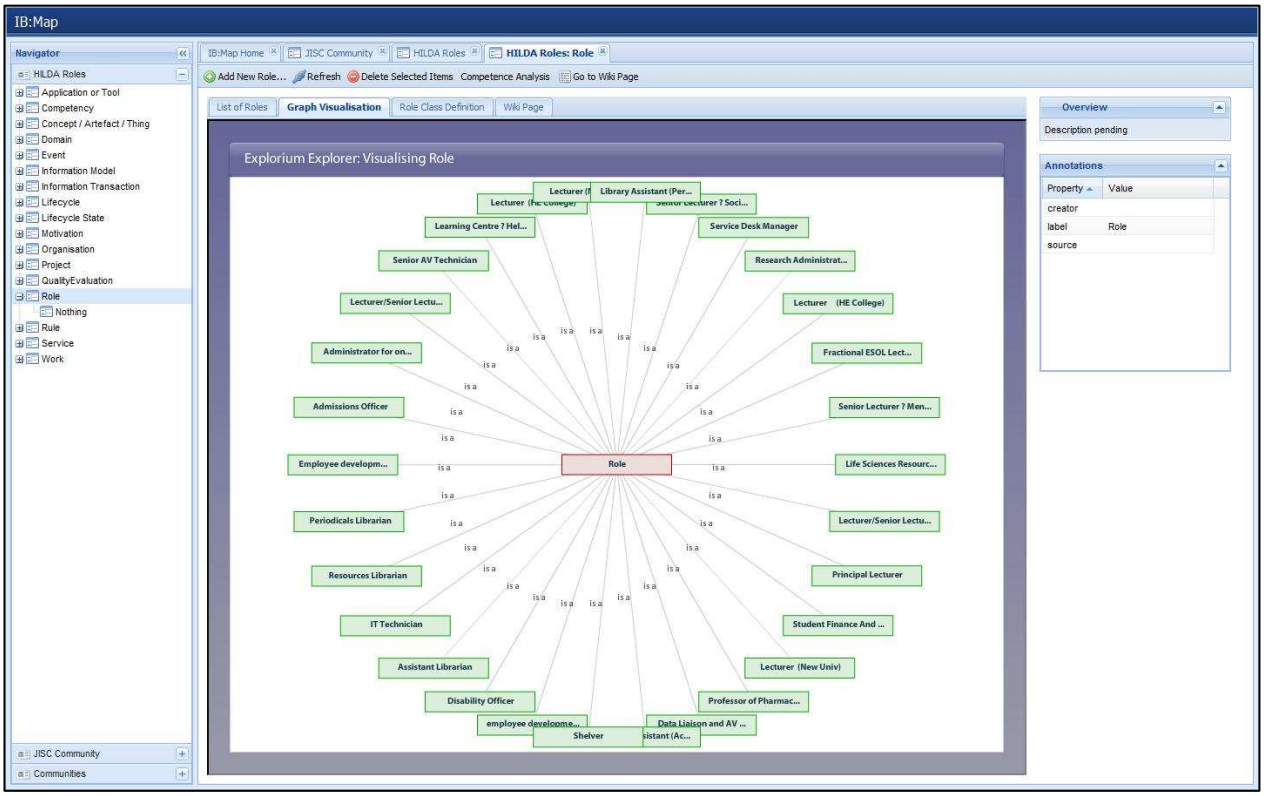

Figure 11: Visualisation of Roles

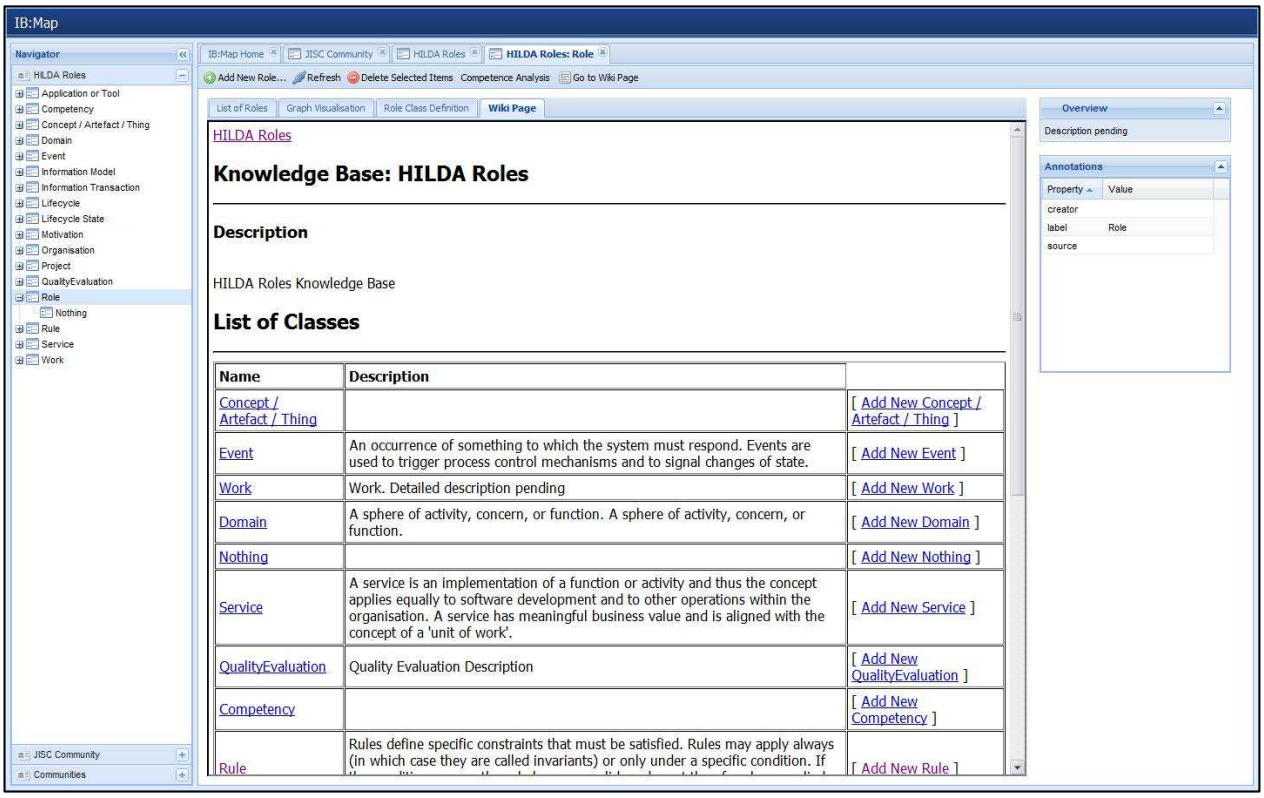

Figure 12: Roles wiki page

The following shows how one might use the system. Suppose that new regulations have come out on the use of photocopiers (due to possible ozone emissions from them), and that all people who are **required** to use them as part of their jobs have to be told about the new regulations. With current systems there is no easy way to identify these people. However, using HILDA we can do this quite easily:

Going to the Domains view:

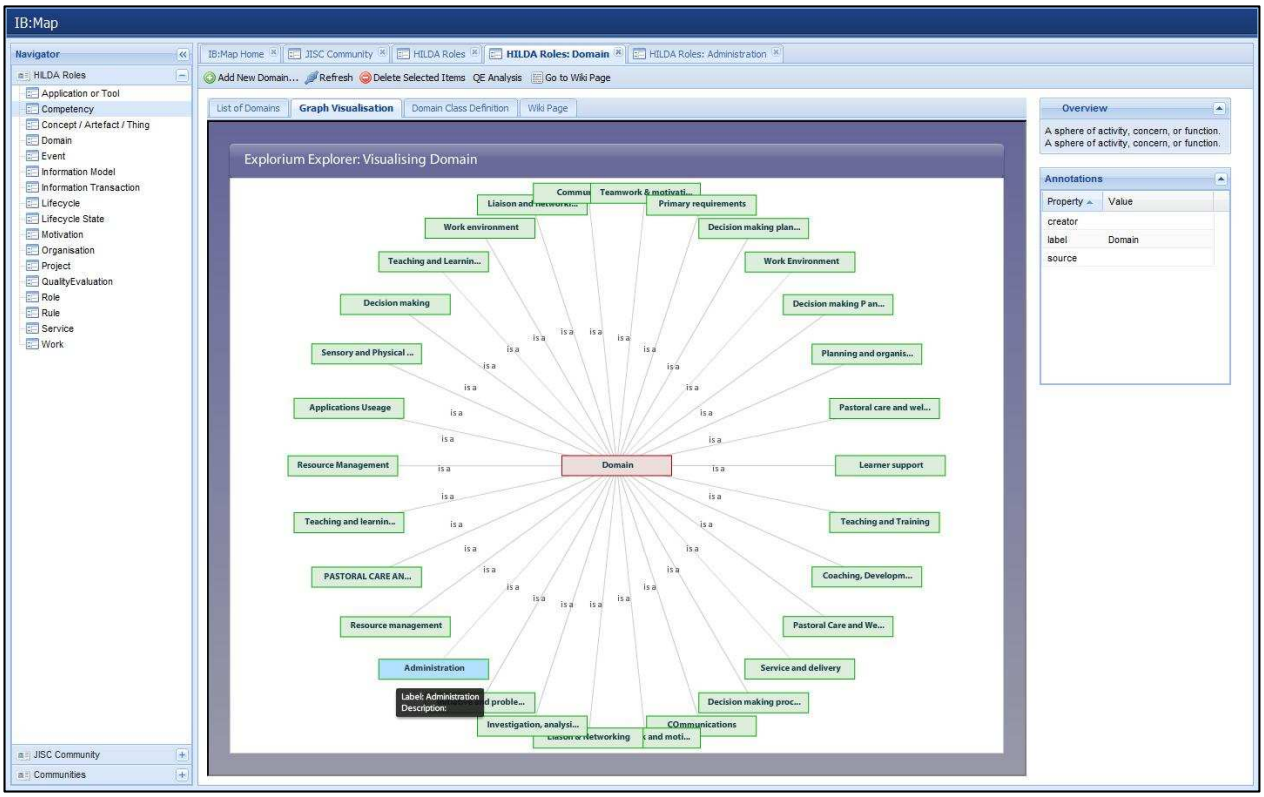

Figure 13: Domain view with Administration highlighted

By selecting the Administration domain, all the other domains get collapsed (to right of screen) and we can see the work and competencies etc that belong to the Administration domain.

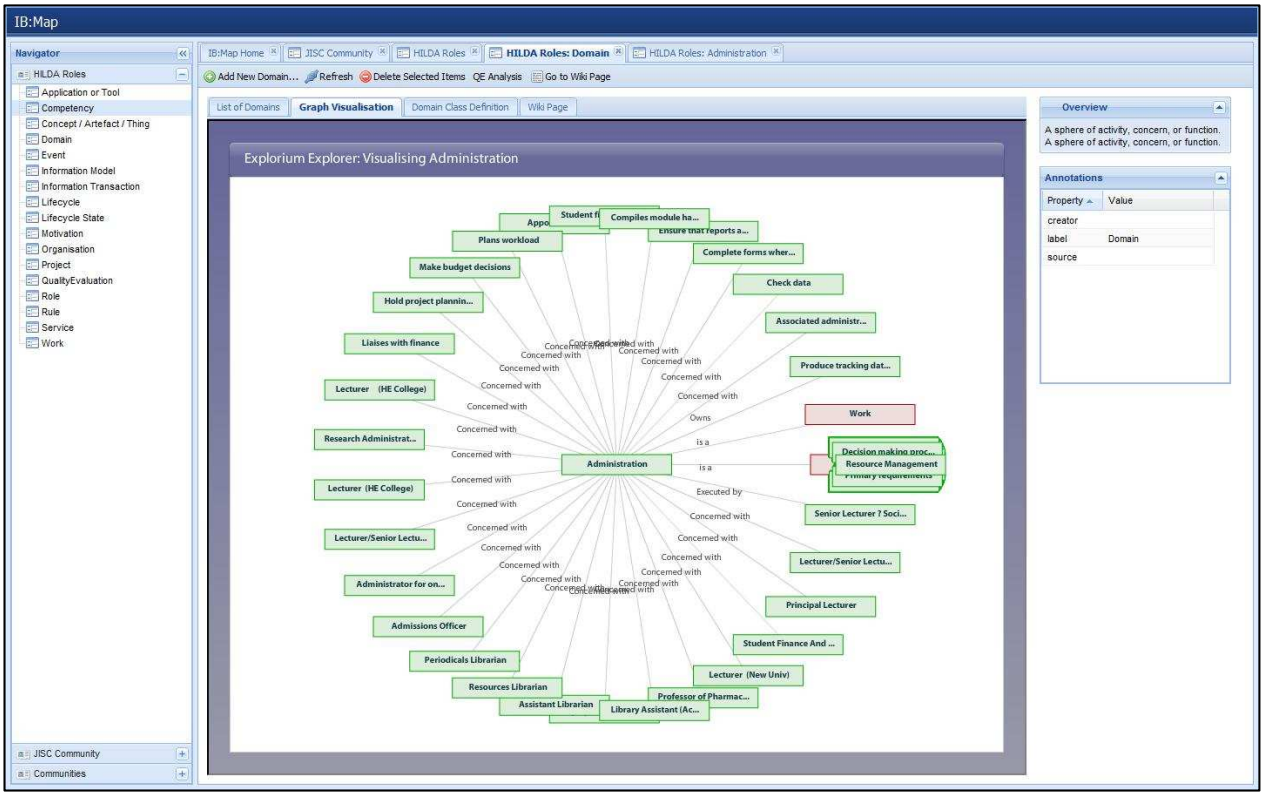

Figure 14: the Roles and Competencies in the Administrative domain

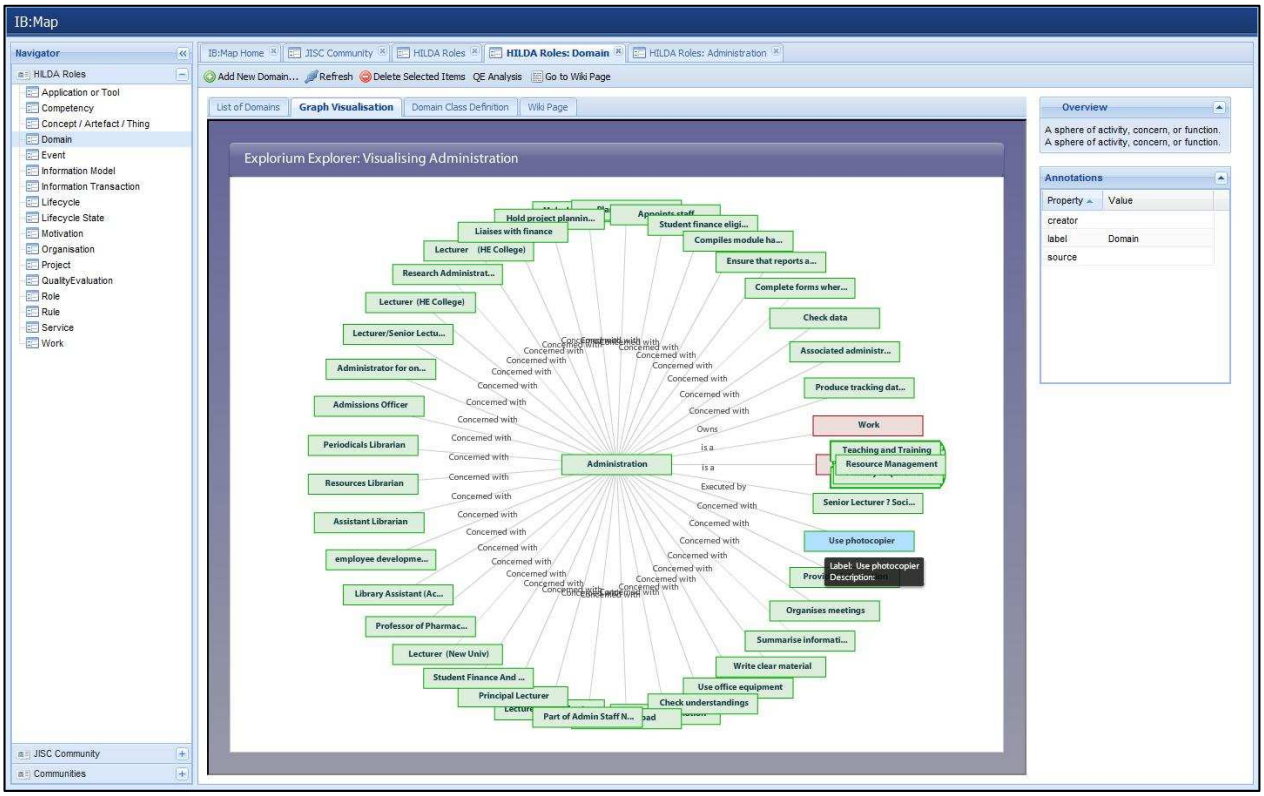

Figure 15: Work, Roles and Competencies in the Administration domain

The next image shows all the roles that require the use of the photocopier.

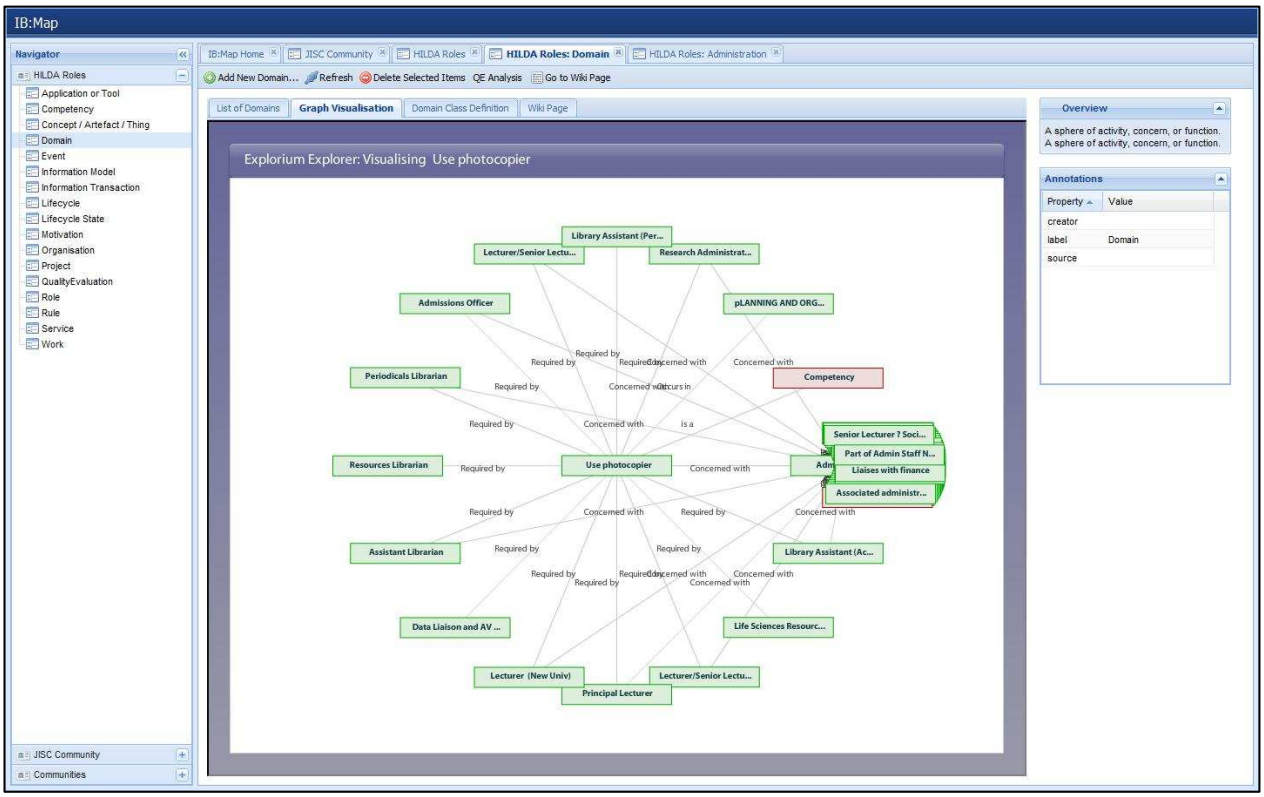

Figure 16: Roles that have use photocopier.

Having identified the roles, one could then use the HR system to find all the people that hold those roles and provide them with the information about the changes in photocopying regulations.

From this it can be seen that HILDA offers a very effective way of finding information and locating it within its wider context.

As additional information is added, this type of activity will become increasingly powerful, with the ability to find which roles are responsible for enforcing rules, are affected by different motivations etc. It also allows for the capability of doing "what if?" type modelling where the user can see the effects of changing any of the entities within the model - which processes are affected if I change this rule? Who will be affected if I alter that motivation? Etc.

The HILDA model and its enhancement for organisational development

The HILDA project was a domain analysis that began with the people in HE and what they do, making the functions in HE the focus of the underlying model. The functions are driven by goals, have principal actors, collaborations with other actors, and a number of possible routes to achieving their goals i.e. their processes.

The HILDA model addresses:

- The vision, goals, plans and strategy of the HEI;
- Interaction of the HEI with its environment of external organisations;
- Functions and processes of the HEI (A 'function' here is taken to mean what is done and a 'process' is taken as meaning how the function is performed);
- Information and other artefacts used and produced by the processes of the HEI functions;
- Roles and responsibilities;
- Organisational structuring of HEIs;
- Enterprise architecture mapping the links between processes and practices to the underlying infrastructure and standards;
- Reference models for showing how services may be used to meet functional requirements in particular areas.

The HILDA model provides the basis for construction of a knowledgebase that contains concrete examples of the different element types and a knowledge explorer (Innovation Base) that allows navigation and visualization of the content of the knowledgebase.

Figure 17 shows the base domain model which underpins the HILDA knowledgebase. The model has six distinct regions: **Organisation**, **Role**, **Work**, **Domain**, **Service** and **Control**.

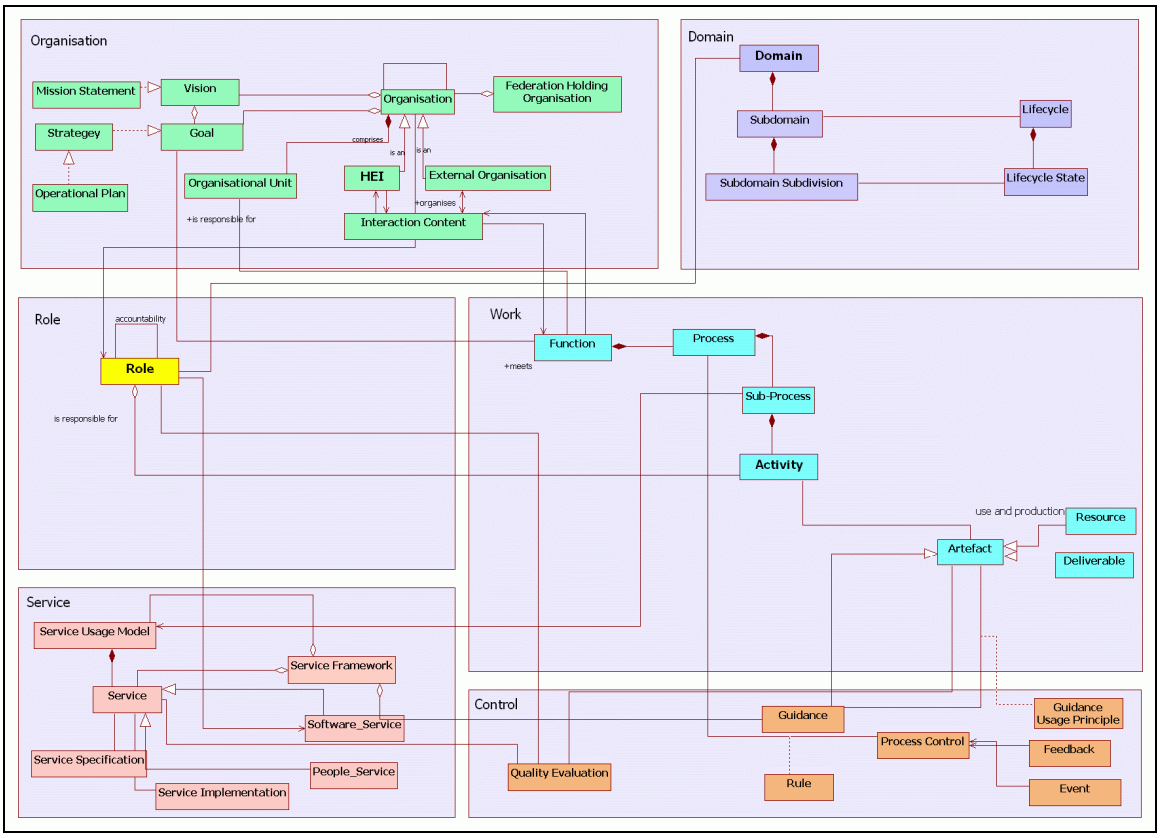

Figure 17 HILDA base model

During the HILDA project considerable effort was invested in reaching agreed definitions of the elements in the model. The elements of the model are defined in the following glossary table.

Term	Definition
Activity	An Activity (or Key Activity for role) is executed by a role, has an identifiable outcome, contributes to a purpose and comprises tasks. It may be a discrete action, executed by a role, within the flow of events (process) of a function.
Artefact	Activities have input and output artefacts. An artefact is a work product of the process: roles use artefacts (resources) to perform activities, and produce artefacts (deliverables) in the course of performing activities.
Deliverable	Is an Artefact. Roles produce artefacts in the course of performing activities
Domain	A sphere of activity, concern, or function.
Event	An occurrence of something to which the system must respond. Events are used to trigger process control mechanisms and to signal changes of state.
External Organisation	Organisation outside the boundary of the HEI that interacts with the HEI.

Term	Definition
Federation-holding Organisation	A management organisation for a group of member organisations. The degree of autonomy of the federated organisations varies.
Feedback	The return of a portion of the output of a process or system to the input, especially when used to maintain performance or to control a system or process. The return of information about the result of a process or activity; an evaluative response.
Function	The function describes what the actors (people or services) do to achieve their goals (aims and objectives). The function will contain flows of events (process) that show how value is obtained from that function for the actor(s).
Goal	A goal is a desired state of affairs of a system. Goals provide general purpose and direction. They are the end result of ultimate accomplishment toward which an effort is directed. They generally should reflect perceived present and future need. They must be capable of being effectively pursued.
Guidance	Is an artefact. Additional information related to roles, tasks (activities), and work products (deliverables). Examples of guidance are: Guideline, Template, Checklist, Tool Mentor ,Supporting Material ,Report ,Concept ,Practice, Reusable Asset, Term Definition, White Paper, Example
Guidance Usage Principle	The way in which a knowledge (guidance) artefact for an activity is used in a particular process context
HEI	Higher Education Institution. Organisation that provides learning products, primarily for higher education.
Interaction Content	The information provided in response to a request from another organisation or information received from another organisation. This information specification contributes to the domain information model.
Lifecycle	The description of the distinct phases through which an object passes during its life (Lifecycle States). This includes phases such as requirements definition, concept design, production, operation, maintenance, etc. It is a series of states, connected by allowable transitions.
Lifecycle State	A state is a condition of an object in which it performs some activity or waits for an event. An object may remain in a state for a finite amount of time. It is a component part of a Lifecycle.
Mission Statement	A mission statement defines the core purpose of the organisation
Operational Plan	Deals with the internal operations and equipment necessary to produce the organisation's products and services. The operational plan is derived from the strategy.
Organisation	A company, corporation, firm, enterprise or institution, or part thereof (whether incorporated or not, public or private) that has its own function(s) and administration, that supplies products or services
Organisational Unit	Named subdivision of an organisation with defined responsibilities.

Term	Definition
People Service	A people service is an implementation of a function or activity by a role (individual or team or organisational unit). A people service has meaningful business value and is aligned with the concept of a 'unit of work'.
Process	Sequence of activities that implement functions. A process is a set of linked activities that creates value by transforming an input into a more valuable output. Both input and output can be artefacts and/or information and the transformation can be performed by human actors, machines, or both.
Process Control	A decision point in a specific location in a process (workflow) which may branch based upon guard conditions. It is a decision point with a set of possible outcomes.
Resource	Is an artefact. Roles use resource artefacts to perform activities
Role	A role defines the duties and responsibilities of an individual (Person), or a set of individuals working together as a team, within the context of an organisation. A role is responsible for delivery of its main purpose through one or more activities.
Rule	Rules define specific constraints that must be satisfied. Rules may apply always (in which case they are called invariants) or only under a specific condition. If the condition occurs, the rule becomes valid, and must therefore be complied with.
Service	A service is an implementation of a function or activity and thus the concept applies equally to software development and to other operations within the organisation. A service has meaningful business value and is aligned with the concept of a 'unit of work'.
Service Framework	The systematic format and technical structure that supports metadata, concepts, contents and controlled vocabularies for managing the provision of services.
Service Implementation	The execution in code by a software service or by people in a people service of the operations declared on the service interface.
Service Specification	A description of the service operations and the way in which they may be accessed and requested through its interface.
Service Usage Model	The relationship between a process and the set of services required for its execution It provides a description of the needs, requirements, workflows, management policies and processes within a domain and the mapping of these to a design of a structured collection of Service Genres and Service Expressions, resources, associated standards specifications, data formats, protocols, bindings, etc., that can be used to implement software applications within the domain. Service Usage Models (SUM) model how services meet business needs.
Software Service	A single component or assembly of components that aligns to a 'unit of work' in a business process. It is packaged as an autonomous unit with a defined interface. May be deployed as a Web Service

Term	Definition
Stakeholder	An individual or group with an interest in the success of an organisation in delivering intended results and maintaining the viability of the organisation's products and services.
Strategy	The plan and means by which an organisation intends to meet its goals.
Subdomain	Also called work area. An area of control or a sphere of knowledge, identified by a name, within the domain sphere of knowledge.
Subdomain Subdivision	A defined part of a subdomain, often relating to a particular function or activity.
Sub-Process	A process can be decomposed into a number of sub-processes, which have their own attributes, but also contribute to achieving the goal of the overall process.
Vision	A shared mental framework for the direction and aspirations of the organisation.

Table 2 HILDA base model glossary

The HILDA Roles project extended this model to include the elements required for organisational development. Eight new elements were needed to include the role analysis functionality offered by HERA: these are shown in Figure 18 below.

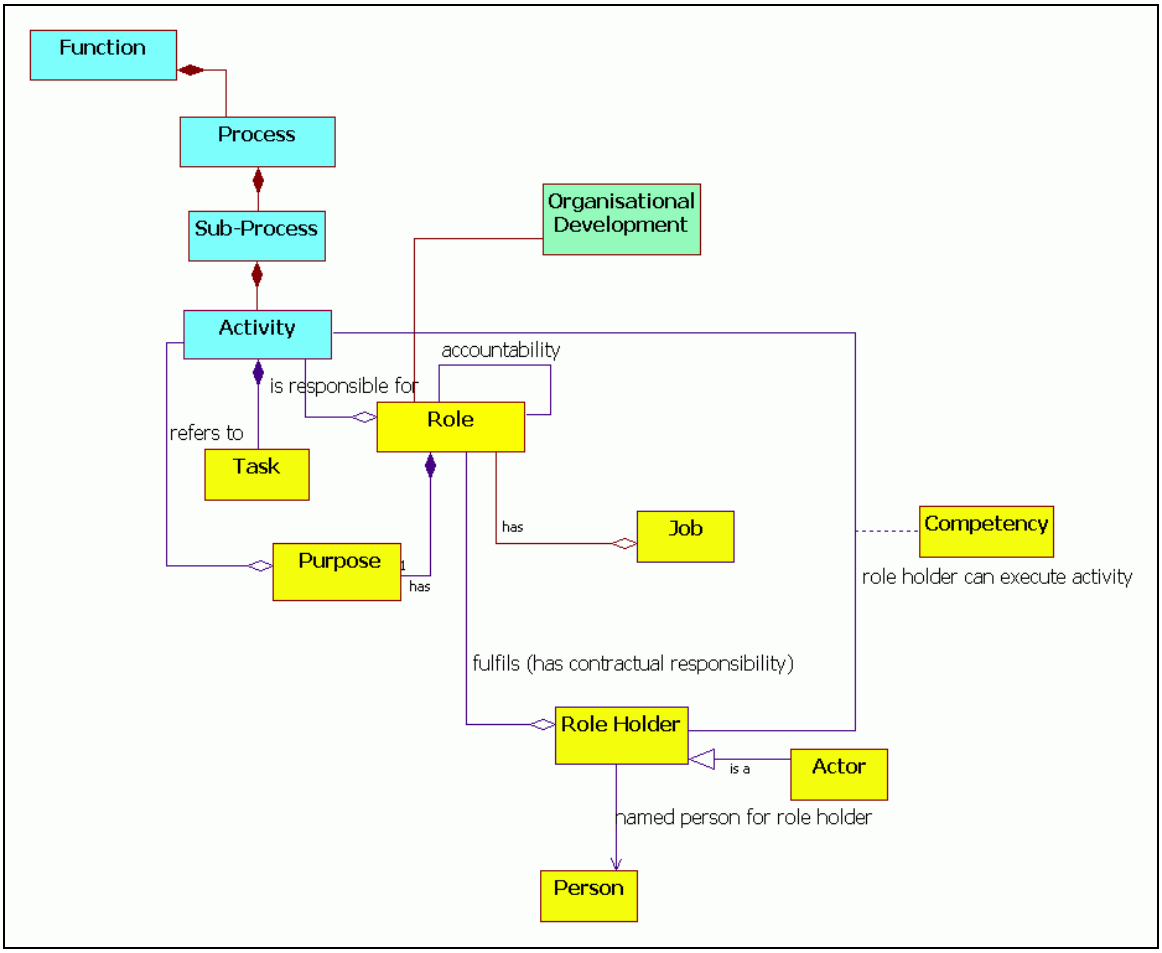

Figure 18 Extension to the HILDA model for Roles

Definitions for the new model elements were agreed across the HILDA Roles team and then added to the glossary, as shown in Table 3 below.

Term	**Definition**
Actor	Person or system component (service) fulfilling the responsibilities of a role. A primary actor is generally identified for a function. An actor is the same as a role holder.
Competency	The ability to execute a task or activity.
Job	The same as Role.
Organisational Development	Organisational development is the process through which an organisation develops the internal capacity to be the most effective it can be in its mission work and to sustain itself over the long term.
Person	A human individual.
Purpose	The value to an organisation to be brought by a particular role. A role has a (main) purpose which includes reference to its key activities.
Role Holder	Person or component (service) fulfilling the responsibilities of a role. A role holder is the same as an actor. A role holder has contractual responsibility to fulfil a role.
Task	Component part of activity.

Table 3 HILDA elements added for Roles

Validating the approach

The practicalities of using HILDA and HERA in conjunction were tested with a group of HR professionals at a workshop held in JISC's London offices in October 2008. The workshop started with a presentation of the approach we had taken, and our results and then the participants modelled a scenario that we offered them using paper and pencil supported by cards which represented the various classes in the model. See examples below:

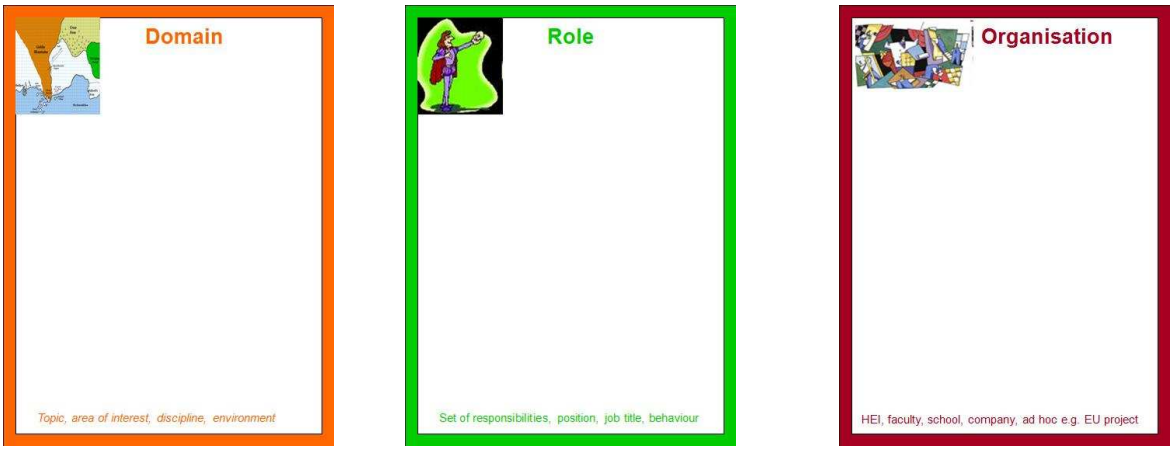

Figure 19: Sample cards used in workshop to validate our method

Considerable interest was shown in the concept and those present agreed that the approach was certainly usable. They could see where it could be put into practice and contribute to the development of improved people management practice.

The benefits identified include:

- The support provided to organisational restructuring through their ability to allow new structures to be and roles designed for the change situation.
- The provision of an ongoing analytical tool which helps managers to understand incremental change, and how and where processes and roles are affected and are in need of alteration.
- Enabling managers to present business cases which outline their proposed changes and are supported by a rationale with visual interpretations of options, and cause and effect diagrams and pay bill costings.
- Accurate process mapping for use in change management projects, in particular identifying key milestones, critical project phases and targeted communication plans.
- The combination of process modelling and role design to give a holistic approach to human resource management.

Mapping to other Roles and Competencies Frameworks

The roles modelling needs to be carried out in the context of the other frameworks used for organisational and career development purposes in the sector. To this end, three additional frameworks were reviewed and mapped against the HILDA Roles model.

These frameworks have also been mapped against the contents of the HERA scheme as part of ECC's work with its member institutions. Other frameworks, including that produced by the Higher Education Academy, the Association of University Administrators (AUA) and other professional bodies have also been mapped. This work has demonstrated considerable complimentarity and HERA can be used to integrate these different frameworks to integrate career and professional development within an institution. Work has also been carried out in association with HEATED to produce exemplar role profiles to support continuous professional development. Further information about these projects and HERA's ability to be mapped against specific occupational standards can be obtained from ECC.

The frameworks referenced as part of the HILDA: roles model are:

1. Skills for the Information Age http://www.sfia.org.uk/

2. e-Skills http://www.e-skills.com/

3. National Occupational Standards http://www.ukstandards.org/Find_Occupational_Standards.aspx?NosFindID=2

Skills for the Information Age

"The overall purpose of SFIA is to assist organisations employing IT professionals to

- reduce IT project risk
- retain staff
- make recruitment effective
- enhance the effectiveness and efficiency of the IT function

SFIA uses a common language and a sensible, logical structure that can be used to facilitate the processes of skills development in all businesses using or providing Information Technology."

The framework has 3 underpinning concepts: Categories, Levels, and Description of Skill at a level.

Categories:

There are 6 categories:

Figure 20: Skill for the Information Age Categories

Levels:

There are 6 levels of Accountability/Responsibility:

Figure 21: Skill for the Information Age levels

Skill at a Level:

There are up to 7 definitions of 'skill-at-a-level'. These map on to the levels as shown in the diagram below.

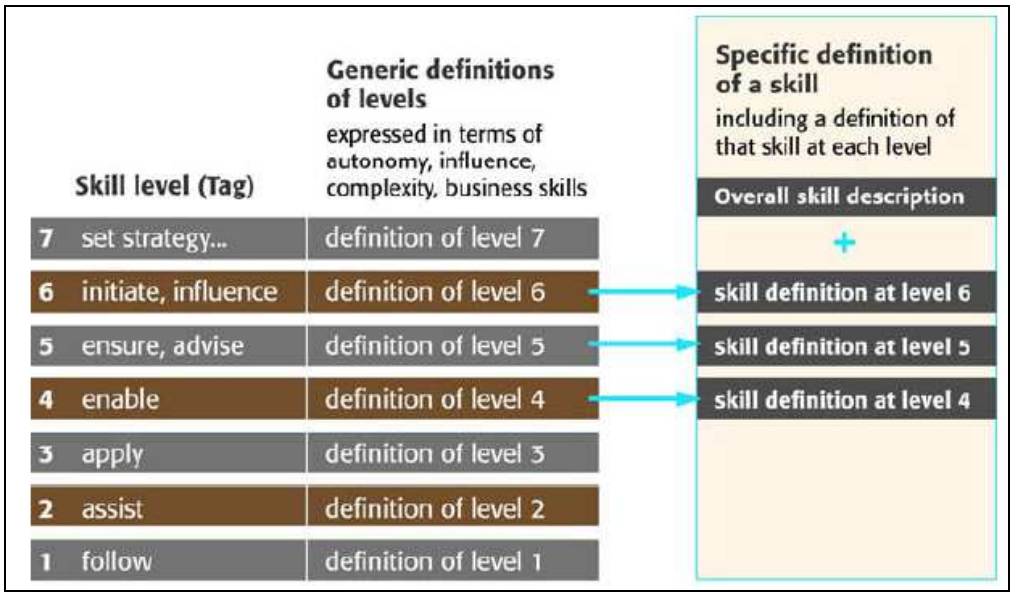

Figure 22: Skill for the Information Age mapping of skills at a level to level

This framework maps on to the HILDA Roles model as follows:

SFIA	**HILDA Roles**
Category	Domain
Sub-category	Sub-domain
Skill Name	Competency
Skill Description	Competency data property 'description'
Skill at level	Work executed by Role

Table 4 Mapping between SFIA and HILDA Roles

The following are some examples taken from the SFIA framework:

Category (HILDA: Domain)
Business Change
Sub-category (HILDA: Sub-domain)
Business Change Management
Skill Name (HILDA: Competency)
Project Management
Skill Description (HILDA: Competency data property 'description')
The management of projects, typically (but not exclusively) involving the development and implementation of business processes to meet identified business needs, acquiring and utilising the necessary resources and skills, within agreed parameters of cost, timescales and quality.
Skill at level (HILDA: Work executed by Role)
Level 4 Defines, documents and carries out small projects, actively participating in all phases. Identifies, assesses and manages risks to the success of the project. Prepares realistic project and quality plans and tracks activities against the plans, providing regular and accurate reports to stakeholders as appropriate. Monitors costs, timescales and resources used and takes action where these deviate from agreed tolerances. Ensures that own projects are formally closed and, where appropriate, subsequently reviewed, and that lessons learned are recorded.

Table 5: Mapping of SFIA Business change management to HILDA

Category (HILDA: Domain)
Development
Sub-category (HILDA: Sub-domain)
Systems Development
Skill Name (HILDA: Competency)
Data Analysis
Skill Description (HILDA: Competency data property 'description')
The provision of specialist expertise and practical assistance in the investigation, evaluation and interpretation of data in order to ensure its coherence, availability, accuracy and security to meet information and communication systems requirements.
Skill at level (HILDA: Work executed by Role)
Level 2 Applies data analysis and data modelling techniques to establish, modify or maintain a data structure and its associated components (entity descriptions, relationship descriptions, attribute definitions).

Table 6: Mapping of SFIA Data analysis to HILDA

Category (HILDA: Domain)
Development
Sub-category (HILDA: Sub-domain)
Systems Development
Skill Name (HILDA: Competency)
Database Design
Skill Description (HILDA: Competency data property 'description')
The specification, design and maintenance of structures for information storage and access to support business information needs.
Skill at level (HILDA: Work executed by Role)
Level 4 Develops and maintains specialist knowledge of database concepts, object and data modelling techniques and design principles and a detailed knowledge of database architectures, software and facilities. Analyses data requirements to establish, modify or maintain object/data models. Evaluates potential solutions, demonstrating, installing and commissioning selected products.

Table 7: Mapping of SFIA Database design to HILDA

Category (HILDA: Domain)
Procurement and Management Support
Sub-category (HILDA: Sub-domain)
Quality
Skill Name (HILDA: Competency)
Quality Assurance
Skill Description (HILDA: Competency data property 'description')
The process of ensuring that the agreed quality standards within an organisation are adhered to and that best practice is promulgated throughout the organisation.
Skill at level (HILDA: Work executed by Role)
Level 6 Develops organisational commitment to ongoing quality and environmental improvement by ensuring that the quality assurance process is robust and is based on the best industry practice. Considers implications of emerging technological developments, economic and social trends, etc. Reviews the audit process to ensure that it continues to meet needs of the standards.

Table 8: Mapping of SFIA Quality assurance to HILDA

Category (HILDA: Domain)
Service Provision
Sub-category (HILDA: Sub-domain)
Infrastructure
Skill Name (HILDA: Competency)
Configuration Management
Skill Description (HILDA: Competency data property 'description')
The systematic management of information relating to the documentation, software, hardware and firmware assets of an organisation. This will involve identification and appropriate specification of all configuration items (CIs). Required information will relate to storage, access, problem reporting and change control of CIs. Application of status accounting and auditing, often in line with acknowledged external criteria such as ISO 9000, throughout all stages of the CI life history.
Skill at level (HILDA: Work executed by Role)
Level 5 Manages CIs and related information. Applies and maintains tools, techniques and processes for managing CIs and ensuring that related information is complete, current and accurate.

Table 9: Mapping of SFIA Configuration management to HILDA

Category (HILDA: Domain)
Strategy and Planning
Sub-category (HILDA: Sub-domain)
Advice and Guidance
Skill Name (HILDA: Competency)
Technical Specialism
Skill Description (HILDA: Competency data property 'description')
The management and provision of expert advice on a specific technical specialism. Examples of specialism can be any technology, technique, method, product or application area.
Skill at level (HILDA: Work executed by Role)
Level 6 Maintains an in-depth knowledge of specific technical specialisms and provides expert advice regarding their application. Can supervise specialist technical consultancy. The specialism can be any aspect of information or communication technology, technique, method, product or application area.

Table 10: Mapping of SFIA Technical specialism to HILDA

The link between HERA and SFIA is found at a level of granularity below that currently covered in the HILDA Roles model. The following explains how a detailed competency analysis is aligned between HERA and SFIA.

The HERA elements can be broadly related to the SFIA competencies as follows:

SFIA Core Competency	HERA Element
Autonomy	Teamwork & Motivation (TM)
	Knowledge and Experience (KE)
Influence	Decision Making (DM)
	Liaison and Networking (LN)
Complexity	Planning and Organising (PO)
	Initiative and Problem Solving (IPS)
	Service Delivery (SD)
	Sensory and Physical Demands (SPD)
Business Skills	Communication (C)
	Analysis and Research (AR)
	Work Environment (WE)
	Team Development (TD)
	Pastoral Care and Welfare (PCW)
	Teaching and Learning Support (TLS)

Table 11: Mapping between SFIA core competencies and HERA elements

Therefore, particular HERA score patterns can be associated with each SFIA competency at each SFIA level. These will different from one organisation to the next and one set of scores that suits all organisations cannot be used

e-Skills

Model description

“e-skills Procom is an industry-recognised training framework for organising courses and qualifications by the disciplines of the IT profession. Built on IT professional National Occupational Standards, Procom defines knowledge, understanding and competencies for seven broad disciplines (and their sub-disciplines) at five levels of progression, incorporating technical, business and personal skills.”

The structure is designed to enable employers to identify relevant qualifications and to plan training and development based on a self assessment of needs or on a SFIA-defined job role (see SFIA Framework above). e-skills Procom also aims to help providers of education and training to develop new courses to meet the needs of different IT disciplines, and is the basis for e-skills UK's work to reform and simplify the qualifications map for IT professionals.

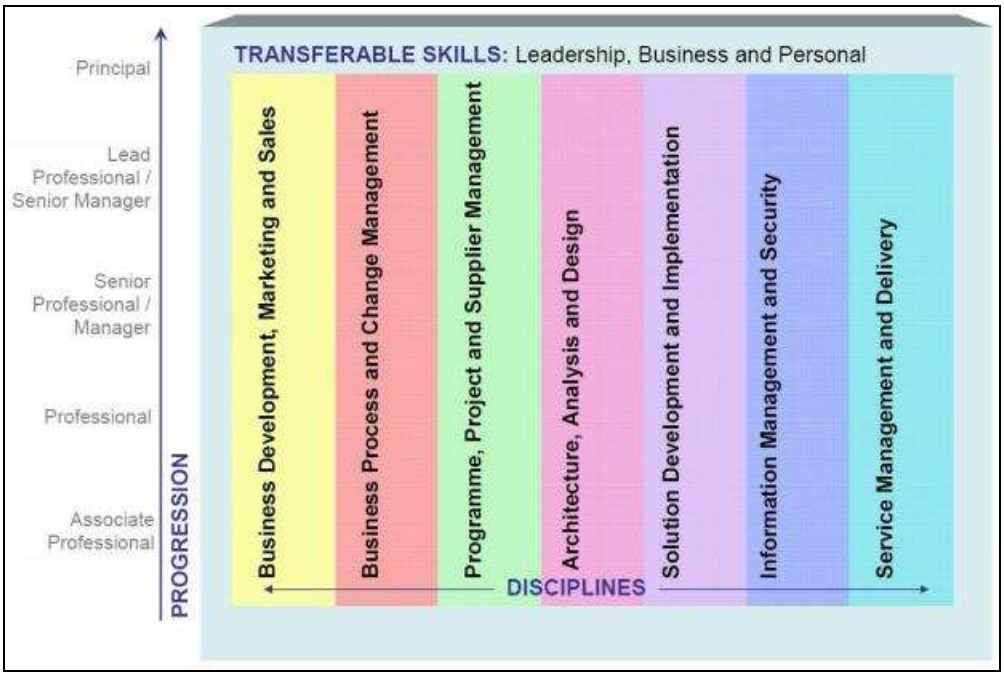

Figure 23: The e-skills Procom framework

The e-skills framework has 3 underpinning concepts:

"Disciplines

Disciplines define areas of competency, with each discipline comprising related subject matter expertise, techniques, tools and processes. The model defines seven broad disciplines, within each of which may exist a number of specialisms. IT professionals are likely to possess competencies from more than one discipline, increasingly so as they progress. The most senior professionals will need a solid understanding and often practical expertise across many disciplines.

Progression

Professionals at the same stage of progression will share a comparable depth of knowledge, understanding and skills. To progress in their career, a professional will develop increasing competencies both within and across disciplines.

Transferable Skills

Transferable Skills reflect the importance of every IT professional possessing, in addition to their specific subject matter expertise, a balanced set of 'transferable' business and personal competencies as appropriate to their role.

e-skills	HILDA Roles
Discipline	Domain
Sub-discipline	Sub-Domain
Sub-discipline description	Work executed by Role AND owned by Domain
Knowledge	Competency data property 'type' value knowledge
Understanding	Competency data property 'type' value understanding

Competency at level	Competency data property 'type' value competency at level
Qualification	Role data property 'requires Qualification

Table 12 e-skills mapping to HILDA Roles

The following are two abbreviated examples from the e-skills framework:

Discipline (HILDA: Domain)
Business Process and Change Management
Sub-discipline (HILDA: Sub-domain)
Business Analysis
Sub-discipline description (HILDA: Work executed by Role AND owned by Domain)
This sub-discipline is concerned with the competencies required to assist an organisation in improving its business performance through a set of integrated and systematic activities designed to analyse opportunities for improvement and identify possible options that may be adopted. Business analysis may be conducted with a view to improving a specific, element of a business's operation or strategy such as profitability or customer service, or a combination of elements. It may also consider both what an organisation delivers (e.g. its products or service proposition) or how it delivers it (e.g. the efficiency and effectiveness of its processes or its organisational design). Business analysis may result in recommendations for change to what currently occurs, addition of new or enhanced features or the removal of activities which do not add value.…
Knowledge (HILDA: Competency data property 'type' value knowledge)
• How to carry out business analysis to an appropriate standard that is in line with organisational strategy, policies, procedures and standards • How to design, implement and maintain strategy, policies, plans and standards relating to business analysis • How to select, use and apply the processes, procedures, methods, tools and techniques for undertaking business analysis • How to identify business requirements and ensure that these guide the analysis assignment…
Understanding (HILDA: Competency data property 'type' value understanding)
• What is meant by business analysis and the stages of activity that constitute it • The role and value of business analysis in improving the business performance of an organisation • That business analysis activities frequently result in the need for the implementation of new or enhanced information technology systems • The importance of undertaking business analysis in line with organisational strategy, policies, procedures and standards…
Competency at level (HILDA: Competency data property 'type' value competency at level)

Senior Professional/Manager level • Select and apply policies, plans, processes, procedures, standards, methods tools and techniques relating to business analysis assignments • Accurately scope business analysis assignments • Accurately identify all internal and external sponsors of and stakeholders for a business analysis assignment • Ensure business requirements guide business analysis assignments undertaken by self or others • Supervise the activities of less experienced individuals working on a business analysis assignment • Review the documentation completed by others at each stage of business analysis, ensuring external factors have been considered…
Qualification (HILDA: Role data property 'requires Qualification)
Principles of Change Management Qualification ITIL® Change Management BCS ISEB Practitioner Certificate in IT Service Management: Change Management

Table 13 e-skills example 1

Discipline (HILDA: Domain)
Solution Development and Implementation
Sub-discipline (HILDA: Sub-domain)
Software development
Sub-discipline description (HILDA: Work executed by Role AND owned by Domain)
Create software to address the needs of business problems and opportunities, resulting in a variety of software solutions, ranging from operating and control software to web based or specialist applications, such as accounting software and games software. Development activities produce software that translates the design deliverables from HCI design, data design and software design, into working software. These designs will include, at a detailed level, functions and processing, interfaces, data handling and storage needs and how the system will be used by and interact with people, as appropriate. Development involves the translation of the designs into working information technology software solutions that meet the business needs.…
Knowledge (HILDA: Competency data property 'type' value knowledge)
• How to develop software aligned, as appropriate, to IT architecture, data models, business and HCI design deliverables • How to accurately interpret physical designs • How to define functional requirements for individual software components • How to design, implement and maintain, select use and apply ,strategy, policies, plans and standards relating to software development activities and their deliverables • How to apply lessons learned from previous software development assignments…
Understanding (HILDA: Competency data property 'type' value understanding)
• What is meant by software development and the stages of activity that constitute it • The relationship between physical software design, data and HCI design and

software development • The relevance of software development activities and their deliverables to testing activities associated with production of an information technology system • The importance of the systems development lifecycle as it relates to software development activities • The importance and relevance of software development activities on the full life cycle of information within an organisation…
Competency at level (HILDA: Competency data property 'type' value competency at level)
Professional • Correctly select and apply the processes, procedures, methods, tools and techniques applicable to software development activities and their deliverables • Use and apply the systems development lifecycle, as appropriate to software development activities, in line with organisational strategy, policies and standards • Assist with the identification of sponsors of and stakeholders for any software development activities.…
Qualification (HILDA: Role data property 'requires Qualification)
ISEB Qualifications in Systems Development and software testing: Foundation Certificate in Systems Development Certificate in Systems Development Essentials Diploma in Systems Development Systems Development Essentials Systems Development Diploma Foundation in Development and Delivery Structured Systems Development Essentials

Table 14 e-skills example 2

National Occupational Standards

"National Occupational Standards (NOS) describe what an individual needs to do, know and understand in order to carry out a particular job role or function.

National Occupational Standards (NOS) define the competences which apply to job roles or occupations in the form of statements of performance, knowledge and the evidence required to confirm competence. They cover the key activities undertaken within the occupation in question under all the circumstances the job holder is likely to encounter.

They can be used to:

- describe good practice in particular areas of work
- set out a statement of competence which bring together the skills, knowledge and understanding necessary to do the work
- provide managers with a tool for a wide variety of workforce management and quality control
- offer a framework for training and development

- form the basis of National Vocational Qualifications (NVQs) , Scottish Vocational Qualifications (SVQs) and Vocationally Related Qualifications (VRQs)."

NOS	HILDA Roles
Area	Domain
Sector	Sub-Domain
Occupational Area	Sub-Domain subdivision
Job Role	Role
Function	Function
Competency overview	Competency attribute 'description'
Generic Knowledge	Competency data property 'type' value knowledge
Competencies	Competency
Activities and their Competencies	Work executed by Role AND their required competencies

Table 15 mapping between NOS and HILDA Roles

The following table is an example taken from the NOS catalogue:

Table 16 example from NOS

Area	Information and Communication Technology
Sector	e-Learning
Occupational Area	Professional
Job Role	Research Professional
Function	Track and assess learners using ILT
Competency overview	Staff carrying out this function need to use ILT to record information about learners' participation and achievement. They need to record information about learners' attendance, participation in learning activities and use this information to identify any need for intervention. They need to assess what individuals have learned and achieved against their personal learning plans. With this information, staff need to provide feedback to learners and to report on learner participation, progress and achievement.
Generic Knowledge	• the organisation's policy and procedures for tracking and assessing learners • the organisation's policy regarding the confidentiality of data and relevant data protection • legislation, and how to ensure these are rigorously applied • the organisation's requirements for reporting on learners' participation, progress and achievements

	• the importance of maintaining and providing complete, accurate and up-to-date information, and how to do so.
Competencies	Staff need to be able to: F1 Track learner participation with the help of ILT F2 Assess, with the help of ILT, what individuals have learned and achieved F3 Record and report on learners' progress and achievements using ILT.
Activities and their Competencies	F1 Track learner participation with the help of ILT To do this, staff a) use ILT systems to capture and process data about learner participation b) encourage learners to use ILT to record and update details about themselves and their participation c) use ILT to evaluate learners' participation and identify trends d) establish any need for intervention to improve learners' participation. This requires critical understanding and essential knowledge of: • the data required about learners • the ways in which ILT can be used to record, process and provide information about learner participation • how to use information about learner participation to identify trends and establish the need for intervention. F2 Assess, with the help of ILT, what individuals have learned and achieved To do this, staff a) identify and evaluate appropriate ILT assessment tools b) use ILT to conduct initial assessment c) use ILT to help carry out formative and summative assessments of learner achievement d) provide feedback to learners on progress and achievements with the help of ILT. This requires critical understanding and essential knowledge of: • the range of ILT assessment tools available • how to evaluate ILT assessment tools

	• how to use ILT assessment tools • how to integrate ILT within an appropriate mix of assessment tools and techniques • how to provide clear and constructive feedback. F3 Record and report on learners' progress and achievements using ILT To do this, staff a) use appropriate ILT tools to record learners' progress and achievements b) use ILT to automate reporting on learners' progress and achievements, taking into account the c) organisation's policies d) provide as required complete, accurate and up-to-date reports on learner's progress and e) achievements to those entitled to this information f) ensure the confidentiality of information about learners in line with the organisation's policies and legal requirements. This requires critical understanding and essential knowledge of: • the range of appropriate ILT tools available for recording learners' progress and achievements • how to use ILT tools to record progress and achievement • how to use ILT tools to create appropriate reports on data sets • the organisation's policies and legal requirements with regard to data protection.

The HILDA Roles model was shown to be capable of handling all the element types from the three frameworks tested. Future use of the knowledgebase can build on the large collections of information in these frameworks and create a coherent picture across them all.

Extending the HILDA Roles model for process improvement and decision support

Process Improvement

As part of a national e-learning benchmarking initiative of the UK Higher Education Academy, the University of Manchester carried out a pilot study of a method to benchmark e-learning in an institution. The pilot was designed to evaluate the operational viability of a method based on the e-Learning Maturity Model developed at the University of Wellington, New Zealand, which, in turn was derived from Carnegie Mellon's widely accepted Capability Maturity Model. The method is based on gathering evidence about the many and interdependent processes in the e-learning and student lifecycles and takes a holistic view of maturity, addressing multiple aspects.

The pilot study produced a map of evidence of e-learning practice across the processes matrix and a measure of the degree of embedding in a sample of faculties within the institution expressed as capability and maturity. To provide a useful measure of where an organisation is with respect to a particular aspect of e-learning, it needs to be able to act on that measure, finding any new activities required or modifying current activities to improve its processes.

The e-Learning Maturity Model (eMM) model was developed in New Zealand based on two complementary models, the Capability Maturity Model (CMM) from the Software Engineering Institute (SEI) and SPICE (Software Process Improvement and Capability dEtermination). The Capability Maturity Model for Software characterises a mature, capable software process and the progression from an immature, ad hoc software process to a mature, well-managed software process. This model is currently applied to a number of industry sectors. SPICE, which is a joint effort by the International Standards Organisation (ISO) and International Electrotechnical Commission (IEC) to create an international standard for software process assessment adds the approach for organising the e-learning provision practices and processes into process areas.

The CMM has five levels of maturity, ranging from 'initial' to 'optimised'. Each level of maturity in the CMM has a corresponding set of key practices. The practice descriptions are an elaboration of what is meant by maturity at each level of the CMM. From the first phase of his work in New Zealand, Marshall[1] has come to a more holistic view of process maturity in which there are five dimensions of maturity. There is not necessarily a linear progression of capability from one to the next. That is, it is not necessary to reach full capability in one dimension before progressing to the next. It is possible for organisations to develop different patterns of capability across the five dimensions that are to some extent independent.

The combination of CMM with SPICE as a basis for eMM provides a means for an institution to appraise their ability to perform their key business processes, such as those required for e-learning provision. It also provides the mechanism for giving guidance to improve process capability. The eMM also offers the means to create the underlying reference model for measuring process maturity from multiple aspects and assessing capability within each aspect. Implementing the CMM determines the state of an organisation's current software process, the high-priority software process-related issues facing an organisation, and obtains the organisational support for software process improvement. Implementing the eMM should similarly create a picture of the current e-learning provision processes across the institution and highlight issues facing the HEI.

In order to succeed with the implementation of eMM it is important first to reach an understanding of the terms 'process' and 'practice'. A process is usually taken to mean the 'who', 'what', 'how' and 'when' of doing something in a context. A process in eMM is a

[1] Stephen Marshall http://www.utdc.vuw.ac.nz/research/emm/

description of the goal of a set of activities, each of which will be the responsibility of some role(s) and carry constraints concerning the timing and manner of their execution. The activities carried out to achieve the five maturity dimensions of that process goal are captured in descriptions of practices. eMM seeks to identify the dimension and capability of processes from evidence about practices. These measures, for a set of processes, form the basis for assessing institutional (or other level) capability and maturity.

It is a method to allow a visualisation of the state of the organisation and compare parts of the organisation, or to view state change over time. This is an essential aspect for engaging operational managers and strategic managers as well as academics. Additionally, the value of the method as developed by Marshall is in its ability to handle and display large amounts of data in single graphics. The development of rich visual design by Marshall is a valuable development of eMM that makes it an effective management and communication tool.

The e-Learning Maturity Model (eMM) offers a framework to identify the set of processes and their underlying practices that comprise the whole e-learning provision lifecycle. eMM is designed to be used as a benchmarking tool that can examine different organisational levels with a view to prioritizing areas of work for improvement. Following assessment, changes can be proposed for specific known practices, and their impact understood. It is used to highlight specific areas of activity within an organisation in a way that can be associated with existing and desired dimensions of practice maturity. Combined with other methods for working towards change in specific cases, including process and transition modelling, individual areas of work can be guided towards improvement by encouraging discrete measurable adaptations appropriate to their circumstances.

The ability to underpin long term success for innovation-based investments relies on an organisation being clear about its responses to certain key questions which may relate to its capacity and ability to change:

- Does the HEI need to grow, be more agile, and/or compete in different markets?
- Does it need the kind of change that can be engendered by innovative technology?
- Does it recognize that it could improve its performance?

HILDA can provide all the above things to the institution in the form of a process driven knowledgebase for Teaching and Learning Quality Management in HE. To be effective, the knowledgebase should be integrated and interfaced by a visual model of the processes that make up the e-learning provision lifecycle, as well as the eMM structured collection of processes and practices. Figure 24 shows a high level conceptual model of the core elements addressed in using the knowledgebase for process improvement.

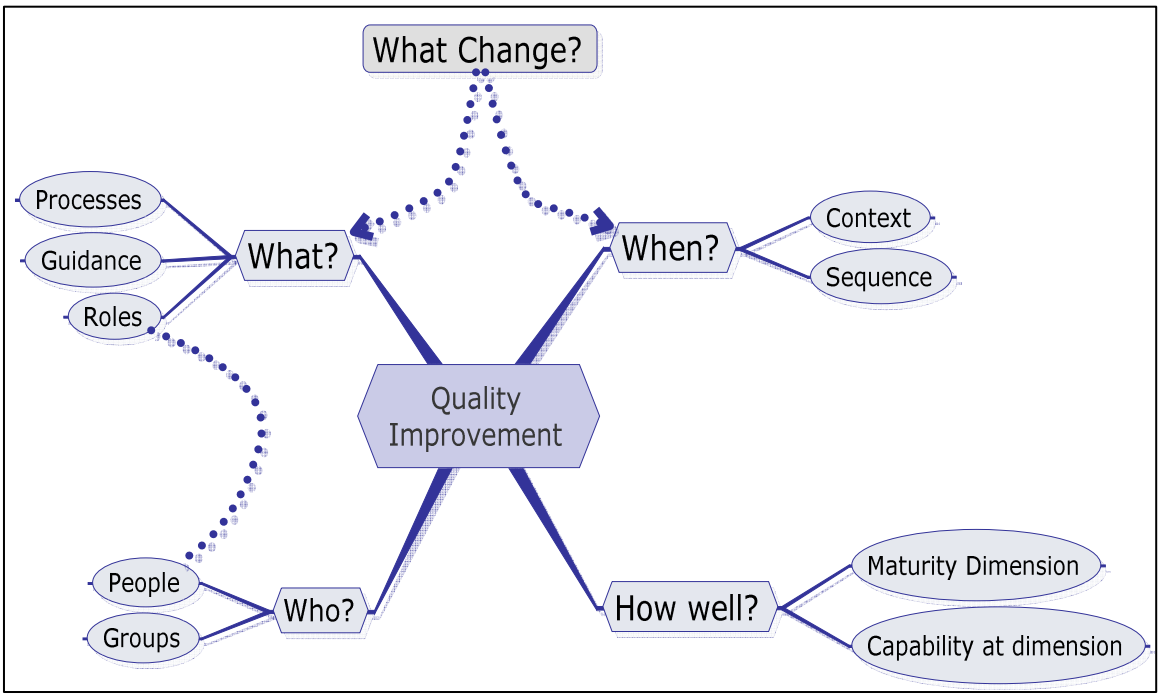

Figure 24 High Level Model for Process Improvement

This combination of elements can be articulated as five key questions that must be contained and managed for all the processes that are addressed:

- **What?** The 'what' of a process is a set of practices or smaller units of work or individual tasks each of which comprises the roles (skills and competencies for responsibilities), activities (tasks carried out), artefacts (the resources required for the work being done and the outputs or products of that work), rules (policy, procedure and contextual logic) and guidance (exemplars, templates, white papers, checklists, procedures etc.).

- **When?** The 'when' of a process is the semi ordered collection of practices or units of work or tasks that comprise an actual run or instance (real-world example) of a process. The process instance takes place in a particular context which may introduce its own constraints on the sequencing of the units or the way in which the tasks are executed, allowing contextual customisation.

- **How well?** The 'how well' aspect refers to the assessment of capability in the different dimensions of maturity of a process. It assesses whether practices (process chunks) are being carried out and how widespread and effective they are.

- **Who?** The 'who' aspect refers to the actual people, groups and organisational units that fulfil the roles required for the activities in a process.

- **What Change?** The 'what change' response will take the form of suggestion of new practices or the modification of existing practices. Change thus operates on the 'what' and the 'when' of processes. The 'what change' elements may be characterized by its complexity, cost and support implications.

The following five new elements were added to the HILDA model in order to support the concept of organisational capability and process maturity as expressed in the eMM model: MM Process Area, MM Process, MM Process Dimension, MM Practice and Quality Evaluation. Their definitions are given in Table 17 below.

Term	Definition
MM Practice2	Maturity Model Practices support the goals of an MM Process. Practices are organised according to which practice dimension of a process they support
MM Process	Maturity Model Process is a description of the goal of a set of activities, each of which will be the responsibility of some role(s) and carry constraints concerning the timing and manner of their execution.
MM Process Area	Maturity Model Process Area divides the capability of institutions to sustain and deliver into five major categories or process areas.
MM Process Dimension	Dimensions are a set of five aspects of a process, giving a holistic view of the process. They refer to the kinds of process maturity that may be assessed and are: delivery, planning, evaluation, support and organisation.
Quality Evaluation	Quality Evaluation is an attribute that may apply to, Artefact, Role or Work. It is the measure of how well a role has performed its work and/or how good is the output of work. It may be applied to work in the maturity model as a measure of capability in and widespread occurrence of a recommended practice.

Table 17 the eMM elements for HILDA Roles model

The HILDA base model is thus extended with roles (organisational development) elements and the maturity model (process improvement) yielding the following complete model:

[2] eMM Quality Improvement Framework
http://artemis.utdc.vuw.ac.nz:8000/pebble/2007/06/26/1182827934197.html

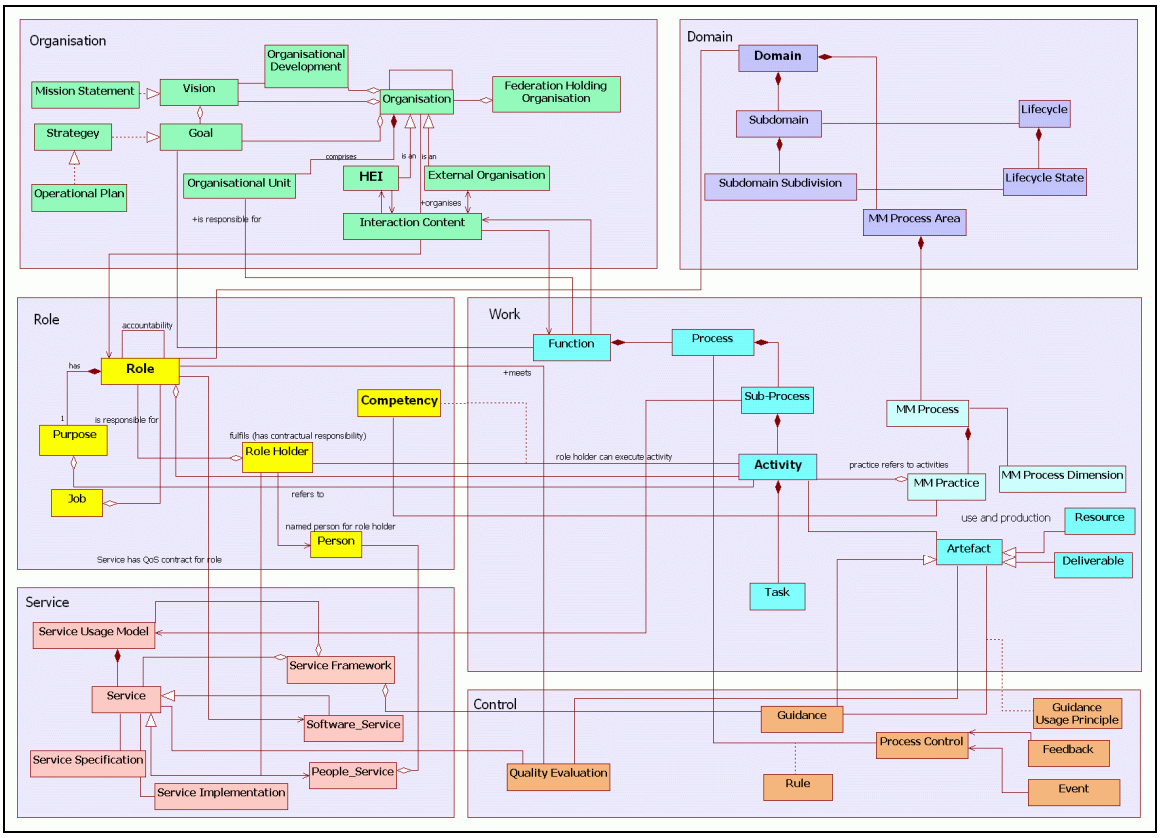

Figure 25 The full HILDA model with roles and process maturity

Decision Support

The Innovation Base application running on the full HILDA model was tested as a proof of concept Decision Support Tool (ELDER) which is aimed at supporting managers in HE with responsibility for e-learning. This tool is designed to provide timely, context specific information and guidelines to managers in order to help support their decision making process and builds on the work done on the Pathfinder[3] project. The pathfinder project in Manchester studied a series of change cases across the university in order to determine if a change strategy and process for change could be identified and captured for future use. In order to achieve this, the knowledgebase was populated with data to capture relevant knowledge elements from each of the individual cases.

The Change Process is characterised by the following sequence of activities:

1. Select case based on external driver or own benchmarking results
2. Establish change team
3. Identify current work practices
4. Design new practices
5. Design pathways of change in practices
6. Implement changes –

[3] Pathfinder project funded by Higher Education Academy
http://www.heacademy.ac.uk/ourwork/learning/elearning/pathfinder

a. Promote and explain change

b. Negotiate changed roles

7. Facilitate the adoption of new practices

8. Revise models of processes and practices

9. Monitor and analyse actual practices, roles, relations, communication networks

10. Adapt and adjust of processes as required

11. Evaluate the change process

12. Monitor and evaluate the change

It is possible to link this work to the use of HERA to map the changes required to existing roles and help plan development programmes to enable the individual role holders to acquire new skills.

The knowledgebase, however, though information-rich, requires a user application layer that will allow it to be applied easily to a variety of new change scenarios. The decision support tool needs to:

- Access good practice and guidance for a particular case
- Support benchmarking against good practice
- Make visible the Interdependencies between activities
- Highlight staff development requirements
- Present information clearly and simply

The elements and relationships required for the tool are:

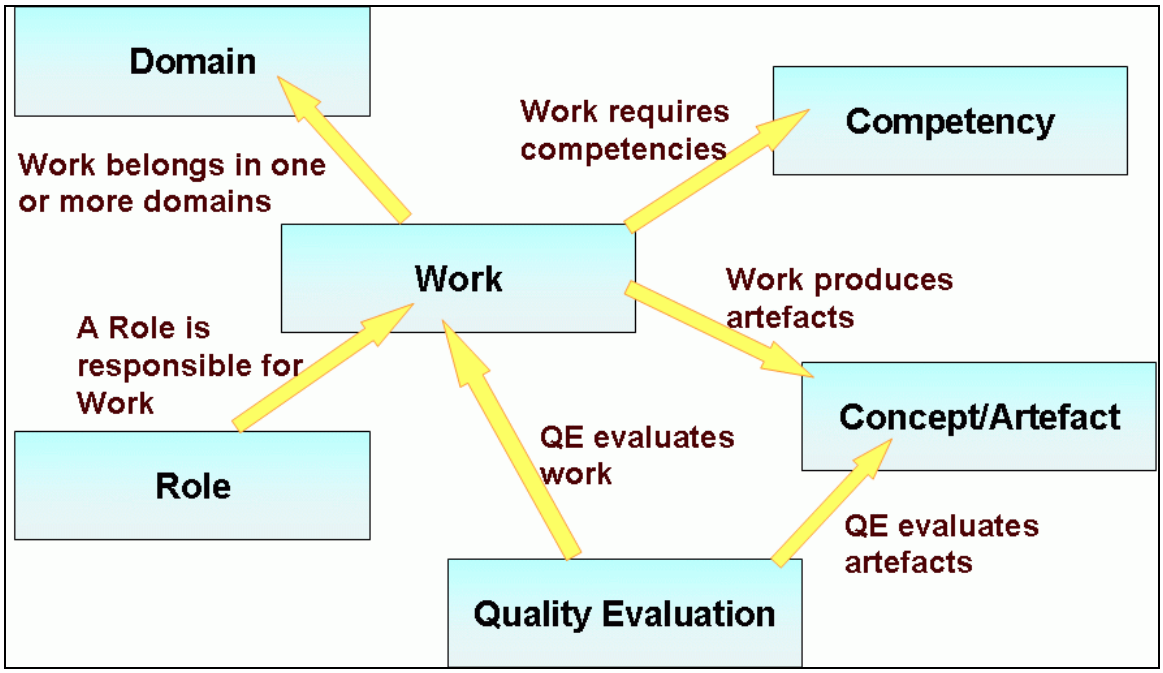

Figure 26 Model elements for decision support

The following is a simple case example using the Innovation Base knowledge explorer The **E-learning co-ordinator role** is selected from the list of instances of the **Role** class. The Competence Analysis function then finds all the practices that are linked to that role to give a picture of the responsibilities of that role:

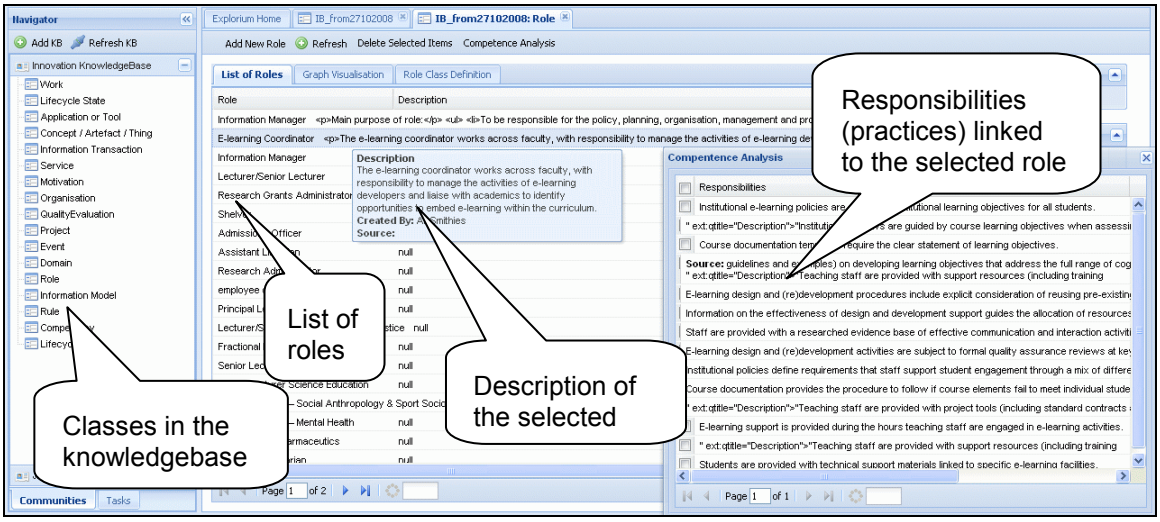

Figure 27 Competency Analysis in Innovation Base -1

Selecting one of the responsibilities brings up the required competencies:

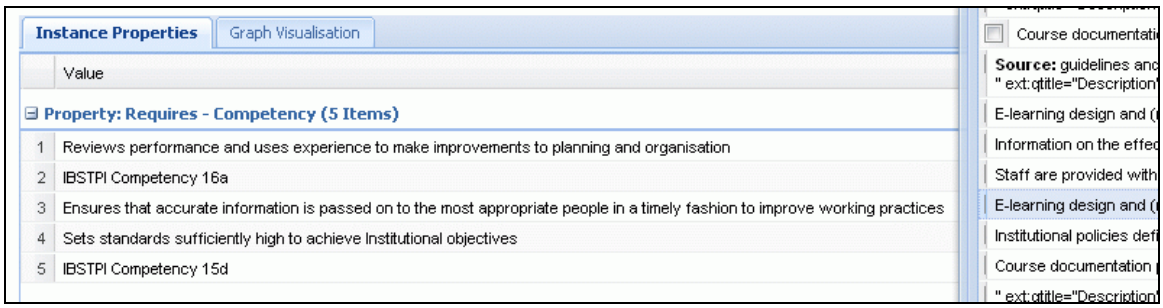

Figure 28 Competency Analysis in Innovation Base -2

The knowledgebase can serve the analysis of response to change in a practice by finding all the roles involved and the competences involved. In this way it is possible to carry out a training needs analysis for the planned change. The roles and competencies can then be mapped into HERA and they can be quantified within HERA and training needs identified.

The knowledgebase can serve the analysis of response to change in a practice by finding all the roles involved and the competences involved. In this way it is possible to carry out a training needs analysis for the planned change.

Firstly the activities required as a result of the changes can be compared to the activities currently required. The extent of these can be assessed, in terms of role size and shape and the implications identified. This will highlight what needs to done differently.

The competency framework can be used to highlight what the changes will mean to how the duties and responsibilities are carried out using the behavioural statements. These can be used to construct training and development plans, thus focusing effort, activity and resources onto the areas that will make a difference.

A second example, using this tool, was to carry out quality evaluations on a domain area, in this case the practices required for the introduction of an e-repository in an HEI. In Figure 29 below the domain e-repository is selected from the list of domains and the QE Evaluation function operated. This finds all the practices related to e-repositories and the history of the quality (capability maturity) of each. The example here shows that the 'compliance with policies' practice (in the area of e-repositories) was judged to be 'largely adequate' on 23.6.08. The future version of this application would produce a report of all the relevant practices and their history of quality evaluation outcomes. This will allow the assessor to see whether there has been progress and improvement in a particular area.

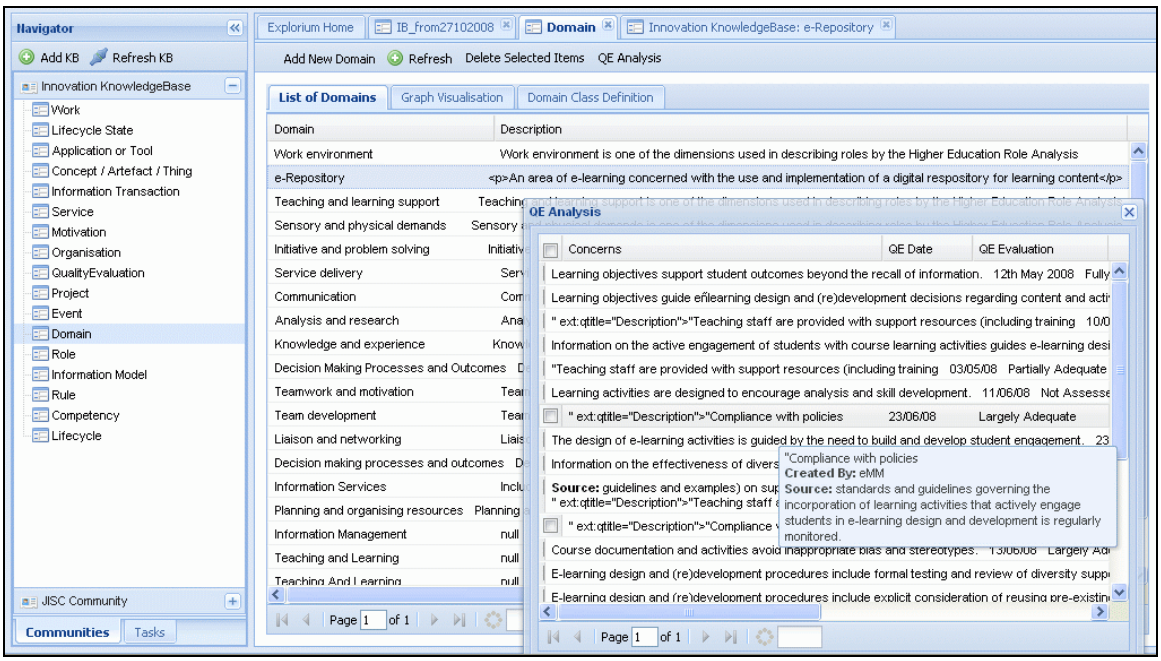

Figure 29 Quality Evaluation (Capability Maturity) in Innovation Base

An example of the Quality Evaluation for embedding e-learning practices is show in Figure 31 below. There are five process areas and between 3 and 10 core processes in each area. Each process contains a number of practices. The practices are all evaluated and scored in a range as shown below (Figure 30):

Rating	Meaning
	Not practiced/not adequate
	Partially adequate
	Largely adequate
	Fully adequate
	Not assessed

Figure 30 Maturity Model Rating

The final result of rating all the practices is a picture of capability maturity across the chosen slice of domain or organisation. As demonstrated here the requirements for staff development can be planned for changes in practice. Therefore the impact of any decision made to improve capability in a particular area can be assessed in terms of the roles involved, the competencies required and hence the training needs.

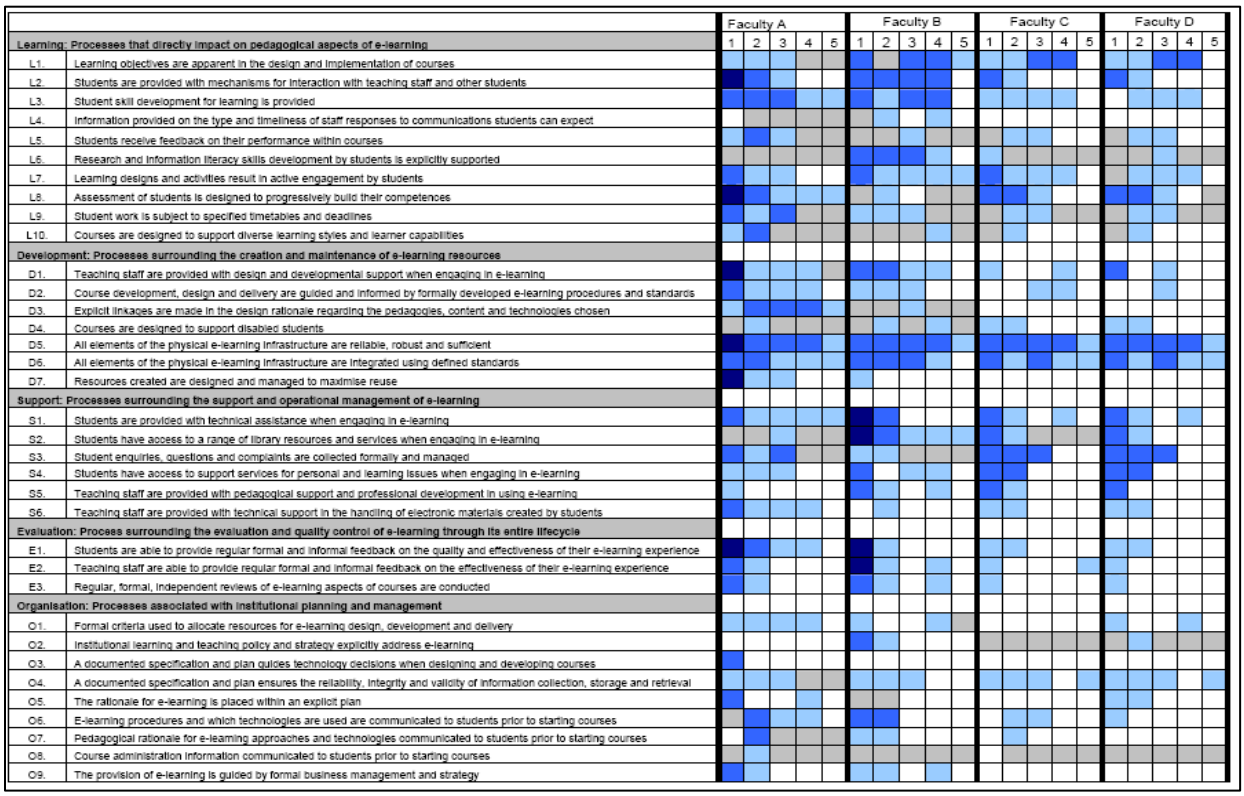

Figure 31 Assessment of capability maturity across four faculties of a university

Future development of the ELDER (Innovation Base on the full HILDA model) decision support and process improvement tool will deliver this kind of picture of process capability maturity, highlighting the areas most in need of improvement. The tool will then assist in analysing the impact of change in these areas, that is where new practices will be introduced and which set of roles will need to acquire new skills and competencies.

Integration of HERA and HILDA

It had been hoped, at the start of the project, to be able to integrate HILDA and the HERA software so that users could explore HILDA in order to find appropriate roles, and then find further information on them in HERA directly. However, as this information is the property of individual institutions, it has not been possible to create these links. The other possibility that was considered was the use of URIs (or URLs) in order to be able to take people directly to the relevant place within the HERA database. However, this was not possible without the express permission of each separate institution and would not be practical.

The creation of links is possible but this would mean either building and paying for a separate HERA database to work with HILDA and populate it with a full set of roles, or we would have had to link to the HERA database for a particular institution. The former would have been a major undertaking involving designing and developing a full set of roles for an archetypal institution. Even if this were for illustrative purposes only, it is possible institutions would not support the initiative. The latter may not be possible nor desirable given the degree of difference between institutions.

Integration between HILDA and the HERA software was therefore not possible as part of this project. However, what we have established is that the use of HERA to create role information can be used to populate HILDA with roles, the associated competencies and the work that the role undertakes, so long as this has been recorded in the role description.

HILDA and the Innovation Base

There has been a parallel project to the Roles Landscape Study, also funded by JISC which has been extending HILDA in order to support the e-Framework. As part of this latter project HILDA was renamed the Innovation Base (or IB), and for the sake of simplicity we will refer to work done under this project as HILDA, and work in the other project as IB. The IB project was a joint project between Franklin Consulting, the University of Manchester and the University of Southampton and involved five key tasks:

- remodelling the underlying ontology,
- enhancing the user interface,
- integrating a wiki into the system,
- trialling the system with representative users,
- populating the model with sample data.

There was therefore significant synergy between the two projects, which has enabled us to take both projects further than if only one of them had been funded.

Remodelling the ontology

For the IB work it was decided to simplify the ontology to reduce the complexity of the model and ease understanding of the concepts. This was achieved in two ways: Firstly, where there were a series of separate but related concepts in the ontology such as Function ⇨ Process ⇨ Sub-process ⇨ Activity ⇨ Task it was decided to coalesce these into a single entity. This was because different people would use the terms in different ways and the borders between them are very fuzzy. That is, what is a function to one person might seem to be a process or activity to another, because of their different view of the system. A vice-chancellor might consider student registration to simply be a task, whereas the registrar might consider it to be a process or function. It thus became apparent that there was considerable scope for confusion, and the easiest way to avoid this confusion was to coalesce the several classes into a single super-class covering all aspects. Thus, the following aggregations have been made:

- Work includes Function, Process, Sub-Process, Activity and Task
- Domain includes Domain, Subdomain and Subdomain Subdivision
- Organisation includes Organisation, Organisation Unit, HEI, Federation Holding Organisation and External Organisation
- Motivation includes Mission Statement, Strategy, Operational plan, Vision, Goal and Purpose
- Artefact (also known as concept and thing) includes Artefact, Resource, Deliverable and Interaction content

However, we are aware that the distinctions are useful for some people and therefore we are allowing people to "tag" items with which of the more precise categories they wish an item to belong to.

Enhancing the user interface

It is not possible to distinguish the developments to the user interface undertaken as part of the Roles Landscape study, and those undertaken for the Innovation Base project as we have undertaken the developments as the need arose regardless of the source. The workshop carried out as part of the Roles Landscape study did make real contributions to the way in which terms need to be defined and to the way in which people from the HR domain use and relate the elements of the knowledgebase. These factors were taken into consideration in the interface design for Innovation Base.

Integrating a wiki into the system

For historical reasons we started the development of the Innovation Base with a separate wiki that programmatically connected to the Innovation Base because we had believed that it would be appropriate to make use of a semantic wiki. However, over the course of the project it became increasingly clear that the semantic functionality should only be in a single place, and not duplicated in the wiki. This has meant that we have now moved the wiki functionality within the Innovation Base itself, which has the advantage of simplicity - there is a single system to maintain, coherence - the two systems cannot get out of line and speed - there is no need for the systems to pass information between themselves.

Conclusions

From the work we have undertaken we are in a position to draw some conclusions about the utility and effectiveness of modelling based on roles in higher education.

1. We have clearly demonstrated that the approach that we have taken allows modelling of roles as part of the higher education landscape, and in particular that by extending the HILDA model to take account of role information we can model roles within the HILDA model.

2. It is possible and practical to work with the HERA and HILDA models together as they provide different, but complementary functionality. HERA is focused on role modelling and determining the size of roles through their scoring system while HILDA offers the ability to see roles in their wider context and to model them in their wider context.

3. It is not currently possible to directly connect HILDA and HERA due to the lack of appropriate APIs in HERA's underlying database. However data can be exported from HERA either as CSV files that could be transformed using macros or, as done in this project, manually transferred to HILDA.

4. Each university that is using HERA has its own version of the HERA database, populated with the specific roles at that university. Some of the differences relate to the ways that roles are defined (for instance due to the different missions and sizes of universities), as well as they way in which individual universities score the roles. However, there is sufficient commonality in work undertaken within roles and competencies required by roles for a national model to offer a robust starting point for institutions to customise the model to their own needs.

5. Modelling roles is not a trivial task, and the scale remodelling roles within HILDA and HERA to understand the effects of organisational development is commensurate to the scale of the reorganisation. A major reorganisation would require significant effort in modelling. However, we believe the return in better understanding the effects of the change and the developmental requirements make this cost-effective.

6. We can collect data for the knowledgebase from a wide range of sources including HERA, and other frameworks such as Skills for the Information Age, e-Skills and the National Occupational Standards and even job specifications.

7. Human Resource and organisational development staff understand the model and its purposes and believe that it can be very useful in supporting their work, and support its construction.

8. It would be useful to undertake further work to align the detail level of various competency frameworks in order to make the most effective use of each of the models. This would enable universities to take better advantage of national frameworks developed outside the sector (such as e-skills).

9. Further work with universities on the using the HILDA (and now the Innovation Base) and HERA together for organisational development is needed to refine the system.

Appendix A: Instructions for loading Excel tables into HILDA

EXCEL sheet is prepared for import as follows (refer to example below):

- Row 1 contains column labels.
- Row 2 contains rules:
  - To create a new **Instance** use:
    - Rule: "**I *Class***"
      - *Class* = the class the instance will belong to.

      Values in this column (row 3 onward) are now the names of instances of *Class* to be created.
    - To create a new **Data Property** of an instance use:
      - Rule: "**D [*Label*] *Property***"
        - *Label* = the label of the column containing the instance to which the new data property will be attributed.
        - *Property* = the name of the data property to be created.

      Values in this column (row 3 onward) are now the values of the data property to be created.
    - To create a new **Annotation** for an instance use:
      - Rule: "**A [*Label*] *Annotation*"**
        - *Label* = the label of the column containing the instance to which the new annotation will be attributed.
        - *Annotation* = the name of the annotation to be created. The can be one of:
          - Comment
          - Source
          - Creator
          - Description

      Values in this column (row 3 onward) are now the values of the annotation to be created.
    - To create a new **Relationship** use:
      - Rule: "**R [*Label*] *Relationship Class***"
        - *Label* = the label of the column containing the instance to which the new relationship will be attributed.
        - *Relationship* = the name of the relationship. **Note:** this must be the correct name for the relationship from the ontology, not the label name. It should contain no spaces and is case sensitive.

- *Class* = the class of the instance that the labelled instance is to be related to.

Values in this column (row 3 onward) should now contain the names of the instances to be related to the labelled instance.

Role	**Purpose**	**Duties**	**Domain**	**Source**	**Author**
I Role	D [Role] purpose	D [Role] duties	R [Role] isOwnedBy Domain	A [Role] [Domain] source	A [Role] [Domain] creator
Information Manager	To be responsible for the policy, planning, organisation, management and promotion of information services.	Lead and develop departmental planning and policy.	Information Management	ECC - Information Manager	Tom Franklin

Table 18: Example table for batch uploading to knowledge base.

Appendix B: Technologies

1. The HILDA model was built in the Unified Modelling Notation (UML) [4]using the open source tool StarUML[5]

2. The knowledgebase ontology was built in the OWL[6] language using the open source tool Protégé[7]

3. The knowledge explorer was build in AJAX with Google Web Toolkit and is an ongoing development under the e-Framework related JISC Programme X (Programme Manager Alex Hawker) [8]

4. The HERA software is a web-based application provided to ECC's members by Towers Perrin. Each member institution has a separate secure database which is held on Towers Perrin UK based servers. The role and employee contents of the database are the property of each individual member institution. The contents of the HERA and FEDRA scheme, including the elements, questions, competency framework and scoring scheme are the intellectual property of ECC. The underlying database is the property of Towers Perrin. The source code is protected by an escrow agreement with ECC.

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[4] UML at the OMG http://www.uml.org/

[5] starUML in SourceForge http://staruml.sourceforge.net/en/

[6] OWL language reference at W3C http://www.w3.org/TR/owl-ref/

[7] Protégé at Stanford http://protege.stanford.edu/

[8] JISC e-Framework manager Alex Hawker http://www.jisc.ac.uk/publications/publications/bpeframeworkv2.aspx

Appendix C: Relationships in HILDA

Class	Domain	Work	Event	Rule	Concept / Artefact / Thing	Motivation	Role	Competency	Lifecycle	Lifecycle state	Organisation	Service	Application or tool	Project	Information model	Quality Evaluation
Common elements																
Domain	Decomposes To is Example Of	Is Concerned With Owns	Is Concerned With	Concerned with Governed by	Owns Concerned with	Concerned with	Concerned with Owns	Concerned with	Concerned with	Concerned with	Concerned with Relates to	Concerned with	Concerned with Supported by Interested in	Concerned with Owns	Concerned with Owns	Concerned with
Work	Occurs In Is Example Of	Decomposes To describes is Example Of is Implemented By	triggers is Triggered By	Governed by Describes how implemented	Produces Consumes	Has	Responsibility of Done by Involves	Requires		Occurs in	Responsibility of Owned by Receives from Sends to	Supported by	Implemented by Supported by	Part of		
Event	Occurs In	Is Triggered By triggers	Is Example Of											Triggers Triggered by		
Rule	Occurs In governs	Governs		Decomposes To is Example Of			Responsibility of			Concerned with	Owned by Constrains		Implemented by	Governs		
Artefact	Occurs In is Owned By	Is Produced By is Consumed By			Decomposes To Is Example Of						Owned by Produced by Consumed by	Produced by Consumed by	Produced by / consumed by	Produced by Consumed by	Described by Related by	

Class	Domain	Work	Event	Rule	Concept / Artefact / Thing	Motivation	Role	Competency	Lifecycle	Lifecycle state	Organisation	Service	Application or tool	Project	Information model	Quality Evaluation
Motivation	Occurs In	Is Motivation Of				Decomposes To is Example Of	Of				Of					
Role	Occurs In is Owned By	executes is Responsible For works On is Involved In		Responsible for		Has	Decomposes To Is Example Of requires defines	Requires		Involved in	Owned by Manages Responsible for			Occurs in Manage Work for		
Competency	Occurs In	Required by					Required by	Is Example Of								
Lifecycle	Occurs In								Is Example Of	Comprises	Relates to			Occurs in Of		
Lifecycle State	Occurs In	Allows		Has			Involves		Part of	Decomposes To is Example Of	Owned by			Occurs in		
Organisation	Occurs In relates To	Is Responsible For owns sends To receives From		Owns Governed by	Owns Produces Consumes	Has	Owns Managed by Reports to		Concerned with	Concerned with	Decomposes To Is Example Of Sends To Receives From			Occurs in Owns Funds		

Class	Domain	Work	Event	Rule	Concept / Artefact / Thing	Motivation	Role	Competency	Lifecycle	Lifecycle state	Organisation	Service	Application or tool	Project	Information model	Quality Evaluation
Service	Occurs In	supports			Produces Consumes							Decomposes To Example Of manages references contains	Specifies	Produced by Consumed by		
Application	Occurs In supports Of Interest To	implements supports		Implements	Produces Consumes							Implementation of	Example Of	Produced by Used by		
Project	Occurs In Owned By	Includes	Triggered by Generates	Governed by	Produces Consumes		Concerned with Managed by Includes		Concerned with Has	Concerned with	Concerned with Owned by Funded by	Produces Consumes	Produces Uses	Decomposes To Example Of		
Information Model	Owned By				Describes										Decomposes To Example Of	
Information Transaction	Occurs In															Decomposes To Example Of
Quality Evaluation	Occurs In	evaluates			Evaluates Evaluated by											

Table 19: Relationships in HILDA

Terms on the diagonal	Inverse term
Decompose	Compose
Example of	Generality
Part of	Contains
Described by	Describes
Implemented by	Implements
Requires	Required by
Defines	Defined by
Sends to	Receives from
Receives from	Sends to
Manages	Managed by
References	Refers to
Contains	Contained by
Evaluates	Evaluated by

Table 20: HILDA relationships to same class