Integrated Research Reporting – Getting off the Ground into ORBIT

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Abstract
'Research Management' is diverse, while management systems are traditionally poorly integrated with other corporate systems. Thus integrated research reporting has proved difficult to provide. ORBIT (Operational Research Business Information Tool) is an initiative to address this. Part of a larger project, the first ORBIT release comprises three discrete but related modules - Student Profiles for postgraduate management; Project Reporting to integrate research financial, ResearchMaster (grants management) and HR salaries data; Researcher Profiles bringing together strategic data concerning academic research activity, permitting researchers to maintain up-to-date C.V. and perform researcher activity analysis. ORBIT leverages off web technologies. Using its own database, reports are delivered via intuitive screens, with fully controllable and exportable data.

This paper discusses the broad issues underpinning the project and its development. Demonstration of features will be followed by some ideas for future development.

'Research Management' is a broad church.
Today's academic, proposing to undertake research, is faced with a range of sponsor requirements, compliance issues and university processes which must be understood and negotiated before, during and following the actual research exercise. These all represent hurdles, often moving ones, as governments, sponsors and the universities themselves impose new obligations, making more detailed management reporting demands upon the researcher. Further, high level reporting at a variety of management levels – whether at faculty/school level, centrally or for mandatory reporting – often requires a complex combination of data extracts from various (generally) unrelated corporate systems. The drawing together of a complete 'research' picture from a variety of systems into one tool is, to all intents and purposes, still the Holy Grail of research management.

Research Management Demands
External demands often impose new constraints that can only be met by support at the university administrative level. Amongst these are:

- The proposed requirement that grant recipients lodge publications, derived from ongoing ARC-funded research, in open-access digital repositories. Omitting issues relating to Intellectual Property (I.P.), confidentiality and ability to commercialise research, it requires the provision of a centralised digital repository with associated corporate systems and business processes.
• Revised 2008 ABS research codes, necessary for ARC and NHMRC grant applications, for the next ABS survey, and which underpin the ERA process. Not only must management systems quickly accommodate to use these codes, but a process is required for retrospective code-matching to collect the required data elements over the ERA reporting timeframe.

• International research with unique compliance issues. Anyone undertaking research through the US National Institutes of Health, for example, will be aware of the compendious application process, and the requirement to have detailed financial and evidential information at hand for an audit of research at the sponsor's request.

But even leaving aside new external demands, research requires some or all of the following undertakings.

• A detailed application to a sponsor, generally conforming to a specific sponsor template. A common aspect of an application is the listing of current research C.V. data – e.g. an up-to-date publications list, a list of research grants undertaken with their value, academic achievements in related areas and other relevant data (such as supervision of post-graduate students and post-doctoral researchers).

• On-going financial and progress reporting to sponsors in respect of awarded grants.

• Day-to-day financial management and acquittal of research projects. Even where this task is managed by faculty/school business managers, this requires budgeting and acquittal at a detailed level against pre-determined category limits defined within sponsor contracts.

• Applications to ethics committees for clearances. Where animal usage is involved this will require extensive documentation and, in many Australian states, on-going statutory reporting of animal usage. Involvement in clinical trials brings further prudential compliance issues in respect of relevant researcher indemnification and patient insurance.

• Supervision of post-graduate students and the need to manage student higher degree load, progress management and candidature processes.

• Lodging of research publications to university systems – specifically digital repositories. Already some Australian institutions have made this mandatory.

**Diverse Administrative Needs**

In Australian universities 'research' is generally managed in several administrative areas, using (generally) disparate systems, and with limited detailed awareness of each other's specific processes and relationship to the academic research community.

Commonly universities have a Research Office. This is responsible for competitive grants application and on-going reporting management.

It may also be responsible for ethical clearance and management and compliance reporting. The same office, or in many instances, a separate office (e.g. Graduate Centre) is responsible for management of post-graduate research, candidature, thesis tracking and associated scholarships.
The collection of research outputs (publications) may be conducted by the library and/or the Research Office, often with different requirements. The need for a centralised repository and catalogue of all outputs differs from narrower statutory reporting requirements, and usually with differing quality assurance checks of relevant bibliometric data. There is often a commercial arm responsible for contract/consultancy research, the management of Intellectual Property and the commercialisation of cutting-edge research.

The research manager also needs recourse to the finance system to acquit income and expenditure, a student system to manage postgraduate students and a Human Resources (H.R.) system to budget salaries for academics and research associates employed on grants.

**Lack of System Integration**

To support these various processes and administrative areas, there are usually (generally) technically unrelated corporate or specific database systems. In this respect 'research management' systems still lag behind larger corporate systems in terms of development, as well as university investment and support. In our 2005 paper [1], Jewell and Carpenter reviewed existing research management systems and examined a model for an integrated solution. In the three years since there have been some advances in respect of the use of web technologies, and initial moves into new areas of software support. But both full integration and a single reporting portal remain in their infancy.

Traditionally research management falls under many system umbrellas. These include a 'research' system for grant applications and possibly publications and ethics protocols; a student system for post-graduate management; scholarship system (may be integrated with post-graduate); library digital repository; a commercialisation system (for contract research, commercialisation and I.P) - and, of course, the larger corporate Finance and H.R. systems.

**The Adelaide Experience**

In 1999-2000 the University of Adelaide moved to implement corporate software. This included a Finance system (PeopleSoft), Student and HR systems (also PeopleSoft), and ResearchMaster (an Australian product used in Research Branch to support grants management, publications collection and ethics clearances). Postgraduate students were incorporated into a PeopleSoft student modification, permitting candidature and thesis management, while scholarship management remained in a legacy system lacking a PeopleSoft Student interface. The only research interfacing represented feeds from HR and Student systems into ResearchMaster. Several in-house customisations within ResearchMaster have enabled enhanced business process support and reduction of data entry in some areas.

In 2005 an on-line animal ethics application form was scoped and developed by ResearchMaster P/L and incorporated into the existing system (currently being updated to add more sophisticated data entry, email functionality and document storage). This was followed by a similar clinical trials web form in 2007.

Reporting, however, remained poorly developed and, despite some limited warehouse developments, cross-system data integration for any structured analysis has not been achieved.
It is recognised that there are several related but distinct reporting requirements, few of which are adequately supported in the current environment. These are:

- **Operational reporting** – e.g. day to day management of grants, especially at a detailed budgetary level; the simplified tracking of postgraduate students.
- **Strategic reporting** – involving the meeting of KPIs, using time-series data to extrapolate and budget, and the ability to draw academic performance data together from disparate sources.
- **Up-to-date information on academic achievement** readily available to underpin maintenance of academic C.V.s, to support an expertise system and to support generation of management research reports and profiles.

**Going into 'ORBIT' - The Way Ahead**

In the middle of 2006 the DVC(R) undertook to escalate developments for the 'research' portfolio and instituted a Corporate Research Systems project.

The brief for the project has broadened over time to include:

- The provision of technical support for the ERA process.
- Enhancements to the animal ethics web form – introduction of application workflow, interactive modification before submission and document attachment.
- Development of a Bio-Safety system – management of ethical issues in relation to quarantine, and licensing/management of specialised laboratories or physical containment areas.
- Involvement with a centralised research output portal that will integrate the digital library, ResearchMaster and the Researcher Profiles Module scoped for ORBIT (to be discussed).
- Development of a Scholarship system, given that projected PeopleSoft developments, sufficient to meet business needs, remain some years off.

**Designing a Solution**

The main thrust of the project, however, is to provide integrated reporting from corporate systems. The Operational Research Business Information Tool (ORBIT) system involves the development of a web-based product that meets both operational and strategic needs. Acting in many ways like a sophisticated warehouse, it draws data from Finance, Student, scholarship, HR and ResearchMaster systems, as well as user-entered data, in its own Oracle tables, and represents data via user-friendly reports. Data is refreshed overnight from core source systems.

**Technical Considerations**

The front-end of ORBIT is a web-based solution using extensive Java-scripted code, with **Ruby on Rails** as the web server application. **Ruby on Rails** itself is open-source code, so that ORBIT leverages off ongoing developments by users world-wide.

Access security is maintained within ORBIT via an administration module. Academic access is, at the first level, determined by normal user/password authentication tied to the University ldap system. Specific security rules apply to the various modules (and will be described with these modules.)
Functional Modules

In its initial implementation ORBIT is to consist of 3 modules.

1. **Student Profiles**
   This draws data from PeopleSoft Student and the legacy Scholarship systems. It provides operational reports in respect of applications, candidature and thesis management, as well as associated scholarship information. Time-series strategic reports are available for a period of 5 years prior to the current year. All data is currently read-only.
   This module was released in April 2008. Two subsequent updates have expanded reporting. A 2009 release will incorporate a milestone-driven emailing functionality to support central thesis and candidature management processes. The module has been very well-received, making summary and simplified data readily available whereas, previously, reports were difficult to obtain or required use of a complex array of PeopleSoft screens. At the same time it has led to improved data accuracy (since errors are immediately visible to a broader user audience) and has underpinned a review of centralised business processes.

   System access generally reflects user access to student data. However access can be granted at central (full) view level, at Postgraduate Coordinators level (relevant school and faculty data being visible), or at Supervisor level (i.e. data for one’s own students is visible).

   The scope of the module will be given later in conjunction with relevant screen shots.

2. **Project Reporting**
   This module is seen as the lynchpin of the system, integrating financial, research management and salary information. As such it draws together ResearchMaster projects data (with its details concerning dates, personnel, funding sources with their indicative awards and milestones), financial actuals from the Finance system, gathering data at journal transactional level; as well as HR salary data for research staff and projections data to enable income and expense budgeting based on up-to-date information that takes into account grant termination dates, Enterprise bargaining changes etc. Budgeting is permitted for specific financial activity groupings common to research contracts – e.g. Salary, Stipend, Operating etc. In fact the module is capable of managing all financial projects, but has a research specific focus.

   While data drawn from other systems is read-only, this module incorporates its own series of tables to permit entry of detailed income and expenditure breakdown, enabling financial projections and ongoing tracking at summary or detailed levels against imported actuals. As such it offers enhanced functionality supportive of the current implementation of the Finance system.

   Since ResearchMaster holds (generally) only those grants which are managed via the Research Branch (viz. competitive research), ORBIT will also display all other project data kept in Finance, enabling users to provide some additional summary information re project participants and milestones. At this point in time contract and consultancy data from the University's commercial arm, ARI Pty Ltd, is not being drawn into the system. In fact, the actual financial data is available from the Finance system – but the link to collect ARI project information has been flagged for future release.
Access to academics will be reflected by their being as first-named investigators on ResearchMaster-held grants. For school/faculty managers, data access will reflect corporate access to the existing Finance system, but an ORBIT access module will permit request and authorisation of higher access levels. However, HR data access for salary purposes will require system authorisation via the ORBIT Administration section (used also for Student Profiles but not discussed here).

This module is due for implementation concurrently with this Conference. A more detailed discussion, along with development screen shots, will be given later.

3. Researcher Profiles
The third module, scheduled for 2009 development, will draw together data about researchers from the relevant systems – e.g. lists of grants applied for as well as awarded; lists of publications (by category); postgraduate supervision data. It will also permit academics to maintain personal data under other headings – e.g. achievements, collaborations, awards, lists of seminars, visiting scholar information, research keywords etc. It will allow addition of missing information by academics, but will obviously encourage them to ensure that relevant personal information exists in corporate systems and be maintained there (where possible).

This module will permit simple on-screen organisation of data and the ability to extract to other output forms in order to facilitate:
* maintenance of C.V.’s
* production of research grant and/or publication lists for use in grant or other academic applications.

At the time of writing the scope and type of access has yet to be finalised. There will be less restrictions than exists for other modules, with information being generally publicly available, but updatable only by data owners.

User Features
The implementation of ORBIT utilises a set of design principles. These are:

- Screens should be largely intuitive – not menu-driven.
- Search screens enable data selection for all significant data elements.
- Results are largely displayed in simple grids.
- Grid columns can be searched, filtered and sorted.
- Grid columns can be suppressed.
- Data can be exported as CSV files to Excel, reflecting all sorting, filtering, visibility options selected by the user.
- Breadcrumbs maintain navigation control.
- ORBIT functions on commonly used browsers in Windows and Mac environments.
- Hover tool tips are given explanatory of data elements for both headings and report tabs.
- Comprehensive and contextually aligned help is available at all times. This includes a user manual and structured, indexed Help pages.
- Administrative level access permits analysis of use, logging of errors, usage statistics and general performance analysis.
• Provision of an ORBIT support team, independent of but supported by the University IT HelpDesk, to deal with user issues, to manage fixes/enhancements and further developments, and to liaise with functional administrative areas so that business and/or system changes in source systems are reflected within ORBIT screens.

System Demonstration

Features of the system are best shown by referring to the Student Profiles Module. Screenshots are taken from a UAT database and so critical data elements are blurred for confidentiality purposes.

The opening screen (after log-in) shows:

Operational and strategic reports are separated; important news items can be conveyed, and relevant overdue milestones are highlighted for the attention of Postgraduate Coordinators and Supervisors.

Choosing 'Candidate' we obtain:
Major reporting components are represented as tabs. The icon, wherever visible, supplies an export of the complete displayed dataset with all selected grid criteria.

Data is always in Excel-like 'grids'. Now selecting a student we obtain:

Screen reports are clearly demarcated and RTS load/EFTSUL expenditure displayed graphically.
Breadcrumbs maintain user history and links.

Moving to the 'Supervision' tab we can see how grid columns can be used:

Filtering, sorting and column selection are available.

Drill-down links via (say) supervisor yields:

This in turn permits lists and analysis of all students for this supervisor.

The 'Completions' tab shows an operational feature – separate status lists, assisting prompt attention to critical candidates.
The 'Thesis' tab also is operationally important—an example is shown (here at second screen level for a selected candidate):
Strategic Reports build on the growing data-set, beginning with 5 years initial data. An example is displayed next:

The next screen shows the use of 'hover' tool tips which apply to every tab and field header.
Help screens are always available – here seen, firstly at the index level, and then contextually.
One area demonstrates the underpinning support structure for ORBIT.

Having examined the key features, as well as a quick look at the Student Profiles module, the focus now turns to Project Reporting. Images are from (initially) a UAT and (then) prototype development versions.

The basic Search Form is shown with an example of tool tips on the use of each element. Searching is very flexible, allowing (in some cases) multiple searches within the same field, as well as concurrent searches across multiple fields.

The full Search Form (by use of down arrow icon) gives:
The results of a search against a particular researcher yield the following.

The financial data is comprehensive. Panning to the right we also have:

Projects are hyperlinked. Clicking on one leads to this second level screen.
Finance journal transactions are summarised by month and General Ledger account.

And at the bottom, Purchase Order commitments are displayed by GL account. This is not displayed here.

A few other features of note include:

- Standard red and use of brackets for negative values.
- Drill down to all GL transactions for any blue or red values.
- The ability to see data for any 12-month period, with start and end month being user selectable (to cater for specialised reporting periods). The data selection feature is evident.

The 'General Details' tab brings in ResearchMaster data, showing indicative (and updated if CPI has occurred), inkind contributions (where known), project abstracts, research codes, milestones, researchers and funding bodies. Researchers are listed in named order with assigned roles, while externals displayed affiliated organisations.

For projects not recorded in ResearchMaster components of this screen can be added and stored within ORBIT, including projected income amounts, project participants and milestones.
The grant information presented within this page is sourced from the ResearchMaster system by the Research Branch. If you believe any of the project details is incorrect or requires updating within RM, please contact us at orfh@adelaide.edu.au.

### General Project Details

**Title:** Functional and separate consequences of maternal fetal discordance, supplementation and fetal growth outcomes  
**Project Description:** Growing data indicates that fetal growth restriction (FGR) is a major contributor to perinatal morbidity and mortality. The Institute of Reproduction and Development has a unique opportunity to address this problem through its expertise in maternal-fetal medicine, fetal modeling and human genetics. We aim to investigate the mechanisms by which maternal and fetal factors interact to influence fetal growth and development, and to develop novel interventions that can improve perinatal outcomes. The project will address the following objectives:  
1. To identify maternal and fetal factors that contribute to FGR.  
2. To develop novel interventions that can improve perinatal outcomes.  
3. To evaluate the long-term effects of FGR on the health and development of the offspring.

### Project Research Classifications

- **RCI Codes:**  
  - 080103 Systems Physiology  
  - 110124 Obstetrics and Gynaecology  
  - 270221 Gene Expression

- **RCI Codes:**  
  - 730110 Chronic (Cardiovascular and Abnormal Conditions)

### Project Participants

- **Enrollee/Student ID:**  
  - E77502  
  - J94352-1

### Funding

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<td>275,350.00</td>
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<td>275,350.00</td>
<td>175,000.00</td>
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### Milestones

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**References**


'Expenditure Limits' permits a variance analysis of grant expenditure limits against actual expenditures by year.

As shown an icon at top right permits data entry to set up expenditure limits which can be viewed against finance system actuals.
A 'Full Life Estimate' tab provides a net available balance for the period, taking into consideration all actual income, as well as projected income and expenditure over the life of the project. **(The following screenshots are from a prototype since UAT for this functionality not available at time of writing)**.

'Payroll Details' permits analysis of job contract details and personnel costs for all employed and paid from project funds.

A detailed breakdown of Salary expenditures by year is supplied. Only a portion of the full screen is shown. Sections below display On-costs, Provisions and Overtime separately.
Significantly the system prototype was presented to the ARC during their last University audit. It was said to represent state-of-the-art project management and would meet anticipated new ARC compliance requirements regarding separation and acquittal of funds from the ARC vis-à-vis contributing sponsors (e.g. Linkage grants).

The Researcher Profiles Module will utilise the same design features and format. But it will also permit sophisticated selection, reorganisation and export of data. It is expected to provide academics with a versatile tool, allowing them access and manipulation of their personal corporate research data.

**Future Developments**

In the first instance ORBIT will be broadened to include:

- Enhanced Student Profiles operational functionality – referred to above.
- A new Scholarship system – interfaced with Postgraduate data.
- Enhanced Project Reporting, allowing grouping of projects and hence aggregation of selected data sets.
- Incorporation of ARI commercial contract/consultancy data into both Project Reporting and Researcher Profiles modules. This will enable a far more comprehensive picture of 'research' and researcher activity.

Investigations may well lead to a further module, providing more operational reports for use by Research Branch, along with enhanced strategic analysis of grants information and researcher activity analysis (as time series data grows). This is seen as a means of addressing limitations with (supplied) ResearchMaster reporting.

It is expected that academic and management use of the Project Reporting module will generate wider interest in ORBIT and hence generate further development directions.

Clearly ORBIT is not the complete answer to 'research management' integration in that it connects data but not business areas and processes. Operational business workflow remains outside of its scope. But its own defined rules for data extraction and display must reflect business area practice. Hence ongoing maintenance, as process changes occur in functional areas (for those reasons described initially), will drive closer integration of business processes to guarantee system integrity.

In reviewing the model we proposed in 2005 [1], we see that ORBIT has gone part way toward addressing 'research' integration. An Animal House system remains currently outside of scope, as does a full human ethics web form. The University still has multiple management systems, but 'research' is now recognised as a diverse area inadequately supported at the system level. ORBIT is an attempt to underpin the portfolio, to simplify a complex area, and to support the University across its many organisational tiers as it deals with 'research management'.

**Reference:**