THE HKU SCHOLARS HUB; UNLOCKING COLLECTIVE INTELLIGENCE

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Abstract

In 2009 The University of Hong Kong (HKU) wrote mission and vision statements, and strategic plans highlighting Knowledge Exchange (KE). The HKU Scholars Hub, the institutional repository of HKU, was chosen to be the chief vehicle to forge the necessary culture for KE within HKU and engage staff in delivering the desired outcomes of KE. Development work to create this vehicle serendipitously created other desired outcomes. Chief amongst these is a collective knowledge system, created from the interaction between machine and data, author and institution, and, local authority and remote indexing. The result is a bootstrapped "intelligence", greater than the sum of its parts.

Keywords: institutional repository; The University of Hong Kong; knowledge transfer; knowledge exchange; Scopus; ResearcherID; ORCID; Collective Knowledge Systems; Collective Intelligence;

1. Introduction

The research funding body for Hong Kong academic research, The University Grants Committee (UGC), in 2009 charged and funded all of its eight tertiary education institutions to begin programmes for Knowledge Transfer (KT). Their definition of KT:

"the systems and processes by which knowledge including technology, know-how, expertise and skills are transferred between higher education institutions and society, leading to innovative, profitable or economic or social improvements" [1].

Upon receiving this UGC directive, The University of Hong Kong (HKU) set several initiatives in motion to uniquely do and show KT, with HKU characteristics. They re-articulated their mission and vision statements, showing three themes; 1) research, 2) teaching and learning, and 3) knowledge exchange (KE) – HKU's local interpretation of KT, emphasizing bilateral exchange between HKU and its community. They created a five year strategic plan [2, 3] based upon these three themes, showing strategic initiatives and operational priorities, two of which read,

- "… setting up a database to record knowledge exchange activities in the University and improving communication within and outside the University, we will facilitate dissemination of information and service as an exchange hub.
- "… implementing a sustainable web-based expertise directory which draws upon research output, research grant records, contract research, media expertise and community service databases, we will facilitate inbound enquires that seek to identify expertise" [4].

Finally, key indicators were assigned to determine the success of HKU's KE initiative [5]. These include,

- Item count of HKU theses in open access (OA)
- Item count of HKU research in OA
- Applications for patents
- Download counts of the above
- Number of staff available for media contact
- Number of collaborative researches
- Number of contract researches
- Number of consultancies, and income thereby generated
- Number of invited public lectures, symposia, exhibitions, performances & honorary degree speeches
- Number of University staff invited to be mentors
- Number of positive media impact related to knowledge transfer coverage, including print, online and electronic media
- Number of appointments of external members to HKU advisory boards

The Hub.   The HKU Scholars Hub [6] (The Hub) is the institutional repository (IR) of HKU.   It began in 2005 with a mission to collect, preserve, and provide OA to the intellectual output of HKU.   The HKU Knowledge Exchange Office (KEO) realized that the goal of The Hub -- OA on HKU research -- largely already aligned with that of KE, and with development could be used as the key vehicle to enable, and show KE at HKU.   The Hub could directly measure, and answer several of the key indicators above, and actively promote the increase of several others.   The Hub was therefore designated to be an "exchange hub" to make HKU research and expertise highly visible.

With encouragement from the KEO and others on campus, Hub administrators began to plan, how best to make The Hub,
- An expert finder, showing many relevant particulars on each HKU scholar, enabling their discovery by searchers in government, industry and academia
- A supplier of metrics to evaluable these experts and their research
- An "exchange hub", to show and measure all relevant HKU KE activities

2.   Methodology

Item-centric.   Traditional IRs are item-centric, with metadata records for each separate item. Similar to IRs at other universities, we were collecting the published and grey literature of our academics, and the theses of our postgraduates.   Because of a policy requiring thesis deposit, and a program of retrospective digitization, HKU was the first university in Asia to show online theses for all students – 17,000 theses in 2009.   However the published and grey literature of our academics proved more difficult to collect – we were ingesting perhaps only 10% of the total.

Metrics in IRs will normally cumulate for each item.   In this regard we used APIs from Scopus and Web of Science, to show citation metrics for each Hub item, if also available in Scopus or Web of Science.   More article-level linking is planned, such as trackbacks, links to corresponding entries in the blogosphere, etc [7].

Author-centric.   Besides IR items in OA, the KE initiative also called for an online locus where details particular to one HKU author could be found.   We therefore planned the creation of ResearcherPages (RPs) for each current HKU scholar with these particulars, and metrics that will cumulate to this individual scholar.   To build these RPs, fortunately there were several data silos internal to HKU and external, from which we could extract and quickly build a mash-up.

After tendering for this work to be done, we chose Cilea Consorzio Interuniversitario [7] as our partner in development.   The first round of enhancements completed in 2009, with others still in progress, and many others still in planning.

On Campus.   HKU has long required authors to input data regarding their research output and professional activities; albeit in several disparate and often overlapping databases.   Chief amongst these is the Research Output System (ROS), which allows data input directly, but also receives data from the Academic Performance Appraisal (APA), used for performance appraisal, and the Research Grants Committee Administration System (RGCAS), used for applying for, and reporting on, grants given by the Research Grants Committee (RGC) – the research arm of the aforementioned, UGC.

We set up a process in 2007 to receive publication data for journal articles, conference papers, and books, from the ROS.   ROS input screens ask for author permission to post to the Hub, and for attachment of the author's manuscript.   These items were posted to The Hub, only if publisher and author permission allowed.   However with the KE initiative, we began to plan to import all relevant data from the ROS, to repost to The Hub.   If relevant permissions cannot be obtained, citation data only will be posted.

There are several other sources which we plan to harvest.   The following chart shows data to be obtained and from where.

Table 1: Data Elements & Sources (HKU)

Data Element	Source (HKU)
Publications, awards, prizes, etc	ROS
Contact details	Communications Directory
Professional qualifications	Central Personnel Database
Supervision of Research Postgraduate Students	Postgraduate Student Systems
Expertise / Research Interest	APA
Public & Community Service	APA
Research grants received & project undertaken as principal or co-principal investigator	RCGAS
Patents applied for & granted	Technology Transfer Office
Picture	Departmental / personal web pages
Subjects for media comment	Media Content Directory

KEO arranged permission for The Hub administrators to extract initially and then for weekly updates.   In 2009 administrators set up unattended batch processes to extract data from the Media Content Directory and Communications Directory, and to marshal into Excel files.   Cilea created a procedure that would load the data from these Excel files into The Hub.   Future work will use similar processes to load data from the other sources.

External to HKU.   Working with the various publication lists, it became apparent that sources within HKU and externally all had different subsets of the total output for any one staff; the reasons for which are many and varied.   Therefore, it is valuable to show all sources, with their different publication lists and citation metrics.   The two largest providers on the planet for paper counts and citation metrics are Elsevier's Scopus, and Thomson Reuters' Web of Knowledge (TR WoK).   Although for certain subjects, other sources are perhaps better, these two provide the widest coverage across the most disciplines.

We have long used each of their APIs to show article level metrics on Hub items, and therefore quickly thought of them to also provide author-cumulated metrics.   Before we could begin however, there were several problems to overcome; chief of which, disambiguating names variants, and like-named individuals, one from another.

Scopus.   This database [9] provides a unique AuthorID and page for each author, on which paper counts and metrics will cumulate for this author.   However these pages, which are created by machine algorithm, are frequently in error, cumulating two or more like named individuals into one AuthorID, or, creating two or more separate AuthorIDs for one individual when he or she used two or more variants to publish.   The affiliation information was frequently in error also because, 1) most of the UGC universities in Hong Kong have very similar names, and, 2) second and subsequent authors frequently showed erroneously, the affiliation of the first author.

Although authors themselves can request these changes, they rarely do.   We therefore hired research assistants to search out these problems, and report them to Elsevier.   Elsevier has committed to fixing these reported errors and that changes once made will not need to be made again.

Figure 1. Example of Scopus AuthorID (April 2010)

ResearcherID.   We could not find similar procedures to correct data in Web of Knowledge.   We then happily learned of Thomson Reuters ResearcherID [10].   Although researchers themselves could create these accounts for themselves, they rarely do.   We therefore used XML files to create in batch mode, ResearcherID accounts for each of the approximate 1,500 HKU professional staff. We used publication data from the HKU ROS, placed into XML, and uploaded to these accounts. We then gave the unique ResearcherID and password to each individual researcher, who can now personally edit this information.   If the data matched upon entries in WoK, citation metrics from WoK will accrue in real-time to the entry in ResearcherID, and cumulate to its author.   Using ResearcherID, we generated an "R" badge and HTML code to place on each scholar's ResearcherPage.   MouseOver on this badge will show the author's top three cited articles. ResearcherID is public, needing no paid subscription to view.

Figure 2. Example of ResearcherID (April 2010)

With both AuthorID and ResearcherID ready for extraction, The Hub administrators used Visual Basic Application (VBA) in Excel to build scripts to extract data from both repositories. Scopus AuthorID and ResearcherID were input into the Excel file, whose VBA script then returned 15 fields of relevant data.

There are several other repositories from which we hope to do similar.
- BiomedExperts
- MathSciNet
- Mathematics Genealogy Project
- ACM Digital Library
- Social Sciences Research Network (SSRN)
- Research Papers in Economics (RePEc)
- Google Scholar

As Google Scholar does not provide an author page, or a way of cumulating citations to one author, we must rely upon the authors themselves to run software such as Publish or Perish [11] on their Google Scholar data.   We will build a function for them to input this data themselves, with an accompanying RIS file made from Publish or Perish, into The Hub.

Matching Publications with ResearcherPages.   Cilea built procedures for cumulating author name variants to one established name, or ResearcherPage.   They then built procedures to make preliminary matches between ResearcherPages and item records whose author names matched the established name heading or any of its cumulated variants.   Hub administrators confirmed or rejected these preliminary matches.   Authority control and preliminary matches now work on the DSpace Dublin Core element, "dc.contributor", and any of its qualified variants; "dc.contributor.author", dc.contributor.editor", etc.

3.   Results

In the initial 2009 round of developments, The Hub administrators, Cilea, and the data providers produced these results,

- **TR ResearcherID accounts** for each HKU scholar populated with their HKU research publication lists.   Thomson Reuters will begin to use ResearcherID numbers in Web of Knowledge entries later this year, to reduce search noise, and to create a more exact method of author name searching.   Some researchers use their publicly accessible accounts as online CVs.   HKU uses them to harvest Web of Knowledge metrics and display in the Hub.

Figure 3. Example of a ResearcherPage (April 2010)

- **Clean AuthorID records in Scopus**. Users of Scopus, search and retrieve on HKU author names with greater accuracy. Government reports and university rankings using Scopus data, will show greater accuracy of HKU research output (described below). HKU can harvest cleaner and more accurate data, and display in the Hub.
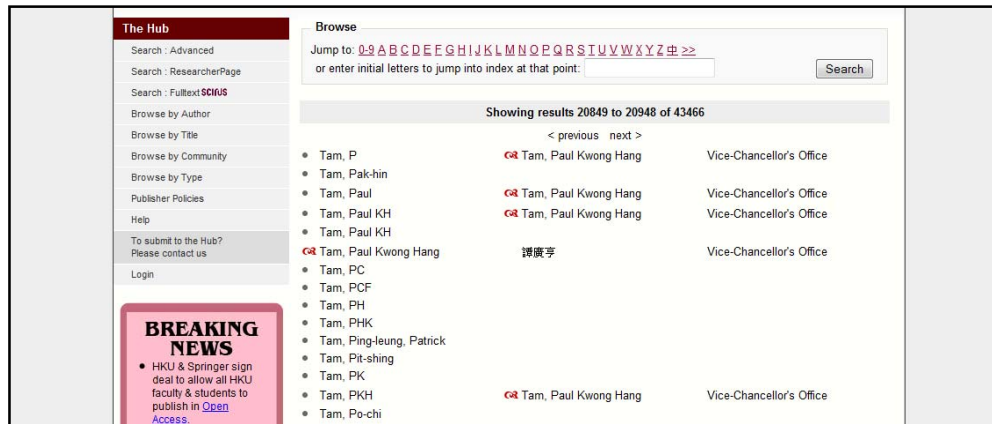
Figure 4. Example of Authority Control. The "⊞" denotes established heading.

- **HKU ResearcherPages** with author-centric details and metrics, and linked publication lists with fulltext articles. Searchers in government, industry, the media, and academia use Google and other search engines to find HKU experts for media comment, contract research, research collaboration, supervision of graduate students, speaking engagements, etc. RP owners use them for online CVs, publication lists validated by the institution, reputation management, publication list export (explained below), etc. The University uses them to highlight its research talent, and for KE with its community.

Figure 5. Example of Edit Page for RP Owner

- **Authority control** indexing to gather variant names together and disambiguate like-named individuals, in Roman scripts and in Chinese, Japanese, and Korean (CJK) scripts. Initiatives such as the Bibliographic Knowledge Network use this HKU established authority

control, along with the ResearcherID and Scopus AuthorID (manually matched by HKU staff) to ascertain identity and link to corresponding records in other sources. Readers within HKU and externally, use them as a finding aid for further publications by the same author, past history of the author, co-authors, etc.

- **Individual login authentication** using the HKU LDAP (CAS). RP owners login to edit or add details, personalizing their individual RP. Data extracted from other sources – Media Content Directory, Scopus, and ResearcherID – must be changed in the source silo, and not The Hub.
- **Unique author identifier,** to further disambiguate each current HKU author. This number appears in the ResearcherPage URL; for example, http://hub.hku.hk/rp/rp00060. Elsevier and Thomson Reuters in the future will allow this number to be written the Scopus AuthorID and ResearcherID records, respectively, and thus increase the trust of all three sources of disambiguated identity.
- Procedure for **matching Hub items with RPs**. Hub administrators examine each potential match before confirming.
- High visibility of HKU research and authors in **Google and other search engines**.

HKU administrators in KEO have lauded these developments and asked The Hub staff to take a "road show" to each of the departments. Elsevier and Thomson Reuters have been enthusiastic, and each claims that HKU is the first in the world to achieve these results. Scopus and ResearcherID add value to the Hub, and The Hub adds value to Scopus, and ResearcherID, driving traffic to both.

Individual scholars at HKU have, for the most part, also been enthusiastic. Upon seeing their results in The Hub, Scopus and ResearcherID, several have begun to take an active interest in showing their metrics in the best possible light; adding missing citations, variant names used, and asking for corrections. Several have suggested other sources of data, especially good for their discipline. This reputation management done by the individual also enhances the reputation of the institution.

Not all of the results are in. Development continues, and an authoritative survey has yet to be done. However along the way, a few more purposes for this work have appeared.

RAE. The UK and Australia report that bibliometric data from Scopus, WoK, or both will be used in their upcoming research assessment exercises (RAE): Research Excellent Framework (REF), and Excellence in Research for Australia (ERA), respectively. Hong Kong is heavily influenced by both. A subgroup in the UGC is now considering whether bibliometrics will be used in Hong Kong's own RAE, to be done in either 2011 or 2012.

Re-Positioning the Library. A recent report on research assessment in five countries by OCLC highlighted the role of libraries in this process. It noted that in those countries where bibliometrics are central to RAEs, academic libraries and librarians are often pivotal. The author writes,

> "In terms of information infrastructure, the libraries that are playing a central role in the research assessment process – particularly Australia – are those which have been able to leverage the value of the institutional repository, which is typically managed and populated by librarians" [12].

He describes the role of librarians in each of the five countries surveyed. For Denmark, he observed,

> "There is a general sense that the traditional library business of books on shelves is being consigned to the past and that librarians see their libraries as having an institutional information infrastructure role within the universities" [13].

A companion report to the above, gave seven recommendations on how libraries can, "provide a researcher-centered view" [14]. Curating the institution's research output and providing expertise in bibliometrics for RAEs and other purposes are clearly directions in which libraries can move, to their benefit. This will increase their usefulness to researchers and the institution, and correspondingly align libraries with the mission and vision of the hosting institution.

University Rankings. Though many criticize these studies, they have taken on ever more importance in recent years. Parents use them to decide which school to choose for their child. Governments use them to distribute research & education funding, etc. Research metrics from Scopus, WoK, or both play a large part in these rankings. HKU is taking charge of its own reputation, and applying resources to ensure proper accounting of its research output.

ORCID. A new worldwide initiative was announced in December 2009, the Open Researcher & Contributor ID (ORCID) [15]. Members include Elsevier, Thomson Reuters, major publishers, and large universities. The ORCID will be based upon, or perhaps use, the ResearcherID, and will be operational in June 2010. Authors will use the ORCID when submitting articles to publishers. Publishers will record the ORCID in the metadata for each article, and pass to third parties such as Scopus and WoK. Therefore institutions, publishers, and database managers will finally have a way to disambiguate authors and assign unambiguous identity. At this time, HKU is the only institution in the world to have ResearcherIDs for all of its authors. In June 2010, we expect to announce to our HKU authors, that they must begin using the ResearcherID / ORCID to submit articles to publishers, record their publications in the HKU ROS, place in their CVs, etc. With each member already having a ResearcherID, we expect almost full, and immediate compliance. This will finally consign to history, problems of HKU author name ambiguity.

Publicaton List Export. Although only minimal publication lists are now available in The Hub, authors still could envision and suggest to us, a use very relevant for them. We will build a procedure for authors and their readers to select on publications, and export them in their desired format; RIS, Endnote, csv, etc. HKU scholars are presented with dozens of requests for publication lists during the year for various purposes; grant application, conference papers, postgraduate student supervision, etc. The present HKU Research & Scholarship pages do not allow this. In future work, publication lists in The Hub will be made complete with each scholar's full HKU record.

4. Discussion

Traditional IRs are item-centric, and done for the purpose of OA. Most suffer low population rates. The Hub has luckily enjoyed the attention of HKU's policy on Knowledge Exchange, which has meant a change in focus and alignment. The Hub has therefore grown beyond its initial scope as an institutional repository. Besides cumulating data around the item, it now also does the same around authors. It serves other purposes besides that of OA. Our primary goal is to create a system that will forge the necessary culture for KE within HKU and engage staff in delivering the desired outcomes of KE.

However, whether done for OA or for KE, the results are much the same in many cases [16]. Work done for either OA or KE, mutually contribute to each other.   Recent months have seen these developments in OA at HKU:

- The Vice-Chancellor of HKU signed the Berlin Declaration on Open Access in November 2009 [17].
- With funding again from HKU KEO, HKU Libraries came to agreement in March 2010 with Springer, to allow HKU faculty and students to publish using Springer's Open Choice [18] option for one year.   All such articles will be in open access, and posted to SpringerLink, The Hub, and relevant ones to PubMed Central.
- In February 2010, HKU Libraries created a mandate for its staff, to deposit authored items in The Hub [19].

E-Science.   "E-science" has been defined as, "shorthand for the set of tools and technologies required to support collaborative, networked science" [20].   Although this was not a consideration in our initial planning, The Hub has indeed become, serendipitously, such a tool.

The Hub is now a unique locus for HKU researchers to interact with the web, and for remote services to interact with HKU researcher data.   Initially the individual data was supplied from various HKU and remote data silos.   HKU researchers then edit, delete, or extend this data.   This data is then exposed to remote web services, which may also enhance this data, for greater value to the individual and his or her institution.   An example of a remote web service doing this, is the Bibliographic Knowledge Network People (BKNpeople) hosted by UC Berkeley, and funded by the (US) National Science Foundation (NSF) Cyber-enabled Discovery and Innovation (CDI) Program.   Still in an experimental stage, BKNpeople displays HKU data, with links to corresponding records held by other data suppliers, such as MatchSciNet and the Mathematics Genealogy Project [21].

Collective Intelligence.   In The Hub paradigm, the institution loads relevant data to create ResearcherPages, which RP owners can then edit and otherwise control for their own purposes. This symbiosis between machine and data, author and his or her institution, local authority and remote indexing, creates a "collective knowledge system".   Tom Gruber's well cited article on Collective Knowledge Systems, argues that these systems, "… unlock the 'collective intelligence' of the Social Web with knowledge representation and reasoning techniques of the Semantic Web" [20].   Other descriptors for this process are "synergy", and "bootstrapping".   Well known examples are of course, Wikipedia, Facebook, etc.   An interesting observation by Chris Dixon of Hunch, writes, "I think you could make a strong argument that the most important technologies developed over the last decade are a set of systems that are sometimes called, 'collective knowledge systems'"[23].

The last player in this symbiosis is Google, in which RPs are highly visible and discoverable. Searching on the interlinked documents of the planet, Google's page ranking, "provide[s] a very efficient system for surfacing the smartest thoughts on almost any topic from almost any person" [24].   Because of tagging done by machine loads, and manually by the RP owner, on any relevant Google search, RP pages are at, or near the top of the hit list.

Authority Control.   An example of this symbiosis is the authority control in The Hub.   The traditional paradigm has been a central or national library maintaining an authority file, to which remote libraries can add; for example, the US Library of Congress and its member NACO libraries. However, The Hub has added a third, and perhaps more important player; the author who is the subject of this authority work.   The Hub begins with a full name, an academic shortened name, and a Chinese name extracted from the HKU Registry's files.   Variants names are loaded from

Scopus.   Hub administrators can edit or add more.   Finally the owning author can also edit or add more.   Each of these parties has incentive to create and maintain an accurate record, with perhaps the author holding the most incentive.   Once this record of name, name variants, and publication list is created, it is valuable to many researchers and web services within HKU and beyond.

In this regard, a draft report by the Working Group on the Future of Bibliographic Control to the Library of Congress, which included librarians and representatives from Google and Microsoft stated,

> "The future of bibliographic control will be collaborative, decentralized, international in scope, and Web-based.   Its realization will occur in cooperation with the private sector, and with the active collaboration of library users.   Data will be gathered from multiple sources; change will happen quickly; and bibliographic control will be dynamic, not static" [25].

Indeed the authority control exhibited by The Hub on its limited data set of HKU authors, appears to be in the vanguard of what the Bibliographic Knowledge Network project calls a,

> "*bibliographic revolution*, whereby responsibility for bibliographic control (the organizing and cataloguing of metadata associated with publications) will shift from centralized agents, such as the Library of Congress, OCLC and large abstracting and indexing services, to an aggregation of many smaller [virtual organizations] which will contribute discipline-specific expertise on a collaborative basis" [26].

Linked Data.   Although we have seen many purposes in which The Hub can serve, there will be many more, as yet unintended.   In the concept of "linked data", data once identified can be re-purposed by many other players.   Data in The Hub now carries the imprimatur of HKU authority.   This data can be used in many future mash-ups, at HKU and beyond, whose purpose is as yet unknown.   Future Hub development will produce APIs or widgets for the purpose of extracting Hub data.

5.   Conclusion

The 2009 development to re-purpose The Hub into a vehicle for KE has produced favourable results, and more besides; 1) infrastructure that can be used for RAE, ORCID, etc., 2) a method for the Library to re-position itself with its institution, and 3) an e-science tool, or a collective knowledge system.   This latter is slowly beginning to be understood, and used to unlock collective intelligence within HKU, and beyond.   It presents a great challenge, and perhaps the area of most reward; how best to extract from the several sources (author included) and structure it in a way that invites interaction with all partners, for present purposes, and for those as yet unknown?

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