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Institutional Approaches to Curriculum Design Institutional Story

Project Information			
Project Title (and acronym)	Principles in Patterns (PiP)		
Start Date	01/09/2008	End Date	01/08/2012
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Partner Institutions	n/a		
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Project blog/Twitter ID	http://www.principlesinpatterns.ac.uk/blog.aspx		
Design Studio home page	http://jiscdesignstudio.pbworks.com/w/page/29227900/Principles%20in%20Patterns%20%28PiP%29%20project		
Programme Name	Institutional Approaches to Curriculum Design		
Programme Manager	Sarah Knight		



Institutional Approaches to Curriculum Design Institutional Story

1. Summary

The principal outputs of the PiP Project surround the Course and Class Approval (C-CAP) system. This web-based system built on Microsoft SharePoint addresses and resolves many of the issues identified by the project. Generally well received by both academic and support staff, the system provides personalised views, adaptive forms and contextualised support for all phases of the approval process. Although the system deliberately encapsulates and facilitates existing approval processes thus achieving buy-in, it is already achieving significant improvements over the previous processes, not only in reducing the administrative overheads but also in supporting curriculum design and academic quality. The system is now embedded across three faculties and is now considered by the University of Strathclyde to be a “core institutional service”.

Alongside the C-CAP system the PiP Project also cultivated a suite of approaches:

- an incremental systems development methodology,
- a structured and replicable evaluation approach, and
- Strathclyde's Lean Approach to Efficiencies in Education Kit (SLEEK) business process improvement methodology

Each is based on recognised formal techniques, providing the basis for a rigorous approach. This is contextualised within and adapted to the HE institutional context thus building the foundation not only for the project but ultimately for institution wide process improvement.

2. What are the headline achievements of your project?

The Principles in Patterns (PiP) Project began with a broad development and innovation brief with a more recent focus on exploring technology-supported approaches to curriculum design, approval and review. This has resulted in numerous outputs and achievements that can be categorised under the following headings:

- A. Development of a curriculum design and approval system: Class and Course Approval System (C-CAP)
- B. Successful resolution to baselining issues and process inefficiencies
- C. Renewed emphasis on academic quality and pedagogy
- D. Improved process transparency
- E. Institutional change approach
- F. Institutional embedding impact and success
- G. Adherence to structured methodologies and formal approaches

A. Curriculum design and approval system

At the inception of the PiP Project the curriculum design and approval process at the University of Strathclyde was largely undocumented and typified by difficulties in process and document management, low adherence to acknowledged best practice within curriculum design, inadequate alignment with institutional policies, and disparate institutional curriculum design practices [1]. The PiP Project focussed therefore on the development of a single online curriculum design and approval system (C-CAP), capable of managing and facilitating the curriculum approval process whilst simultaneously supporting academics in the process of curriculum design. Headline achievements are described below:

- Simplification of the curriculum drafting process
- Demonstrable improvements to process efficacy
- Improvements to process transparency, visibility and control
- Enhanced management of curriculum designs during the approval lifecycle
- Improved curriculum reviewing mechanisms and improved support for academic quality processes
- Creation of a central repository of curriculum designs (“design repository”) as the basis for their curation as “knowledge assets”, thus facilitating re-use, sharing of designs and exposure of tacit curriculum design practice.

B. Addressed baselining issues and process efficiencies

The [PiP baselining report](#) highlighted five general issues with management of the curriculum approval process at the University of Strathclyde [1]. These are described in more detail [below](#) but included various process bottlenecks that disrupted curriculum approval efficiency, poor feedback looping throughout the curriculum review and approval process, the absence of document versioning, the absence of any central repository of curriculum design information, and the complexity of curriculum design templates and their lack of any accompanying guidance. All five of the aforementioned process workflow and document management issues highlighted by the baselining exercise - and subsequent Pareto analysis [2], [3] - have either been entirely resolved or partially resolved by the introduction of C-CAP. Using structural metrics, demonstrable levels of process improvement have also been evidenced [2]. As examples of improved process efficiency, C-CAP has:

- implemented improved process communication mechanisms
- automated entirely or rendered interactive specific bureaucratic activities central to the curriculum approval process
- improved process visibility to all stakeholder groups
- implemented process parallelism where possible, and
- reduced the possibility of human transition delays within the approval process.

C. Renewed emphasis on academic quality and pedagogy

C-CAP has facilitated better adherence to pedagogical principles by promoting best practice in curriculum design [2]. Previous curriculum design practice at the institution was inconsistent and adherence to recognised curriculum design principles was unclear [4], [5]. C-CAP has replaced the faculty specific curriculum design templates and offers a system that better promotes good design

practice whilst capturing the information necessary to verify academic quality and facilitate monitoring. This has been achieved through system logic and improved template design. Context sensitive guidance is available to better support academics during the design process [2], particularly in those areas pertaining to assessment design and constructive alignment. The system has been developed to support the collaborative and often extended nature of the design process and writing teams are now able to collaborate on the design of curricula. Academic and faculty review of proposed curricula has also been rendered more collaborative, enabling the delivery of directed feedback pertaining to specific sections of curriculum proposals all within C-CAP. Common causes of approval delay (e.g. errors within curriculum proposal such as assessment components not summing to 100%, un-assessed learning objectives, etc.) have been addressed using system logic. Faculty and academic quality teams are now better placed to focus on substantive academic issues when considering curriculum proposals and process failure causes have been either eliminated or ameliorated [2], [3]. Indeed, C-CAP has reduced the design burden normally associated with the previous state and has simplified academic review; but it has also brought about a renewed focus on those aspects of curriculum design that are integral to good pedagogical practice and to high academic quality standards [3]. A reduction in superfluous bureaucracy has meant that C-CAP better focuses on the quality and specificity of essential curriculum approval information (i.e. that which is required by the University to facilitate approval) whilst simultaneously serving forms that are less likely to stifle academic innovation and that are neither “daunting” nor “onerous”.

D. Improved process transparency

Throughout the lifetime of the project a recurring issue has been the lack of process transparency surrounding curriculum design and approval. This has generally manifested itself in stakeholder confusion regarding the information and design requirements needed to facilitate curriculum approval and the process milestones involved, particularly those occurring after faculty level approval. Whilst a series of technical solutions have been implemented to improve process visibility to all stakeholder groups (e.g. status indicators, notification emails, etc.), C-CAP has, more generally, improved process understanding and transparency within the institution [6]. By virtue of being a single curriculum approval system, C-CAP encapsulates the agreed existing approval process at Strathclyde and has rendered transparent hitherto [tacit practices and processes](#) [7]. It has become a single point of engagement with curriculum approval and functions as the process mediator, making explicit to stakeholders the process milestones and has sparked wider institutional discussions and initiatives around the wider topic of business process improvement, i.e. the SLEEK project (see [section 7](#)).

E. Institutional change approach

Effecting large-scale change during the project has been problematic owing to institutional reorganisation and the all too common challenges associated with any significant institutional change; however, the project progressed by effecting incremental changes to institutional process and practice. Successful piloting of C-CAP has facilitated meaningful discussion with the Education Strategy Committee [8] and the Student Experience and Enhancement Services (SEES) Directorate [9]. This has provoked a commitment from these bodies to advocate the institutional embedding of C-CAP and – in conjunction with the Information Services Directorate (ISD) [10] - the development of a holistic approach to curriculum data management, facilitating further improvements to system interoperability and rendering C-CAP as a bona fide institutional curriculum data hub, feeding all dependent institutional systems and processes [11]. This activity will be accompanied by the creation of an appropriate educational and curriculum approval policy, to be spearheaded by SEES. This has arguably been the most significant achievement as these bodies are best placed to effect long term change and influence and ultimately embed institutional policy.

The above noted success in improving process efficiency and making explicit tacit processes has functioned as a catalyst for wider process change at the institution. The initial [PiP baselining exercise](#) [1] stimulated institutional discussion pertaining to business process improvement across the University of Strathclyde. The use of formal techniques to map - and render transparent - those processes surrounding curriculum approval, and their use as a basis for process improvement initiatives, has resulted in a dedicated institutional process improvement initiative: Strathclyde's Lean Approach to Efficiencies in Education Kit (SLEEK). SLEEK was commissioned in recognition that a number of key institutional processes could benefit from the application of a single, HE tailored continuous improvement methodology and that new holistic approaches to process improvement would better ensure the achievement of Strathclyde's core strategic objectives. SLEEK has therefore been

extending PiP work within the area of process change and has developed a Lean Six Sigma (LSS) based Business Process Improvement (BPI) methodology that deploys continuous improvement tools and methods to reduce inefficiencies and ineffectiveness in processes across all areas of the University's business [12]. Institutional change has already been evidenced with staff across professional services, academic departments and senior management working together on a number of process improvement projects, with a shared understanding of business processes and methodologies aiding in the identification of improvements and ensuring transparency and the continued review of all processes. At time of writing this activity has motivated the successful completion of 42 process improvement projects, which together are estimated to have achieved savings of circa £178,900 [13]. SLEEK trained staff are now fluent in the LSS methodology and are equipped to deploy its tools and techniques to solve future process failures and effect other process efficiencies. The SLEEK "ethos" is now also an explicit [operational aspect](#) [14] of the [University of Strathclyde Strategic Plan 2011-2015](#) [15] and significant staff resource has been allocated to continue its work.

F. Institutional embedding impact and success

In addition to the longer term institutional changes effected by PiP, a concerted and highly directed [embedding strategy](#) [16] has resulted in all four institutional faculties using the C-CAP system. Within three of these faculties C-CAP has become an embedded technology, in which C-CAP is the default curriculum design and approval tool and where its use is now essential. The fourth faculty entered the embedding phase later than the others and is therefore currently in the middle of a transitional change period, in which a hybrid curriculum design and approval scenario exists; it is nevertheless anticipated that this faculty will join the others later in 2013.

Considerable growth in curriculum design and approval activity has been evident on C-CAP as the embedding strategy has been implemented [11]. At time of writing the following curriculum activity can be reported:

- 256 classes* have been designed, proposed and reviewed using C-CAP. Of these, 44% have been officially approved, are now populating the C-CAP "design repository", and are active on corporate systems. The remaining percentage are currently concluding their journey through the C-CAP approval process and are likely to be active on corporate systems by the end of May 2013.
- 16 courses have been designed, proposed and reviewed using C-CAP, and spanning a variety of degree types, exist awards and modes of study. Of these, 6 have been officially approved, are active and, in some cases, are recruiting students or are being delivered to students at time of writing.
- 133 members of staff across all four faculties have so far received training on the C-CAP system, via induction sessions and/or targeted one-to-one training. This figure does not include similar training provided for core stakeholder groups, such as those within the SEES such as Student Lifecycle (Registry) or Ordinance & Regulations, or within the Strategy and Policy Directorate [17].

It is worth noting that the above achievements of the PiP C-CAP embedding phase have exceeded the expectations set out in the [C-CAP embedding strategy and plan](#) [16].

G. Adherence to structured methodologies and formal approaches

A significant achievement for the project - and a potential area of inspiration for other institutions - has been the Project's continued success in using a suite of formal techniques in all aspects of project activity. This has included:

- Agile and incremental systems design methodologies in the development of C-CAP;
- Lean Six Sigma techniques, such as DMAIC, 7 wastes, cause and effect analysis, value stream mapping and SIPOC;
- Formal approaches to process modelling (e.g. Business Process Modelling Notation (BPMN), ISO5807:1985, etc.) and process analysis

* The University of Strathclyde deviates from common curriculum design parlance by referring to "modules" and "programmes" as "classes" and "courses" respectively.



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- Structural evaluative approaches including heuristic evaluation, protocol analysis, stimulated recall, System Usability Scale (SUS), qualitative benchmarking, Pareto analysis, structural metrics and Most Significant Change (MSC) methodology.

3. What were the key drivers for undertaking the project?

The PiP Project ran during a period of widespread organisational renewal at the University of Strathclyde. The ideals and aspirations underpinning this change were developed and elucidated at the same time the PiP Project was launched and were ultimately captured in the [University of Strathclyde Strategic Plan 2011-15](#) [15]. The Strategic Plan covers all aspects of University life and activity, however several aspects of the Plan are particularly resonant with the work of the PiP Project and in turn shaped the evolution of the Project. This alignment also shaped the Project's interaction with internal stakeholders.

The following elements of the Strategic Plan encapsulate the wider institutional identity and aspirations that shaped the PiP Project:

Our Identity and Future:

- “We continually question our approach so that we are efficient and effective.” (3rd of 3)

Our Values:

- “Working together effectively across traditionally perceived divides, such as academic and professional services; staff and students; teaching and research.” (2nd of 7)
- “Working collaboratively to find the simplest and most effective ways of going about our business, avoiding duplication of effort, sharing good practice and pursuing continual improvement.” (3rd of 7)

Key features of the Strategic Plan:

- “An innovative, stimulating and challenging educational experience.” (5th of 11)
- “Commitment to clear communications, including within the institution” (9th of 11)
- “A flexible, adaptive and responsive organisation.” (10th of 11)

In addition to the attributes enshrined in the Strategic Plan there are broad organisational principles that shape all Strathclyde's activities. This ethos is captured in vision of *One Strathclyde* however within the domain of curriculum approval these can be characterised as four broad guiding principles:

- The devolution of responsibility and decision making is recognised as a core strength of the University of Strathclyde
- Responsibility should sit with those most directly engaged with the activity, i.e. faculties and departments are responsible for the shape and quality of their curricula
- Within this environment of devolved responsibility, the University strives to reduce bandwidth in all its activities, including variation in outcomes, in time and effort, standards, quality, etc.

The themes and perceptions that drove the initiation of the Project

Within the context of the organisational principles, the drivers behind the PiP Project were most clearly exposed and elucidated through the curriculum approval baselining exercise [1]. Baselining offered key stakeholders in the curriculum approval process an opportunity to discuss areas where they felt the existing practice and processes were not working as well as they could. The exercise attempted to cover the full approval lifecycle through department, faculty and University Senate and exposed numerous process, workflow and document management issues that were found to impede the efficiency of the approval process and its overall management. Whilst the project authors and other stakeholders had been aware of some of the issues, the baselining provided an evidence base from which to identify broadly experienced concerns and upon which to direct practical solutions. They also represented a milestone in the Project evolution and a point at which PiP moved from using philosophical perceptions of the issues to one rooted in evidence. The issues raised in the baselining were wide ranging, but can be categorised as follows:

1. *Process bottlenecks:* Process bottlenecks were frequently created as a result of the scheduling of committee meetings, particularly those of Senate and Ordinances and Regulations, such that approval decisions were being delivered too late for classes and courses to be available to prospective students. Faculties were therefore relying on informal arrangements to direct students to local information sources rather than centrally maintained curriculum information. This bottleneck also resulted in difficulties for a variety of primary stakeholders situated at the end of the approval process (e.g. Library, Timetabling, Estates Management, Disability Services, etc.), each of which struggled to discharge their function in

2. *Feedback looping*: Poor feedback looping was disrupting the process. The absence of the tracking of changes requested and/or amendments that were applied to proposals as they progressed through the approval process often resulted in defective proposals returning repeatedly for approval, or the approval of proposals and curricula that deviated significantly from the initial proposal. Unsatisfactory feedback mechanisms also meant that such changes were not always communicated to the department delivering the curricula and – in some circumstances - were not even communicated to the academic staff scheduled to be delivering the teaching.
3. *Version control*: Poor document versioning and tracking was identified as a significant issue. The disparate MS Word templates used by faculties were largely responsible for this, a situation exacerbated by their progression through the approval process via email and on paper. Divergent faculty practice meant that many collected additional information beyond that which is required by central administration. The lack of version control – and the consequent lack of unique identifiers - ultimately meant that considerable effort had to be expended, for example, by administrative staff in order to reconcile versions of proposed classes or courses, significant aspects of which may have changed during the approval process (e.g. change in class or course title, format of study, etc.). The absence of version control was also found to be a particular issue (and coalesced with poor feedback looping) when proposals were resubmitted in response to the conditions set by a committee. It was difficult for committee secretaries and committee members to keep track of feedback or conditions that accompanied previous rejection.
4. *Lack of central repository of curriculum information*: The absence of any central repository (or “single source of truth”) of approved curriculum proposals and descriptors meant that there was no definitive source of approved curriculum information. Not only was this an issue when amended proposals were re-introduced to the approval process, it also meant that reviewers had difficulty in understanding how a class contributed to the overall course (programme). The lack of a central repository of approved descriptors was also an issue when classes and courses were subject to periodic review.
5. *Size of forms and lack of guidance*: The existing curriculum proposal forms were found to be “daunting and onerous” to complete and were reported as an obstacle to pedagogical improvement [1]. Those staff designing modules also reported the lack of guidance accompanying the forms as an additional problem contributing to bottlenecks. For example, policy and best practice guidance was scattered across numerous sources and typically concentrated on the bureaucratic and administrative requirements, without sufficient attention to how University policy should be embedded within curriculum designs, or how specific aspects of the forms should be completed (e.g. to better meet committee expectations). The reverse of this latter issue was highlighted by approval committee members, some of whom encountered forms that were inappropriately or insufficiently completed.

As a counter point to the issues elucidated by the baselining exercise and in line with the organisational principles, it was also clear that core aspects of the curriculum design and approval process were not areas of institutional concern nor were they specific targets for change. In particular, ownership of and responsibility for curriculum design, academic quality and approval decision making remained firmly and unequivocally with the individual academics, departments and faculties, with faculty-based academic quality units playing a central gatekeeper role. This understanding of the fundamental structure and sequence of the approval process was also endorsed by stakeholders, including various central services with responsibility for communicating course and class information to the wider community.

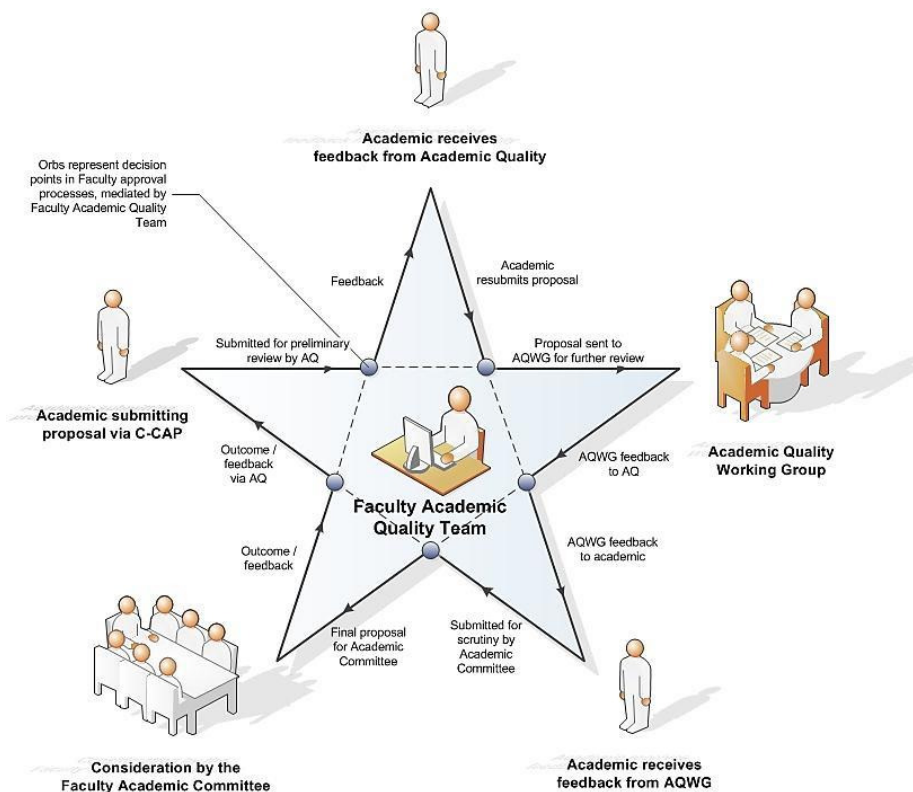


Figure 1: Star-shaped interpretation of faculty level approval processes (for course approval), with the academic quality team at the centre of administrating and managing the curriculum approval process via C-CAP.

Drivers for the Project

Within the context of the institutional strategy and in response to the issues crystallised through the baselining exercise the PiP Project was driven by a set of principles that remained consistent through the life of the project. While they were not formally expressed during the project per se, the ideas can be found in reports and outputs from the earliest stages.

Underpinning the Project’s response to the drivers were two related ideas:

- An intuition that the point at which academics engage with the approval documentation is a “teachable moment” because the requirements of the approval process and supporting documentation play a significant role in shaping the design process.
- As this is a “teachable moment” the documentation becomes an appropriate vehicle for reinforcing pedagogical principles and university policies to course and class design teams

At a more practical level the PiP Project worked to a consistent set of requirements. In the later stages of the project these have been more easily elucidated as principles and it is clear, on reflection, that these principles have in fact driven the requirements of the project from the start. Requirements focussed on:

- The outputs developed must make it easier for all stakeholders to comply with the University’s procedures and policies; both through facilitating an approach that is an evident improvement on the previous process and by ensuring compliance with the new approach is more amenable to staff
- Any technical solution developed must be comprehensive in that it must accommodate the needs of all the stakeholders and obviate the need to develop additional local systems to manage data not captured in the central systems
- Any solution must be flexible enough to support changes in the physical forms and the process workflow while those forms are in use, e.g. questions can be added/removed without needing to wait for the next academic cycle
- Any solution must reduce/eliminate the need to enter the same data at several stages of the process and/or in different places



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- Any solution must have the potential to integrate with existing corporate systems, but cannot depend on establishing this integration before it can be implemented

As the main output of the PiP Project, C-CAP (Class and Course Approval system) moves towards the institutional embedding of these drivers and its principles continue to inform development. Indeed the system and process has already been recognised as the enabler for a revised course and class approval policy which will in turn underpin the forthcoming University of Strathclyde Educational Strategy Action Plan.

4. What was the educational/organisational context in which you undertook your project?

Course and Class Approval Stakeholders

Course and class approval is a highly devolved process involving many organisational units within the University, but without a clear process owner. Throughout the project we have explored and elucidated the latter issue, however it is something that will be addressed through a wider programme of institutional change beyond the scope of this project. Throughout the project contact was maintained with the representatives of the various stakeholder groups even as the University underwent significant reorganisation.

Current role and issues faced	Involvement in project	Project Gains ¹
Academic staff (course/class designers)		
Process Step <ul style="list-style-type: none"> Complete word templates & email to Faculty Admin staff Issues Forms are; <ul style="list-style-type: none"> Onerous to complete Information is duplicated across several forms Guidance materials are difficult to access and quality could be improved No structured feedback and resubmission process Progress of a proposals is not tracked 	<ul style="list-style-type: none"> Represented in focus groups and Steering Group Part of evaluation team(s) for new technical systems and/or information resources 	<i>Improved Approval forms that;</i> <ul style="list-style-type: none"> Are easier to fill in & facilitate single source data entry Allow for higher "first-time" approval rates & reduce requests for more information Provide better review/feedback /revision workflows & track proposal progress Provide easier-to-access information on curriculum relevant to students Provide better information on designing curriculum in line with principles of good design/ pedagogy and give greater opportunity for delivery of desire university portfolio.
Faculty Officers and Faculty Admin Staff		
Process Step <ul style="list-style-type: none"> Manage procedural aspects of approval, orchestrate the information flow and the communication between faculty and corporate committee(s) Issues <ul style="list-style-type: none"> Currently an onerous role in process, with the same information being repeatedly rekeyed -even at the same stage in the workflow Significant effort spent correcting mistakes/ omissions in various forms in the process Time Consumed by manual reconciliation of proposals put forward for corporate level approval and minutes for Senate Sometimes academics directly contact corporate units e.g. Registry, by-passing these staff and causing confusion/ further duplication of effort 	<ul style="list-style-type: none"> Central to the baselining phase, articulating the current processes and identifying areas of improvement Pivotal role as involved in all areas of the process and dissemination of information about the PiP Project to faculties Pivotal to the management of the planned piloting of the improved approach and to securing buy-in across the board. 	<i>Satisfy university/QAA Scotland mandate to standardise information through:</i> <ul style="list-style-type: none"> Improving "first-time" collection of module/programme data Reducing number of modules/programmes rejected at committee Providing better quality and more accessible information for reporting Supporting dissemination around educational strategy

Current role and issues faced	Involvement in project	Project Gains
Faculty Committees.(Academic Quality, Resource Allocation, etc.)		

¹ Some project gains have not yet been fully verified through the piloting, i.e. they rely on widespread adoption before being realised. Where gains have been identified and have successfully passed a proof of concept phase but not tested, they are indicated in italics.

Current role and issues faced	Involvement in project	Project Gains
<p>Process Step</p> <ul style="list-style-type: none"> Play a key role in scrutinising/ approving proposals & providing feedback on proposals requiring redrafting <p>Issues</p> <ul style="list-style-type: none"> Broken feedback loop Forms not collecting all relevant information for judgement against approval criteria Paperwork prepared for committees is unwieldy Approval criteria difficult to identify/ communicate to designers 	<ul style="list-style-type: none"> The faculty committees were represented by the Faculty Managers and in the Steering Group 	<ul style="list-style-type: none"> Business Case information a new mandatory first approval stage Online system gives easy access to proposal with targeted summary views for highlighting key information Tracking / version control ensures creates history Feedback embedded so committees can easily verify satisfaction of requirements Redesigning forms prompts designers to present more information in a structured manner with the quality of the design therefore better assessed
Registry (now Student Lifecycle) and Ordinances & Regulations Committee		
<p>Process Step</p> <ul style="list-style-type: none"> Student record system data entry & scrutiny of proposals, in line with structural/ organisational standards, e.g. assessment regulations, credit hours, credit level, etc. <p>Issues</p> <ul style="list-style-type: none"> Frequently forms submitted with errors/too late/not at preventing timely student registration Data entry requests for student records system often received before course/class has even been approved No communication mechanism to feedback to faculties and departments 	<ul style="list-style-type: none"> Staff from Registry and Ordinances & Regulations participated in the focus groups These staff played a key role in elucidating the baseline processes They have also been involved in the piloting processing proposal that have been submitted using C-CAP 	<ul style="list-style-type: none"> Better information about courses/classes for inclusion in student records system Guarantee that data has passed through all necessary stages before being presented Automated confirmation to course/class designers when requests processed Ability to monitor proposals in process to plan work load and identify issues <i>The data entry process could be automated to eliminate re-keying</i>
Strategic Committees, (Quality Monitoring, Educational Strategy)		
<p>Process Step</p> <ul style="list-style-type: none"> Strategic responsibility for agreeing policy and ensuring implementation Responsibility for quality standards <p>Issues</p> <ul style="list-style-type: none"> Concern that policies e.g. Assessment Policy were not impacting on delivery as hoped Difficulty collecting data on practice across all aspects of curriculum development Addressing the various quality reporting requirements e.g. ELIR [18]² is onerous 	<ul style="list-style-type: none"> Members of the committees were included in focus groups and the Steering Group 	<ul style="list-style-type: none"> Re-designed course procedures provide a better match between institutional strategic priorities and curriculum activities C-CAP process provides better information on the extent to which course and class designs embody the relevant policies Data captured is more accessible <i>C-CAP database is amenable to generating reporting required for internal/ external review</i>
Business Systems (Corporate Information Services)		
<p>Process Step</p> <ul style="list-style-type: none"> Manage corporate information systems including the <i>home-grown</i> student records & finance systems <p>Issues</p> <ul style="list-style-type: none"> Pressure to deliver enhanced information to support approval processes within a significant programme of other developments 	<ul style="list-style-type: none"> Participated in focus groups identifying issues in current processes Technical working groups identified opportunities for harmonising data collected by C-CAP with corporate data 	<ul style="list-style-type: none"> Better information about courses/classes for inclusion in student records system Guarantee that data has passed through all necessary stages <i>An enhanced data source that can be used for data mining</i> <i>The opportunity to automate the data entry process</i>
Current role and issues faced	Involvement in project	Project Gains

² Strathclyde was reviewed during the PiP Project and its projected outputs were highlighted as a solution to a range of deficiencies identified by the review team.

Current role and issues faced	Involvement in project	Project Gains
Curriculum Related Units & Committees i.e. Estates/Timetabling, Library, Disability Service, Marketing, Finance		
<p>Process Step</p> <ul style="list-style-type: none"> All use information about course/class portfolio to plan delivery of supporting services e.g. books, class rooms, publicity, registration <p>Issues</p> <ul style="list-style-type: none"> Concern that new curricula are approved for delivery without informing supporting services in a timely fashion Identification of important requirements can be missed, e.g. need for specialist facilities or reasonable adjustments 	<ul style="list-style-type: none"> Involved in focus groups & informed of piloting and invited to view proposals 	<ul style="list-style-type: none"> Transparency in approval allows stakeholders to view proposals at the earliest opportunity Specific information relevant to Library, Timetabling, Disability Service, Finance and Marketing is identified in forms <i>Opportunity to create dedicated summary views that represent the interests of these stakeholders</i>
Senate		
<p>Process Step</p> <ul style="list-style-type: none"> Approve curricula – courses mainly Responsibility of oversight over the portfolio <p>Issues</p> <ul style="list-style-type: none"> Information provided in summary form with no access to the detailed proposals limiting the opportunity for scrutiny Some courses advertised and recruited, or received external validation before being put before Senate 	<ul style="list-style-type: none"> Senate's interests were represented by the Senate Committee Manager 	<ul style="list-style-type: none"> Better information to inform decision-making Streamlined process with a guarantee that proposals had proceeded through all appropriate stages
Students		
<ul style="list-style-type: none"> Currently experience the courses and classes that are approved and delivered 	<ul style="list-style-type: none"> The student perspective has been represented by staff 	<ul style="list-style-type: none"> Better course designs/information & a more attractive curriculum for all
External Agencies (QAA, SFC, HEIs)		
<ul style="list-style-type: none"> Interested in the outputs of the programmes for lessons learnt and indirectly benefit from better quality curriculum information from Strathclyde e.g. HESA returns 	<ul style="list-style-type: none"> Opinion and discussion with the range of HEI's involved with the JISC programme has informed approaches throughout 	<ul style="list-style-type: none"> Curriculum approval system that is responsive to wider sector guidelines e.g. improved forms that include lists that are interoperable with QA and KIS
JISC Programme		
<ul style="list-style-type: none"> Recipients of outputs /lessons learnt for dissemination/ & funding decisions 	<ul style="list-style-type: none"> Programme Management and Critical friend support 	<ul style="list-style-type: none"> Ensured alignment of project with wider programme/sector aims and objectives

5. What was the technology context?

Development technologies

The technical development requirements were designed to address the issues previously outlined, respond to the drivers that underpin the PiP Project, and instantiate the workflow described in Fig 1.

Architecture

The architecture of the technical solution was for a standalone, self-contained course and class approval system with a loose coupling to other corporate systems thereby allowing broad stakeholder access to the contents of the system [Fig 2].

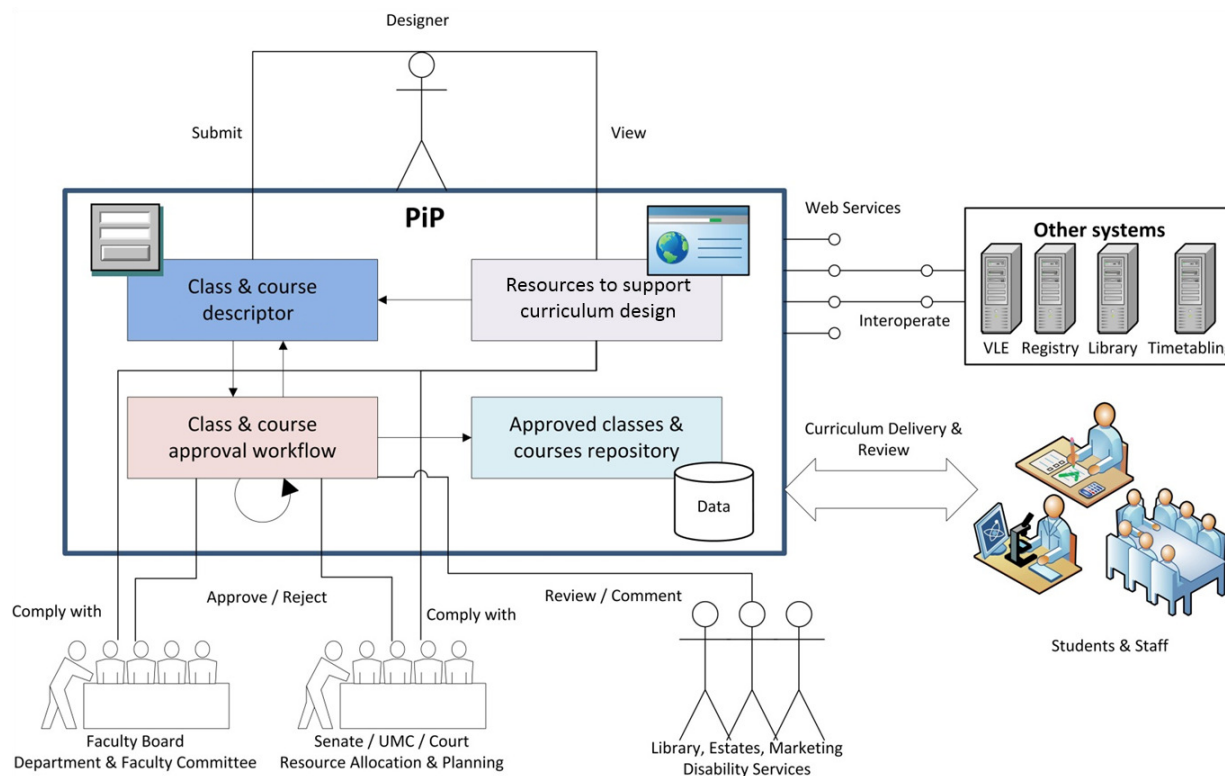


Figure 2: C-CAP Architecture

This approach was adopted for several reasons. In terms of the systems themselves:

- Fundamentally, corporate systems are typically designed for data entry by a small group of specialist staff rather than the widespread participatory engagement required by the C-CAP system
- Corporate systems are also designed as the “source of truth” whereas the course and class approval process is essentially one of draft-feedback-redraft-approval with a final version only emerging at the end of the process
- The data structures in place within Student Records, Finance, etc. represent only a subset of the information used by faculty quality committees to make approval judgements; primarily because this sort of data is not relevant to the other functions

There were also pragmatic considerations that made a self-contained solution the most viable: the current corporate systems, including the Student Records application, were the subject of long standing and extensive development programmes that could not easily accommodate the PiP development and various options were available for integrating a self-contained system with corporate systems.

Microsoft SharePoint as a development platform

The PiP Course and Class Approval system is built on Microsoft SharePoint which was identified at the start of the project as an appropriate platform to deliver the development aspirations as it was being rolled out across the University during the lifetime of the PiP project as a resource accessible to all staff, but with a particular emphasis on supporting administrative and business processes. SharePoint offers a highly flexible platform from which to offer browser-based services through a website interface that can be adapted to offer a rich range of resources and interactivity. As the funded project phase comes

to an end, most of the support staff using the C-CAP system are already regular users of various services delivered through SharePoint, while academic staff are also exposed to the platform through several different applications such as committee management, research and knowledge exchange information, and even booking attendance at graduation events.

SharePoint offers many different development routes. Throughout the life of the project PiP developers explored a range of techniques to deliver the C-CAP system. The [PiP Technical Development Report](#) [19] outlines the strengths and challenges of the approaches; however the main trade-off identified was the ability to customise the user interface and the underlying data structures against the technical skills required by the developer to build and maintain the system. SharePoint native features were clearly inadequate to the complex data collection, validation, review and version control that were envisaged. A custom .NET application, benefiting from the SharePoint interface, authentication and workflow features that offered the most comprehensive toolkit with which to develop a course and class approval system and initial prototypes were very promising [20].³ The Achilles heel of the approach was its requirement for specialist programming expertise to create and maintain; something which the loss of the project programmer brought into sharp relief.

With the loss of dedicated programming expertise the project re-evaluated and the new InfoPath-based approach adopted. Since the initial evaluation other institutional projects delivered by PiP's host department had utilised InfoPath and the team's understanding of the capabilities of the technology had grown considerably. Furthermore, InfoPath requires skills typical of a "power user" that can be taught over a couple of days, rather than specialist programming expertise. InfoPath was therefore ultimately chosen to deliver the system. The flexibility of this technical approach and its alignment with the incremental development lifecycle has been [disseminated in the literature](#) [21] and has [inspired a similar approach at the University of Ulster](#) (see [Section 9](#)).

The resulting InfoPath-based [C-CAP \(Course and Class Approval\) System](#) [22] is the principal technical deliverable of the Project.

Business process analysis and improvement

A second strand of the technical work of the project was the application of formal techniques for process analysis and improvement. Formal modelling techniques such as process mapping, value-stream mapping and Business Process Modelling Notation (BPMN) and ISO5807:1985 were used to model and communicate existing processes. Models (or "mappings") were used to assist in identifying "gaps and blockages" in approval processes and impediments to information sharing. Although techniques such as BPMN and ISO5807:1985 provide a useful schematic of process flows and aid understanding, they do not in themselves provide solutions to the issues they highlight, nor do they assist in identifying or prioritising which issues should be resolved and in which order.⁴ An additional issue is the danger of creating a barrier between the Project and its stakeholders, many of whom are unfamiliar with the visual language of process modelling techniques and have difficulty relating to their underlying purpose.

Process improvement within PiP therefore adopted a toolkit of analytical tools including business process improvement methods (e.g. Pareto analyses), LSS (e.g. SIPOC, 7 Wastes) to better identify, prioritise and solve issues. Such was the success of these formal approaches, they have been refined and reconceptualised within an HE context using a LSS methodology, [SLEEK](#) [12]. SLEEK provides a methodological approach to process analysis and improvement, and one which University staff can better understand and use to solve a wide variety of process based issues.

³ The approach used to build the .NET application within SharePoint is described and illustrated in the [Technical Development Report](#). A video presenting an early proof of concept using the custom .Net application is available on the [Principles in Patterns channel](#).

⁴ An example of an early workflow model using BPMN is available: [PiP Module Approval Workflow v0.1](#)

6. How did you approach the project?

PiP has passed through four main phases, each with varying approaches and strategies for engagement, though these phases often ran in parallel and involved the same stakeholder groups. The colour-coded diagram summarises these phases including the final Evaluation and Dissemination phase, which continued to run until the end of the extended project period (April 2013).⁵ Activities within the phases are grouped by colour with more detail below;

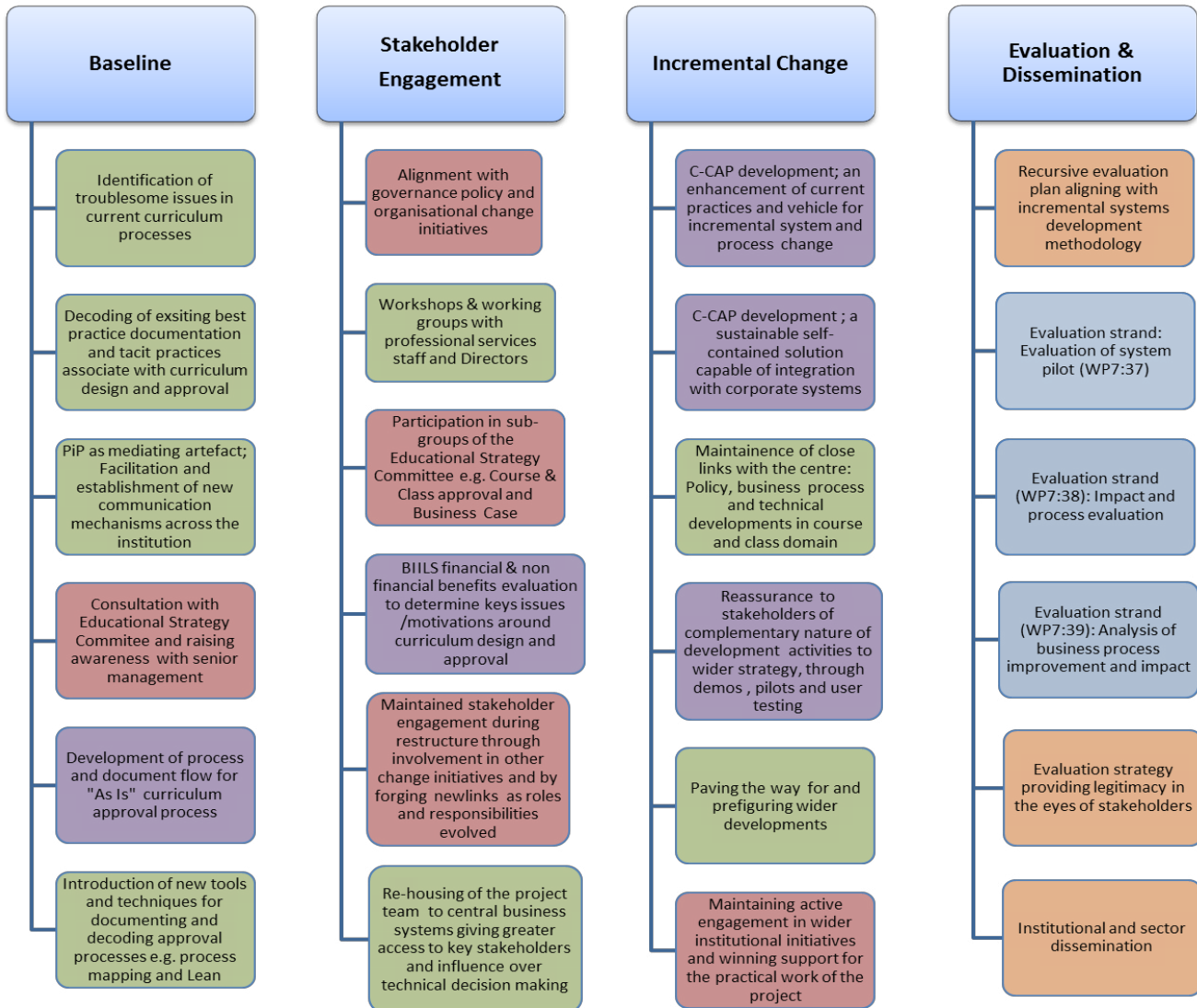
Green “What we did”

Purple “What we delivered”

Orange “Strategic goals”

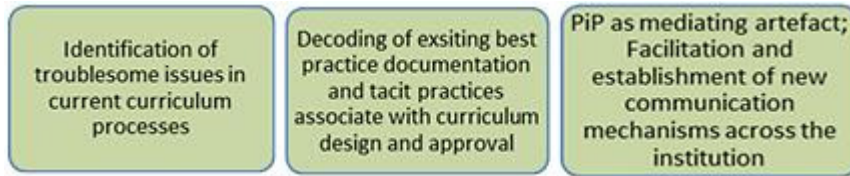
Red “Who we worked with”

Blue “Evaluative Strands”



⁵ This diagram also forms the basis of a visual representation of the Project being developed for dissemination both internally and externally and for the “launch” of the C-CAP system to mark the completion of the PiP Project phase and the embedding of the new course and class approval process and system.

“What we did”



An iterative interview and reflection approach was used to review current approval documentation. This involved discussions with the then Governance, Management and Policy Team (GMAP) with particular responsibility for the approval process, Faculty Officers, Academics engaged in developing programme and module proposals, LASS Faculty course designers,⁶ Professional Services directors, Senior Staff and Vice Deans. PiP team members also met with staff in the core support areas of Registry, Estates, Library, Information Services and the Disability Service to discuss their involvement in the approval process.

The curriculum design and approval process at Strathclyde is characterised by both distinctive faculty-led approaches that feed into institutional activities and by the design of key learning tasks, classes and courses embedded in disciplinary contexts and individual ways of thinking and working. Pedagogical foundations behind learning designs within curriculum are traditionally tacit. This notion is explored by Meyer and Land [23]. Capturing these tacit practices was a significant challenge for PiP and the baseline activity revealed that the processes around curriculum were opaque and varied greatly across faculties and departments, and that very little measurable data was currently being analysed. The following activities aided this process:

- An investigation into how the current and future curriculum design processes might be best represented to all stakeholders within the institution.
- Gathering together of existing best practice to encourage sharing of designs.
- Facilitation of focus groups around good design and best practice to spark more formal mechanisms for capturing knowledge and less reliance on tacit practices and tacit knowledge.

The baseline phase on reflection provided more of an indication of the extent of the “unknown” rather than the known and as such did not provide a traditional benchmark position from which to operate, rather recognition of the need to decode practice and make processes transparent. Without this transparency genuine improvements could not begin to be realised.



The process baselining exercise was carried out to explore approval processes in relation to classes and courses. As part of the research phases, diagrams were prepared using a simple flowchart style that were simple to produce and easy for users to understand. The

diagrams were then refined in consultation with key stakeholder groups. Workshops with Professional Services and Support Staff were, set up by the University’s Educational Strategy Committee, GMAP and PiP and were the first step towards building a learning community that would prove crucial to ensuring stakeholder buy-in. The purpose of the workshops were to inform a group of invited stakeholders from across professional services, about the intended review of course and class approval; to canvass opinion about how best to ensure a coherent, joined up approach to the approval review process; and to inform the group about the PiP Project and the proposed technical solution. The attendees were split into two deliberate “course” and “class” groups and asked to discuss the essential features of a course and a class and the necessary business processes related to these. Participants were then asked to identify streamlining opportunities and ways in which current processes could be improved. The group were also asked to suggest possible communication activities going forward and identify opportunities to share knowledge and thinking about curriculum design and approval. The next workshop with directors of Professional Services was pitched at relevant senior officers and professional services directors to demonstrate the considerable potential of the PiP Project and the relevance of its outputs to the Corporate Strategy, Learning and Teaching Strategy, IT Strategy and issues around Enhancement of the Student Experience.

⁶ During the life of the PiP Project the Faculty of Liberal Arts and Social Sciences (LASS) was merged with the Faculty of Education to form the Faculty of Humanities and Social Sciences (HaSS).

Re-housing of the project team to central business systems giving greater access to key stakeholders and influence over technical decision making

In the baselining phase the Project staff were based within an externally funded and focussed unit: Innovation Services & Projects. This held challenges for any development work that relied upon collaboration with central systems; therefore rather than focusing on integration with corporate systems, the technical development concentrated on developing a sustainable self-contained solution that could be integrated with corporate systems at a later date. After the re-structure the remaining Project staff

moved to the central Business Systems unit, arguably putting them in a better position to ensure development work was aligned with central systems and to influence decision-making around the technologies being used in the project and indeed the opportunities for sustainability of any new system being developed beyond the life of the project.

Paving the way for and prefiguring wider developments

Maintenance of close links with the centre: Policy, business process and technical developments in course and class domain

During the second phase of the Project the team and GMAP worked in collaboration to review curriculum approval policy and processes and to investigate the benefits of a technical solution over the then paper based approach. GMAP had been charged with

conducting an institutional review of curriculum approval and the PiP work provided timely support and resources towards that effort. As with any organisational change this review of curriculum approval necessitated the provision of activities to facilitate better communication with stakeholders across the institution. Decisions made by course and class designers have a knock on effect on the decision making and workflow of the entire institution therefore a new approach was required to capture not only the role of academic staff in curriculum design but also the role of university management, professional services and other related staff in facilitating the translation, approval and efficient delivery of those designs. It was decided that a SharePoint space would be set up to allow the sharing of documents and resources and an initial communication workshop was carried out by GMAP and PiP members in order to establish the most appropriate mechanisms for reporting back to the University's Educational Strategy Committee. This initial communication workshop established the roots of a shared learning environment and recognised the need to involve management stakeholders through the Educational Strategy Committee and GMAP in getting this new forum for discussing course and class approval embedded in the institution. Finding a common ground between pedagogy and practical process meant a success for the Project.

In order to better understand curriculum design, approval and delivery it is now widely recognised that transparency of process is key. PiP paved the way for the SLEEK initiative at Strathclyde [12], [13]. The related course approval SLEEK project, will further refine the new C-CAP approach to course approval, particularly within the Humanities and Social Sciences (HaSS) faculty and map the new process workflow and timeline associated with this. This in time will provide a new baseline from which to implement further incremental improvements to course and class approval processes and the C-CAP system. The SLEEK methodology advocates improvement through the application of LSS tools tailored for higher education and C-CAP and its related improvements will provide an excellent test bed from which to explore wider issues around the provision of curriculum at Strathclyde. The wider SLEEK initiative also provides a new operational and strategic context for the outputs of the project, a context that focuses on continuous improvement and efficiency and effectiveness across all areas of University business processes –with processes around curriculum at the heart of that journey.

“Who we worked with”

Consultation with Educational Strategy Committee and raising awareness with senior management

Alignment with Governance Policy and Organisational Change Initiatives

Participation in Sub-Groups of the Educational Strategy Committee e.g. Course & Class approval and Business Case

Maintained Stakeholder Engagement during restructure through involvement in other change initiatives and by forging newlinks as roles and responsibilities evolved

Maintaining active engagement in wider institutional initiatives and winning support for the practical work of the project

In the wake of the restructure PiP focused on a project management strategy of “incremental change while maintaining links with the centre.” Rather than depending on large scale policy and process change driven by process owners, PiP concentrated on developing C-CAP as an enhanced version of current practice.

The project team were very conscious that such an approach runs the risk of becoming insular and isolated. Therefore, during this phase close links were maintained with the wider policy, business process and technical developments in the course and class approval domain.

During the most intense period of reorganisation (2010-2011) the PiP Project worked to maintain contact with the main stakeholders even as:

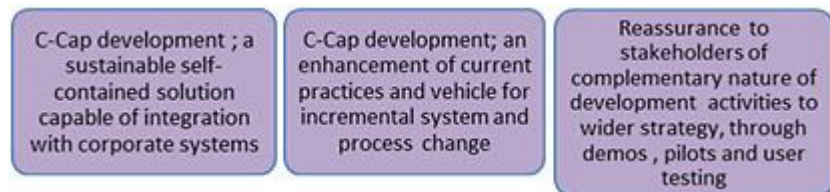
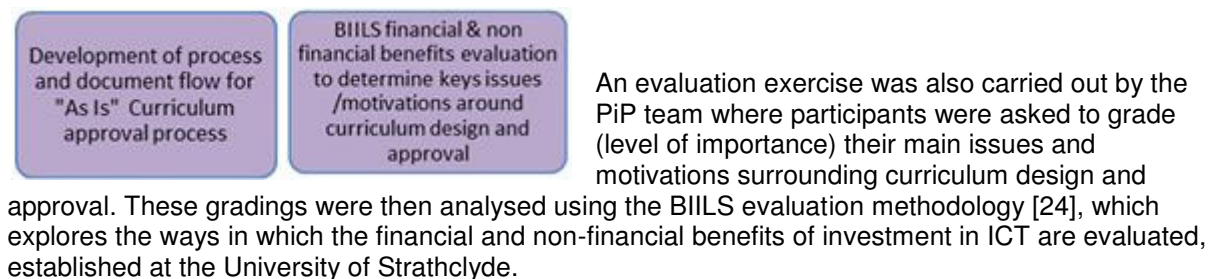
- GMAP was disbanded
- Strategic committees were reorganised with new remits and all process renewal initiatives were suspended
- Two faculties were merged and new faculty staff were appointed
- The PiP Project Manager and three directors left the project and were replaced
- The units where the PiP Project had been based were reorganised/disbanded

However, this was a period in which the desire to remain closely linked with organisational-level change meant that PiP could make little progress as there was a hiatus in developments at the course and class approval level while wider organisational issues were addressed.

Efforts were made to reassure stakeholders that PiP developments were complementary to these wider developments. Indeed, thanks to the high regard in which the Project was held PiP developments were generally seen as paving the way for and prefiguring wider developments.

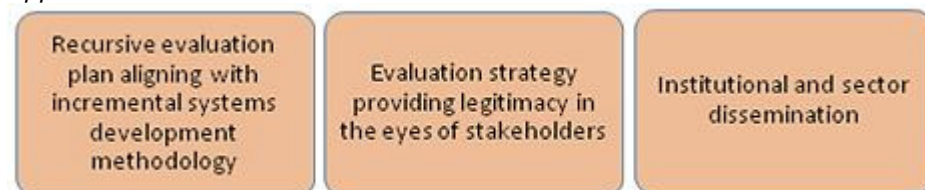
This balanced approach allowed PiP to avoid being hamstrung by delays in wider organisational change initiatives while avoiding becoming isolated from these changes. It has only been possible to maintain this balance by maintaining active engagement in wider institutional initiatives and winning support for the practical work of PiP, but it is a balance we would strive to achieve in future projects.

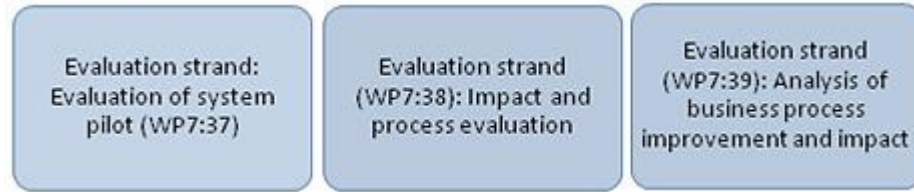
“What we delivered”



The [C-CAP system is described in other sections of the report](#); however in the context of working with stakeholders across the institution it is important to note that the developments were continually communicated with stakeholder groups through various activities and artefacts, providing a tangible expression of the technical development at the earliest stage possible. Even though these initial mock-ups were technically quite different from the final system, the outward experience remained quite similar and provided a largely consistent image of the development [20], [22]. As part of these engagements the PiP team continued to reassure stakeholders that the development remained consistent with the principles and issues that had driven the development from the start and continued to reflect the strategic direction of the faculty and institution decision makers.

Approach to evaluation





The original [PiP Project Plan](#) [25] identified formal evaluation as an important component of the project and included a skeletal embryonic evaluation plan. Institutional reorganisation at the University of Strathclyde in 2010 resulted in a revised project and workpackage plan to reflect the consequent restructuring of the project and its deliverables. An [alternative evaluation plan](#) was therefore finalised in November 2011 [26] and formed the basis for the PiP evaluation work. This evaluation plan was sympathetic to the revisions made to the project’s scope but was also ambitious in scope, making extensive use of formal techniques to ensure evaluative rigour and universality. Four distinct evaluative strands were planned. These strands aligned with the project workpackage plan and were as follows:

1. Evaluation of system pilot (C-CAP system) (WP7:37): Heuristic evaluation and C-CAP user acceptance testing;
2. Impact and process evaluation (WP7:38): C-CAP impact and process evaluation;
3. Evaluation of impact on business processes (WP7:39): Critical analysis of BPI and C-CAP within class and course approval;
4. Final project evaluation (WP7:40)

Each evaluative strand contained several evaluative phases and although the evaluative phases within each strand were relatively self-contained, the evaluation was designed such that some phases would inform data gathering or analysis in other strands. In some circumstances this enabled triangulation to occur thus corroborating evaluative findings from other strands. It was also consistent with the overall incremental systems design methodology adopted by the project [27], [28]. The importance of this approach is highlighted in a variety of evaluation outputs, but its relevance is also described via the [PiP Blog](#) [29] and [YouTube channel](#) [30]. The multifarious nature of the Project’s outputs necessitated the use of quantitative and qualitative data collection methods and theoretical techniques conducive to studying a wide area of domains (inc. information systems, Human-Computer Interaction (HCI), business process improvement, organisational behaviour, pedagogy and curriculum design) [26], [30]. Within each evaluative strand these included:

- **Strand 1:** Heuristic evaluation, protocol analysis, stimulated recall, questionnaire instruments (pre- and post-test) using validated measures such as the Computer Self-Efficacy (CSE) scale, System Usability Scale (SUS), Usability Adjective Rating Scale (ARS).
- **Strand 2:** Group interviews, Most Significant Change (MSC) methodology
- **Strand 3:** Theoretical process analysis, qualitative benchmarking, Pareto analysis, structural metric analysis

Each strand resulted separate evaluation reports ([section 7](#)). These reports detail the evaluative aims, methodological background and way in which the above noted data collection techniques were exploited.

7. What benefits has your project delivered and who are the beneficiaries?

The benefits can be summarised by comparison between the pre-PIP *previous state*, as revealed through the project drivers and baselining, and the *new state* delivered by the Project.

<i>Previous state</i>	<i>New State</i>	
Issue	Status	Summary description
Process bottlenecks Scheduling of meeting dates of key committees resulting in late decisions; primary stakeholders (e.g. library, timetabling, disability services, etc.) informed too late to sufficiently discharge function.	Partially Resolved	<ul style="list-style-type: none"> Course and class development and approval is made transparent through a current read-only version of every proposal along with an indication of its status always being visible to all staff so all stakeholders can track every proposal Workflows are triggered automatically by user choices (e.g. submitting a draft for review), however the progress of a proposal through the approval process remains under the control of the key actors in the process
Poor feedback looping Poor feedback mechanisms throughout process resulting in inadequate change tracking and poor communication of feedback/changes to key stakeholders, including academics.	Resolved	<ul style="list-style-type: none"> Review and comment are built into the system so that there is an audit trail for the development of the proposal in response to reviewer/committee requests The comment log is scoped to particular sections of the form so that comments can be seen in context
Absence of version control No version control or unique identifiers in operation resulting in administrative and review issues; lack of standardisation between curriculum design forms.	Resolved	<ul style="list-style-type: none"> The system provides a common form for all proposals, with variations for faculties, course types, etc. accommodated through extensions The system provides version control by recording each saved version allowing editors to roll back versions Significant events, i.e. status changes are tracked in a history log
Absence of central repository No central repository of approved curricula to function as “single point of truth”. Creates issues for reviewers / faculty and periodic review.	Resolved	<ul style="list-style-type: none"> The system itself provides the repository with all proposals available to all staff as a reference and basis for new proposals Both the current draft version and all previously approved versions are available Approved curriculum designs populate the central “design repository”
Form size and lack of guidance Forms considered “daunting and onerous” and obstacle to pedagogical improvement. Lack of guidance associated with curriculum design process resulting in confusion about approval expectations both at academic and review level.	Resolved	<ul style="list-style-type: none"> Guidance is accessible in all sections of the form The system hides all parts of the form that are not relevant from the user. As options are selected related questions become available The overall <i>bureaucracy</i> of the process has reduced as the data collected has been streamlined and reused The structure of the forms discourages the inclusion of irrelevant information

<i>Previous state</i>	<i>New State</i>	
Theme	Status	Summary description
Teachable Moment The point at which academics engage with the form is a good time to introduce messages on improving pedagogy	Partially Resolved	<ul style="list-style-type: none"> Guidance in the forms includes topics on best practice and pedagogy as well as more functional matters, often enhanced with links to further reading and resources Enhancing and extending this guidance does not require technical expertise However, eliciting content is on-going
The system must make it easier for all stakeholders to comply with the university's procedures and policies and must be comprehensive in that it must accommodate the needs of all the stakeholders	Largely Resolved	<ul style="list-style-type: none"> Entry points for the system are contextualised for the stakeholder communities, i.e. individual faculties, so that each could wrap it with their own materials The user interface adapts to the role of user, the stage of the proposal and the data that is entered, i.e. sections that are hidden until required, registry staff see a view which summarises the core information they require, etc. The system ensures that a common core of information is collected on all forms, but allows for local/context specific extensions to be added However, customisation/contextualisation is limited during the initial phases of embedding

<i>Previous state</i>	<i>New State</i>	
Theme	Status	
Reduce/eliminate the need to re-enter the same data at several stages of the process and/or in different places	Partially Resolved	<ul style="list-style-type: none"> All re-usable data is collected once and then displayed in all the relevant contexts Data structures and validation within the form reduce the likelihood of incomplete/inappropriate data being collected initially and having to be rectified later However various stakeholders continue to require variations on data limiting the opportunities for re-use Integration with corporate information systems promises significant reduction in the need for re-keying
Guiding Principle	Status	
Responsibility should sit with those most directly engaged with the activity, i.e. faculties and departments are responsible for the shape and quality of their curricula	Resolved	<ul style="list-style-type: none"> Each writing team can control its own composition and membership Faculty Academic Quality teams have responsibility for moving proposals through the workflow and can intervene at any point Local requirements can be accommodated
The University strives to reduce bandwidth in all its activities, including variation in outcomes, in time and effort, standards, quality, etc.	Resolved	<ul style="list-style-type: none"> Variation is reduced with a common set of structured questions Bandwidth is reduced through the transparency of the process and the common framework

Beyond the tabular summary, particular benefits can be highlighted:

Supporting better curriculum design and academic quality

The development, piloting and evaluation of C-CAP has demonstrated that it can contribute towards better curriculum design and better support academic quality [2], [3], [6]. Recall that prior to PiP the University of Strathclyde approached curriculum design on a faculty basis, resulting in disparate approaches to design and forms that all collected different academic information and data. Some faculties even operated with no established curriculum design forms, further contributing to disparate teaching and assessment practices within faculties [1]. Faculties still enjoy a faculty specific implementation of C-CAP to enable devolved decision making relating to the academic and business rationale of proposed curricula; but the overall academic information being collected, the system used and the forms therein have all been streamlined and made more structured. PiP has managed to develop a curriculum design approach that fuses the best aspects of all faculty approaches whilst simultaneously incorporating aspects of University policy in areas of, for example, [principles of assessment and feedback](#) [31]. C-CAP also supports staff in designing curricula that better adheres to “good” pedagogical practice. Context sensitive guidance, template structure and system logic supports curriculum design decisions and ensures curricula meet basic design standards prior to consideration by faculty or academic quality. For example, system logic supports academics in pedagogical matters such as engaging in constructive alignment, but also supports error prone areas of design, such as the [correctly summing assessment weightings](#) [32]. Lack of appropriate design and approval guidance – a problem that was exposed during the PiP baselining exercise [1] – has been resolved. C-CAP now provides context sensitive guidance, links to further reading or examples. Academics’ reactions to these innovations were generally positive [33] and detailed interview data is available in the evaluation strand reports [3], [6]. The system has also demonstrated positive levels of [user acceptance in evaluation](#) [3], [6] and has continued to be favourably perceived in [on-going evaluative monitoring](#) [34].

The above noted streamlining of curriculum information capture and the improved mechanisms for managing the academic review of curriculum proposals (e.g. scrutiny by academic quality teams, faculty academic committees, etc.) has improved the efficacy of quality monitoring processes. The feedback and reviewing functionality of C-CAP enables the collaborative annotation of curricula under review and the direct delivery of this feedback to writing teams [35], [36]. Academic quality teams – who mediate faculty level processes as per Figure 1 – benefit from system support in managing all aspects of the approval process, with C-CAP automating entirely or rendering interactive many actions which under the previous state would have been manual. Paring back the curriculum information requirements to that which is essential for facilitating academic quality assurance and resource planning has also reduced the administrative burden associated with reviewing unnecessarily voluminous proposals. The drastic reduction in superfluous bureaucracy has resulted in a renewed focus on the quality and specificity of essential curriculum approval information (i.e. that which is required by the University to facilitate approval). This has simplified and eased the management of academic review whilst simultaneously serving forms that are less likely to stifle innovation and that are neither “daunting” nor

“onerous”. The positive response from Academic Quality staff is also explored in the evaluation report accompanying strand [WP7:38](#) [3].

Process improvements

The principal issues relating to the curriculum approval process and its management identified as part of the [baselining exercise](#) [1] have either been entirely or partially resolved. Qualitative benchmarking undertaken during evaluation and additional qualitative data gathered from group interviews have corroborated improvements [2], [3]. Central management of the curriculum approval process enables quicker processing (e.g. by academic quality, faculty, Student Lifecycle, etc.) of proposals prior to – and following – crucial decision making milestones [2]. The process is now entirely digital, enabling direct, immediate and automatic notification of actions to relevant stakeholders. The management of the approval process workflow via the system also speeds up the submission and subsequent dissemination of curriculum proposals to stakeholders within the approval process. This affords writing teams extra time with which to refine curricula prior to final submission ensures appropriate notification of approval / rejection outcomes, something which was found to be unsatisfactory under the previous system.

Central management of the approval process and its workflow in C-CAP also enables – and provides improved mechanisms for – feedback delivery [2], [35], [36], [37]. C-CAP now enables directed and specific feedback to be delivered (per section of the curriculum design) and allows reviewers to provide collaborative feedback and comment. Feedback and decision outcomes are now communicated to key members of the writing team and members of academic quality / faculty using workflow notifications. The use of human intermediaries to relay feedback has also been minimised such that feedback delivered at later stages of the process is visible and delivered directly to those at the beginning of the process thus facilitating a certain level of disintermediation.

Curricula are now being captured, managed and distributed by a central system, providing a single point of truth that can be accessed by all stakeholders, enabling the assignment of unique identifiers to curriculum proposals, version control, process tracking and improved process visibility. The new “design repository” offers intellectual potential by enabling the re-use and sharing of existing curriculum designs [2], [3]; but it also offers considerable analytical potential, enabling the generation of reports on a variety of curriculum design and academic quality issues to assist in monitoring, strategy formulation and decision making, e.g. data on the extent to which students are exposed to a variety of high impact learning activities during specific courses, level of faculty adherence to policies on assessment and feedback, assessment methods in use, internal quality monitoring and wider portfolio management. These analytical options have only been made possible as result of form standardisation and a central repository of curriculum information.

Using a series of goal based structural metrics [2], [38], improvements to the approval process were analysed and quantified during evaluation [2]. Significant process improvements were made in the following areas:

- **Communication automation:** C-CAP has enabled communication automation improvements of up to 65% and 90% in the course and class process respectively, contributing to better process reliability and reduced costs. Such large improvements are partly attributable to the poor support for communication and, more specifically, automated communication in the previous approval process.
- **Activity automation:** Up to 40% and 55% improvements in course and class process respectively have been made possible with C-CAP, contributing to reduced cycle times and cost, and increased throughput.
- **Process visibility:** Improvements in process visibility contributed the single biggest enhancement to the process under C-CAP. Process visibility was found to be improved by up to 100% in both the course and class approval process, contributing towards improved process reliability. Process visibility in the previous process was non-existent so enhancements with C-CAP have resulted in massive improvements in this respect.
- **Activity parallelism:** Increased levels of activity parallelism are possible using C-CAP, with up to a 13% increase achieved in the course approval process. Such an increase contributes to improvements in cycle time and throughput. Note that the class approval process is significantly shorter and is therefore less conducive to parallelism.
- **Transition delay risk:** C-CAP has enabled a potential reduction of > 15% in transition delay risks across both course and class approval processes, thus minimising potential delays that could emerge as a consequence of frequent transitions of process execution to humans. It

should be recognised that transition delays are inevitable in most processes and human intervention in a curriculum design and approval process can never be completely eliminated.

These process improvements – combined with the contributions to better support design and quality monitoring (as noted above), and an institutional commitment to embed C-CAP – mean that all key stakeholders benefit from C-CAP's introduction. The process improvements contribute to a coordinated curriculum approval process that is better placed to respond to the changing learning demands of employers, professional bodies and University departments.

Business Process Improvement (BPI)

In addition to the benefits of the C-CAP system itself, the PiP Project has also delivered benefits in other areas of the institution and beyond:

Foundations of SLEEK and “culture of continuous improvement”

PiP began with a commitment to use formal methods of analysis (e.g. BPMN), and during the course of the Project this has developed into a full BPI methodology that is being rolled out across the institution (SLEEK). Establishing a culture of continuous improvement at Strathclyde is now very high on the strategic agenda and has attracted the full backing of senior management and the Principal. The PiP Project undoubtedly had a significant role to play in establishing the foundations of SLEEK and Donna Cullen's role in PiP and latterly SLEEK Programme Manager, gave the project another significant institutional channel through which to secure stakeholder engagement and buy-in.

Policy changes and corporate benefits

The increased profile of PiP and SLEEK also strengthened the Project team's relationships with corporate services. After the re-structure, the team became known as somewhat of an authority on course and class approval – working alongside new staff charged with new responsibility for wider institutional curriculum reviews and policies. The team's input here was (and continues to be) significant and was a strong catalyst in affecting policy change and in establishing the role of C-CAP and its streamlined process workflows as the preferred method of travel for the institution.

Working with academic staff and students

Wider collaborations with the Department of Design, Manufacture & Engineering Management (DMEM) and, in particular, the Lean Six Sigma for Process Excellence MSc students, Bhalchandra Pathak and Netasha Krishan, also led to [some interesting outputs for the Project](#); their investigations into the appropriateness of applying methodologies like LSS within public sector and indeed HE Institutions, research into organisational readiness factors for business process/continuous improvement change initiatives and analysis of existing favoured tools and techniques, should be of considerable interest to the wider JISC programme. The students also focussed some analysis on the impact of business process improvement from a curriculum perspective and observed that little previous research had been carried out in this area. The SLEEK project and DMEM will continue these very significant research investigations, initially sparked by PiP, and hope in time to publish findings that will be beneficial for the HE Sector as a whole. Literature reviews and survey results from the MSc projects [are available](#) and a journal paper on initial findings was published in the [International Journal of Productivity and Performance Management](#) [39].

8. What outputs has your project produced?

C-CAP system

Although the full system is only available to University of Strathclyde staff, the C-CAP system is available to the community in several ways:

- End user training materials for all the system roles (designer, reviewer, committee member, etc.) are available publicly giving an in depth insight into the workings of the system⁷
- A detailed exposition of the tools and techniques used to build the system in the widely available SharePoint 2007 platform is available through the [C-CAP InfoPath Cookbook](#) which would allow development teams to build their own “C-CAP system” [22]
- User stories and stakeholder reactions are contained in the Evaluation Outputs [2], [3], [6]

Evaluation outputs

Evaluation activity has generated a number of outputs that are also worthy of wider consideration within the higher education sector:

A structured and replicable evaluation approach

The Institutional Approaches to Curriculum Design Programme [40] represents a unique example of funded innovation and development. As a consequence there is very little available in the academic literature to influence the development and evaluation of technology supported approaches to curriculum design and no approval, or are there related theoretical tools that can be used to subject the approval processes to systematic evaluation. Rather than using informal evaluative approaches, this project has been ambitious in its desire to develop a programme of evaluation that is structural, rigorous and replicable. A significant Project output is therefore an evaluative approach that can be successfully deployed by other HE institutions seeking to experiment or exploit technology support approaches to curriculum design and approval.

The evaluative approach has been published as a detailed plan [26] and is accompanied by four detailed evaluative strand reports [2], [6], [29], [3]. Whilst obviously informing the evaluation of PiP, these strand reports provide a useful case study for similar projects elsewhere in the HE sector, as well as forming important additional PiP evaluation outputs. [A video explaining the overall evaluative approach](#) [30] has also been generated to support other institutions and a generic version of evaluation plan is available via the [PiP website](#).

Strand evaluation reports

The structured programme of evaluation resulted in a series of detailed evaluation reports which were produced and published on the PiP website throughout the lifetime of the evaluation (November 2011 – June 2012). These reports are included as appendices to the final evaluation report. Each strand report describes the evaluation process in detail and provides further specificity on important aspects of the evaluation process (e.g. evaluation aims, methodological matters, data analysis, findings, conclusions, etc.). These strand reports fed into the [Final Evaluation Report](#) [33] and are as follows:

- [Evaluation of systems pilot - Heuristic Evaluation of Course and Class Approval Online Pilot \(C-CAP\)](#) [29]
- [Evaluation of systems pilot - User acceptance testing of Course and Class Approval Online Pilot \(C-CAP\)](#) [6]
- [Impact and process evaluation – C-CAP impact and process evaluation](#) [3]
- [Evaluation of impact on business processes - Critical analysis of business process change and C-CAP within class and course approval](#) [2]

Research Reports

Several reports were prepared to consolidate the work of the project and ground it in the relevant literature. These include:

- [Troublesome Knowledge and Constructivism](#) [42] and [Threshold Concepts and Troublesome Knowledge in Curriculum Design](#) [7] explore approaches to conceptualising the curriculum design problem space
- [Developing an Accessible Curriculum](#) [43] which examines an area often neglected in curriculum development

⁷ Although created primarily for an internal audience examples of these materials can be found on the [C-CAP page](#) of the PiP website.

- The [PiP Technical Development Report](#) [19] and the [C-CAP InfoPath 2007 Cookbook](#) [22] investigate the SharePoint 2007 development platform

Dissemination outputs

A number of dissemination outputs have been generated throughout the lifetime of PiP, including system demonstrations at a various JISC Programme events and a number of articles within [Prism](#), the University of Strathclyde's internal staff newsletter. As PiP entered its institutional embedding phase (July 2012 – April 2013) further dissemination activity within the academic literature and at academic / practitioner conferences was conducted. Such dissemination documented and publicised significant evaluation findings, the methodological approach adopted by PiP, and the positive impact of process improvement within the area of curriculum approval, but also beyond via initiatives such as SLEEK.

Substantive dissemination outputs to date include:

- **Everett, Jim, George Macgregor, and Rehman Mohamed.** "[An Incremental Approach to Technology-supported Curriculum Design and Approval.](#)" *Proceedings of the IADIS International Conference WWW/Internet 2012*, 18-21 October, Madrid, pp.453-457. <http://goo.gl/D8xWm>.
- Antony, Jiju, **Donna Cullen**, Netasha Krishan, and Maneesh Kumar. "[Lean Six Sigma for Higher Education Institutions \(HEIs\): Challenges, Barriers, Success Factors, Tools/Techniques.](#)" *International Journal of Productivity and Performance Management*, Vol. 61 No. 8, pp.940-948.
- **Macgregor, George.** "[What Was Best About Your Evaluation? Principles in Patterns \(PiP\): Evaluation Approach.](#)" *JISC Curriculum Design Webinar, 25 April 2012*, 2012. <http://goo.gl/spcq2>.
- Bartholomew, Paul, and **Jim Everett.** "[Socio-technical Ramifications of a New Approach to Course Design and Approval.](#)" JISC Design Studio, 2011. <http://goo.gl/VUpJe>.
- **Nicol, David**, Gráinne Conole, Alan Masson, **Catherine Owen**, Peter Bullen, Simon Cross, and **Diane McDonald.** "[Representing and Supporting Curriculum Design at Task, Module and Programme Levels.](#)" In *Association for Learning Technology Conference (ALT-C), 08-10 September*. Manchester, 2009. <http://goo.gl/l0Gb6>.
- Bartholomew, Paul, **Jim Everett**, Alan Masson, and Simon Cross. "[What Needs to Change in Curriculum Design?](#)" In *JISC Online Conference: Innovating e-Learning 2011, 22-25 November*. Online: JISC, 2011. <http://goo.gl/d49Ne>.

On-going dissemination continues via the [PiP Blog](#), which includes a number of lengthy scholarly contributions pertaining to the PiP evaluation and the institutional embedding of C-CAP, as well as reflections on other aspects of PiP such as SLEEK.

9. Has delivering the project brought about any unexpected consequences?

Unexpected benefits and opportunities

Opportunities and benefits have emerged through the PiP Project that were not anticipated in the planning phase. They have been seen in three areas:

Business Process

While the use of formal approaches was planned from the outset, the journey towards a Lean Six Sigma (LSS) methodology was not anticipated. This has sparked wider change initiatives and investigations in processes across all areas of University operations, as notably demonstrated by the SLEEK initiative. The SLEEK initiative has motivated the successful completion of over 40 process improvement projects, together estimated to have achieved savings of approximately £178,900 [13], and has equipped staff with the LSS skills necessary to deliver future process efficiencies. Additional staffing resource has also been dedicated to increasing the penetration of the “SLEEK ethos” across the institution.

Technical Expertise

Shifting from a development approach relying on a programming expert to one exploiting the features of SharePoint and InfoPath has brought unanticipated benefits. The low barrier to entry for InfoPath development has meant that the development team has grown beyond the limits of the PiP Project and the techniques are being used across a wide range of technical developments. This in turn has helped to drive the adoption of SharePoint as a platform across the institution.

Activities of the Development and Innovation unit

Now based in the Development and Innovation D&I section of ISD, the success of the PiP Project has enhanced the status of the team and the unit and shaped its direction.

- During the pilot phase Faculty Managers requested that funding initially earmarked for faculty-based projects be used to fund support from D&I rather than come to the faculties
- In recognition of the work and achievements of the project we are now accepted as part of the curriculum community of practice at Strathclyde and are included in consultation around curriculum design and good practice and invited as part of various working groups and consultation sessions.
- The team’s expertise in systems development and stakeholder engagement is also recognised by the established Business Systems unit putting D&I in a stronger position to influence further developments

External interest in the PiP approach: University of Ulster

The approach adopted by PiP in the development of C-CAP - and its subsequent embedding success - has inspired interest from other institutions, particularly the University of Ulster. From October 2012 until time of writing (April 2013) the PiP team has been supporting the work of a similar initiative at the University of Ulster. Ulster’s activities remain at an early stage of development but the intention is that their approach to technology-supported curriculum design and approval will use the C-CAP technical framework and approach. Unlike PiP at its project initiation phase, the University of Ulster benefits from detailed curriculum design and approval process documentation [44], thus providing a useful “paper based” template and creating a favourable system development environment. Curriculum design and approval at Ulster is also less devolved than Strathclyde.

Supporting Ulster in their efforts has necessitated the sharing of PiP Project expertise, entailing several site visits (in both Glasgow and Coleraine) and numerous conference calls with Ulster personnel. It also noteworthy that George Macgregor was invited to the University of Ulster in March 2013 by the “Curriculum Management Project Board” (CMPB) at Ulster to demonstrate C-CAP and discuss the likely development and embedding issues to be encountered. Membership of the CMPB included representatives from across all stakeholder groups, including senior academics, members of information services, and the academic quality office. It is anticipated that links between Strathclyde and Ulster will continue until Ulster’s system has reached a suitable level of technical maturity.

Unexpected challenges

In addition to unexpected opportunities, there have also been unexpected challenges. Many of the challenges were anticipated, e.g. technical issues, resistance to change, suspicion of central initiatives,

etc. and these are addressed in the evaluation and technical reports. However there were some unexpected challenges.

Understanding the “previous state” was much more complicated than expected

It was expected that the baselining phase at the start of the Project would elucidate the pre-C-CAP course and class approval processes through a documentation survey and stakeholder engagement events. In practice, it has been an on-going exercise throughout the life of the project with more complexity, variation, and occasionally clarity emerging as more staff were drawn into the C-CAP development and piloting and were probed for greater and greater specificity on the data collected, its use and its importance. The report [Evaluation of impact on business processes - Critical analysis of business process change and C-CAP within class and course approval](#) [2] explores in detail the role of myth in large organisations and the way myths and firmly held process misunderstandings were found to be held by some stakeholders. The C-CAP development has been effective in identifying and exposing these myths and misunderstandings and has improved process consistency and transparency not only supporting curriculum design by providing greater prescription in terms of the information expected in curriculum designs but also because it made transparent the various approval process milestones.

The “mediating artefact” effect

As the PiP Project engaged with the wider stakeholder community and the methodology was communicated more widely, “PiP” gained currency as shorthand for a technologically enhanced, process-oriented approach. In a time of widespread institutional reorganisation and renewed emphasis on reducing bandwidth and streamlining processes, these ideas were widely attractive with “PiP” used as a *mediating artefact* to facilitate discussions. As a reflection of the high regard in which the Project and the team are held this status opened many opportunities. However this mediating role within the institution threatened to dilute the focus of the Project and confuse the communication between the Project and the wider community. This challenge was addressed by explicitly and repeatedly refocusing PiP on its key deliverables; however it is with the development of SLEEK that the underlying institutional appetite for a structured process improvement methodology has been satisfied.

10. How will the project be developed further/sustained?

The PiP Project was approved to continue to April 2013. During this period the focus was on the refining and embedding the C-CAP system. This activity has provided the opportunity to develop an institutional agenda for further improvements, greater engagement with stakeholders and continued evaluation to achieve greater efficiency and effectiveness of processes around curriculum approval and design.

Adoption of C-CAP

- C-CAP has been adopted across three University faculties for all new curricula. C-CAP is currently underpinning the re-validation of all classes and courses within the Faculty of Humanities and Social Sciences (HaSS).
- The Faculty of Engineering has piloted C-CAP and it is hoped that it will formally adopt the system by the academic year 2013-2014.

Further links between PiP/C-CAP and course approval

Beyond the use of the technological system, the C-CAP provides an added impetus for enhancing the wider approach to curriculum development. The PiP/C-CAP team is exploring various opportunities with the University's Educational Strategy Committee [8]:

- C-CAP provides a platform for delivering existing and new pedagogy/support materials and a leaflet on how to use/access resources is planned for inclusion within induction packs for new academic staff.
- C-CAP could be offered as part of a "suite" of curriculum-enhancement related activities.
- C-CAP could be included as part of wider academic staff development activities e.g. a module within PgCert on the use of C-CAP.

Extending C-CAP

C-CAP is flexible and interoperable, opening the way for further technical development and a more [holistic approach to curriculum data management](#):

- Integration and improved reuse of curriculum data with existing institutional and corporate systems, and the Student Records System in particular, through web services.
- Further development of the C-CAP system to support the generation of Key Information Sets (KIS) and other value-added curriculum information and intelligence.
- The underlying SharePoint/InfoPath approach is also being exploited in other projects, e.g. REF data collection.

Business Process Improvement

The SLEEK methodology is being adopted across the University as the basis for business process improvement and has already delivered improvements in Finance, HR and ISD [13]. In the domain of curriculum development:

- The C-CAP system begins course proposal developments with a structured "business case" allowing the approval process the opportunity to ensure alignment with wider strategic objectives and efficiency and effectiveness measures.
- The PiP/C-CAP team are working together with Student Experience & Enhancement Services (SEES) [9] using SLEEK methods to develop a new approval policy and process that will ensure genuine sustainability.
- A SLEEK project has been commissioned to look at the new established C-CAP mediated process and identify further areas of improvement and the removal of wastes and inefficiencies. Tangible cost and time-releasing savings are expected. The embedding of C-CAP as a core institutional service has meant that it has entered into the SLEEK review and control framework, thus ensuring that improvement is continuous and responsive to further sector shifts and internal changes.

11. Summary and Reflection

With the development of the C-CAP system, this tool has become the most tangible output of the PiP Project and stakeholders readily recognise this tool as the point of the Project. Indeed, C-CAP has been an effective response to the drivers behind the PiP Project and to the issues identified by the Project. However, PiP has produced more than a tool to a set of requirements. Coming at a time of considerable institutional change, the Project has developed and modelled approaches that have resonance beyond the technical development.

The approach can be characterised as one of incremental, emergent continuous improvement. It has been noted that the change approach adopted was incremental; yet fundamental change has only just begun, starting as incremental and then emergent change [45]. Recognising the difficulties in effecting wholesale change, the philosophy of incremental change has supported emergent change: proposing improvements and technologies which point in a direction that management and key stakeholders feel they can support and champion. This has been most obvious during the piloting of C-CAP. Piloting has facilitated meaningful discussions with the institutional actors who are best placed to effect longer term change because they can influence institutional policy, such as the University's Education Strategy Committee (who are capable of influencing curriculum design policy) and SEES (who have been motivated to support and champion the institution wide embedding of C-CAP). This, in turn, has been a catalyst for more concerted change agendas such as SLEEK.

A number of specific lessons can be learnt from the PiP approach of incremental, emergent continuous improvement.

A. Incremental systems development methodology

PiP experiences have demonstrated that in most cases the adoption of an incremental or agile systems development methodology is preferable when developing technology-supported curriculum design and approval solutions. Such an approach is more responsive to the shifting sands of the current university environment and better support the development of emergent change that the upper echelons can then support, thereby effecting larger institutional change. From a technical perspective - and as noted earlier in [Section 5](#) - this approach also supports the system development lifecycle since arriving at a true understanding of institutional processes such that systems can be specified is often difficult to achieve [2].

B. Small design changes can effect bigger changes:

In institutional scenarios, technology-supported solutions to curriculum design can enable subtle but significant adjustments to the way in which academics design curricula. These adjustments may not be radical in education terms, but they can be radical in institutional terms by, for example, setting a minimum level of curriculum design quality across the entire institution, or ensuring adherence to acknowledged curriculum design principles which might otherwise be ignored. When the implications of these subtle changes are scaled up to entire institutions it becomes clear that significant, progressive institutional changes have occurred as the result of small adjustments to the way in which stakeholders engage with the curriculum design and approval process.

C. Small process changes can affect larger process efficiencies:

Owing to the size of HE institutions and the volume of curricula that are proposed and reviewed, small improvements to approval process can affect larger institutional efficiencies. Even replicating an existing process within a system solution can achieve improvements by virtue of the process innovation potential inherent in IT and, more specifically, technology-supported approaches to curriculum design and approval. The lesson is that even where there is hostility from stakeholders to explicit process improvement strategies via technology, smaller scale improvements and streamlining is possible by virtue of using IT to support an existing process which, in itself, can inspire wider, more meaningful process change as stakeholders witness the benefits and transformative potential of technology.

D. Continuous incremental improvement rather than re-engineering:

The change culture – like many public sector organisations – is less receptive to “radical change”, or “radical reengineering” of processes [46], [47]. Processes tend to be shared among numerous stakeholders and are labyrinth-like, extending well beyond the boundaries of single departments to encompass entire organisations. They are also rigidly hierarchical, which can impede change (i.e. talking to the “right people”). HE institutions, at least in PiP's experience, are therefore conducive to incremental change and process improvement, often using emergent change techniques that senior management can then champion.

E. Avoiding perceptions that the system is a panacea:

As technology-supported solutions to curriculum design and approval are unveiled, there is a frequent tendency for stakeholders to consider the system (i.e. the technology supported curriculum design tool) as a panacea; a potential solution to virtually all data and information issues pervading the institution. A lesson is therefore to be prepared to reject the seductive advances of stakeholders - at least initially - who propose system extensions that are peripheral to the aim of improving curriculum design and approval efficacy.

F. Structured evaluation approach:

The need to approach evaluation with a well-conceived evaluation strategy is essential. Such an evaluation plan creates legitimacy in the eyes of stakeholders and makes its subsequent findings, not only an important tool in improving the system and understanding its impact, but important in evidencing the benefits and impact of technology-supported curriculum design and approval solutions. However, it should be noted that disparate techniques are required to reflect the multifarious nature of the project scope (covering a variety of disciplines). A narrow evaluation focus will result in a poor understanding of impact [26], [30].

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