

# Edtech-6 test bed: Letters and Learning

## Underpinned by an Education Materials Digital Platform

EdTech Testbed Project no. 2, HH 01/02/2022

HMC template draft 1.0 SMP 6/2/22

HMC template draft 3.0 SMP 16/2/22

### Introduction

This document outlines a Digital Scholarship @ Oxford digital laboratory pilot project, a cross-divisional research and experimental way-finding of Humanities, Social Science and GLAM academic collaborators. We propose to develop a sustainable platform through iterative learning cycles and standardised digital transformation processes to co-create and utilise the research-cloud, AI, data science environments and digital humanities best practices.

This test bed proposal is supported by the pump-priming funding of the [Oxford-Singapore Human-Machine Collaboration Programme \(HMC\)](#) - Innovation Pillar - [Test Bed Portfolio](#). It is utilising the innovation ecosystem development budget line which supports pilots, test beds, proof-of-concepts in collaborative platform development. The test bed enables cloud-based data lake establishment and cross-departmental/cross-divisional, Oxford lab-driven research collaborations. The funding for this test bed will be transferred from the MPLS OX-SG HMC holding pot to the History Faculty ([£25,000 for the 15 February 2022 - 31 May 2022 delivery period](#)).

### Motivation

**Learning as thematic focus:** Human beings are the only species born without a basic onboard operating system. In other words, of all the world's species, we must devote the largest share of our lives to learning how to survive and thrive in our environment. For this reason, learning is also fundamental to all human cultures. It also happens to be the central purpose of the University, which means that all of our collections relate to it in one way or another. In order to render this theme more manageable, this testbed contracts 'learning' to the more concrete topic of 'letters', since the two have been almost synonymous throughout the ages of script and print.

**Educational challenge:** Another reason for this approach is because Oxford contains an enormous quantity of projects and resources focused on textual material from antiquity to the present day. The specific educational challenge of this testbed is therefore to begin experimenting with the many ways in which the research results of these projects can be transformed into high-quality educational materials linked back to and indeed driven by the research data from which they originate.

**Digital transformation - just once:** This test bed enables us to demonstrate how to focus on the iterative development, learning from experience, previous designs, and what process transformation is needed, in order to ‘practically do the digital transformation just once’! Then lift all kinds of digital scholarship activities on a platform which is constantly renewing under the domain-specific application layer and we don’t need to redevelop the ‘digital scholarship product’ every time when a new technology emerges. This will be a perfect demonstration of the ‘platform’ revolution.

This motivation relates perfectly to one of the core objectives of DiSc: to solve efficiently, creatively and sustainably those challenges too big for individual projects to solve on their own; and it promises to do so at a very high level. It addresses the specific challenge of transforming research materials into teaching resources perfectly, while also raising the game and framing it in up-to-date language.

**Education Materials Platform-as-a-Service:** the basic idea here is simple if, as yet, underdeveloped. There is a gigantic amount of material generated by Oxford’s digital scholarship projects which relates to media of written communication in every period of history. As yet, very little has been done to explore how these research data could be converted into educational material. Cristina Dondi is taking the lead on that in the *Seeing Things* project and producing spectacular results. The natural question then arises: can we generalise the methods to create formulae for reprocessing material from cognate projects in the same way? If we could generalise that formula and iterative method, it could of course then be applied to similar projects outside Oxford, and to projects dealing with something other than ‘letters’.

### Goals of the test bed

**Define a successful shared vision for transformation that inspires and excites people** and calls out what needs to change about the current ways of operating based on changes externally. A vision is ‘shared’ when it requires collaboration from all parts of the organisation in order to achieve it, and outlines what we’re going to do and why, and how we can gain long-term buy-in.

Herbert (2017, p. 54)<sup>1</sup> suggests to “find the common ground that will allow you to understand the fastest and most valuable route to your digital destination, possibly before you even know what the destination is. Reaching a common ground and having interactions are the hallmarks of getting anything done.” Test the viability of a “legacy-free reinvention” (Herbert, 2017, p. 55). Use this test bed opportunity to get away and work out how we would approach solving the problem if we were starting from scratch. Act as if we weren’t surrounded by thousands of

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<sup>1</sup> Herbert, Lindsay. *Digital Transformation : Build Your Organization's Future for the Innovation Age*, Bloomsbury Publishing Plc, 2017. ProQuest Ebook Central/<http://ebookcentral.proquest.com/lib/oxford/detail.action?docID=5097195>.

administrative and academic staff, strict processes and legacies, how would we approach solving this problem as a new modern business?

**Identify the outdated skills sets.** Introduce the skills needed to adapt quickly when digital technology and new ways of working are introduced through any digital transformation efforts.

**Demonstrate a new level of automation.** A lack of automation doesn't just slow things down; it can make certain activities impossible to measure accurately, which creates a vicious cycle. It diverts people's energy and brain power away from tasks that can't be replaced by a machine. Automation wouldn't just free the staff member to do something more valuable, but the data could also help them do their job better.

### Research scope

#### Activity 1: Transform the Digital Scholarship Clusters

The following list provides an impression of the large proportion of the digital scholarship community in Oxford which is concentrated on media communication and texts. This community of cognate projects provides abundant material for experimenting with the iterative methods of digital transformation at the heart of this project.

- **Media of communication** are the focus of the largest cluster of projects in DiSc.
  - In the **ancient world**, these include
    - cunieform ([cdli](#)),
    - papyrus ([POxy](#), [gpb](#)),
    - inscriptions ([isicily](#), [Crossreads](#), [cpi](#), [poinikastas](#)), and
    - writing tablets ([curse tablets](#), [Vindolanda](#)).
  - In the **medieval world**, projects focus on
    - manuscripts generally ([BMMC](#)),
    - their migration ([MMM](#)), and
    - libraries ([MLGB3](#)).
  - In the **modern era**, projects study
    - the exchange of printed books generally ([CSB](#)),
    - incunabula in particular ([15cbooktrade](#)),
    - manuscript correspondence ([e-enlightenment](#), [emlo](#), [catcor](#)),
    - diaries ([godwindiary](#)),
    - learned journals ([constructing-scientific-communities/](#)),
    - libraries ([beckettarchive](#), [voltageproject](#)), and
    - modern electronic communication ([digital-knowledge-and-culture](#)).
- **Texts** form the basis of a second large cluster (which overlaps with the first). As well as large collections of texts of all kinds ([ota](#), [oxfordscholarlyeditions](#)), projects focus on texts in
  - individual disciplines ([englishphilosophy](#)),
  - genres ([dictionarylab](#)),
  - authors ([newtonproject](#), [davidhume](#), [beckettarchive](#)), and
  - works ([Wycliffe Bible](#), [firstfolio](#)).

- **Major projects are also building digital platforms for**
  - editing texts ([digital-enlightenment](#)),
  - developing genetic editions ([beckettarchive](#)), and
  - studying translations ([prismaticjaneeyre](#))
- **Related forms of cultural interaction** are studied in projects on
  - poetic miscellanies ([digitalmiscellaniesindex](#)),
  - theatre ([apgrd](#), [the-london-stage-project](#)), and
  - music ([diamm](#), [tudorpartbooks](#)),
  - the book trade ([stationers-register-online](#)),
  - higher education (e.g. [alumni-oxon/1500-1714](#)),
  - scientific societies (RSL),
  - constitutional negotiations ([quillproject](#)), and
  - travel ([tideproject](#)).

## Activity 2: Digital experimentation - Education Materials Platform

Design a new Education Materials Digital Platform considering the six core functions of a platform (Herbert, 2017, p.91):

1. **sharing:** Displaying or sending any kind of output, whether between people through a user interface - like websites that display content - or between other systems or devices.
2. **receiving:** Accepting any kind of input (e.g. computer code, messages, documents, data, media, signals).
3. **analysing:** Processing, interpreting, and calculating any kind of input to produce a pre-determined output.
4. **learning:** Weighing outputs from past analysis to anticipate and improve the accuracy of new analysis.
5. **managing:** Controlling and monitoring of any process (e.g. triggering an automated system to stop, start, or run faster or slower).
6. **storing:** Collecting any kind of input for future use (e.g. data in a database, documents in a knowledge management system, encrypted details in a hyper ledger).

Capture the characteristics of a platform capable of fast operations, which can be quickly built upon and adapted. A large part of succeeding at digital transformation is the ability to react to change faster and more intelligently than anyone else in the marketplace. It must be easy to use by people (not just by experienced developers), compatible to connect to or work with other systems, devices, or platforms, and fast enough for the current user needs. 'It can't take too long to work', 'risking users to get frustrated, lose interest, or start to distrust technology' - *Ashmolean user conversations...*)

The six core functions of the digital platform maps onto the data life cycle embedded in the MSc in Digital Scholarship.

Flexibility comes from modular, open frameworks. Systems for scaling are composed of self-contained parts that can be combined and interchanged with others to produce different outputs or meet different needs. Each self-contained part must be standardized and adaptable for ease of use and flexible arrangement. Consistency comes from standardization, producing outputs consistent in quality and aligned to the ethos and identity of our organization. However, standardizing for the digital age isn't the same as it was in the past. Instead of trying to prescribe every detail of a self-contained part, standardization for digital requires identifying the core principles that are going to govern and drive each part, as well as the system as a whole (Herbert, 2017, p.232).

There's no more important word in digital transformation than 'culture'. Herbert (2017, p. 235)<sup>2</sup>

It's very easy to get down a rabbit hole of technology and there are various vendors and agencies who will convince you that your technology selection is what will make or break your digital transformation. It's not incidental: technology is of course important. However, the way you leverage it internally is by promoting and engaging with people who are the right mindset to implement this transformation.

Forming cross-functional ways to promote learning and engagement is a big piece. Then externally, co-creation and innovating alongside your customers is the best way to advance digital transformation. What Apple did with its App Store as a platform was to build a place for developers to become partners by building the apps that sat on the platform. As companies look to be more digitally capable, they're going to need to find ways for their customers to help form their products, and that's how you're going to leverage your transformation externally.

Interview with Perry Hewitt, Vice-President of Marketing,  
ITHAKA Former Chief Digital Officer, Harvard  
University, 2011–2016

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<sup>2</sup> Herbert, Lindsay. *Digital Transformation : Build Your Organization's Future for the Innovation Age*, Bloomsbury Publishing Plc, 2017. ProQuest Ebook Central

(Herbert, 2017, p.92):

**Table 2.1** *Platform types and their common barriers*

Platform type	Primary functions	Common barriers
<b>Systems of engagement</b> (e.g. internal and external websites)	Sharing	<b>Inflexible:</b> Changes are difficult and result in breakages.
	Managing	<b>Incompatible:</b> Can't connect with other systems or work with newer technology. <b>Non-user friendly:</b> Even small changes require specialist skills.
<b>Systems of record</b> (e.g. company databases)	Receiving	<b>Isolated:</b> Can't receive from other systems.
	Storing	<b>Poor search-ability:</b> Errors and extraneous data can't be easily found or removed.
<b>Systems of insight</b> (e.g. analytics platform)	Analysing	<b>Unintelligent:</b> Learning is flawed or absent.
	Learning	<b>Unactionable:</b> Analysis doesn't produce the results needed for clear decision making.

Herbert (2017) suggests to define the final stage in the digital transformation scope as self-sustaining digital transformation.

Pump-primed in this test bed project, we introduce and incrementally spread iterative ways of working, data-driven decision making, and processes for ongoing customer/user and external engagement. Benefitting from the unique Oxford bottom-up control mechanisms to act and react and use digital technology and iterative ways Collaborate efficiently to produce results that are consistent, have high impact, and reflect the company's positioning, brand, and values. Getting to this end state isn't as simple as sharing the work that's been done so far, or providing training on how to replicate it. Instead, this stage is about shifting the balance of power in your organization from being entirely top-down

adapt, and thrive in changing environments (p. 201).<sup>3</sup>

<sup>3</sup> Herbert, Lindsay. *Digital Transformation : Build Your Organization's Future for the Innovation Age*, Bloomsbury Publishing Plc, 2017. ProQuest Ebook Central, <http://ebookcentral.proquest.com/lib/oxford/detail.action?docID=5097195>.

### Activity 3: Proposition Development<sup>4</sup>

#### **Platform**

The proposition is to design the operational model of a worldwide, world's first Education Materials Platform-as-a-Service.

NIS (2011)<sup>5</sup> defines Platform as a Service (PaaS) as a capability provided to the consumer to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

The consumer are typically software developers. PaaS is a computing platform that allows the creation of web applications quickly and easily and without the complexity of buying and maintaining the software and infrastructure underneath it. In other words, rather than being software delivered over the web, it is a platform for the creation of software, delivered over the web.

We have to design the desired characteristics of an Education Materials PaaS, e.g. the services to develop, test, deploy, host and manage applications in an integrated development environment, PaaS solution should include all services required to support a complete software development lifecycle.

We shall design the user interface, actually the user interface layer of the application.

In consultation with IT solution architects, we should design, optimise and cost the ability to scale at the processing power that supports the deployed software to meet variations in workloads.

We shall review the integration with web services and database services. Or the collaboration tools with team members or end-users.

The beauty of PaaS is the availability of libraries of predefined components, frameworks and building blocks which can speed up the development process. PaaS approaches will be more and more the norm.

#### *Experimentation with the AWS developer environment and AI/ML toolkit:*

- Attend training session in Oxford and online, and collaborate with AWS solution architect, Master Builder colleagues, interns and local Oxford developer (e.g. Oxford AI Society, interns at colleges - St Anne's and Pembroke, or departmental interns - the software developing talents at Oxford)
- Accessing developer tools and APIs: [HTTPS://DOCS.AWS.AMAZON.COM/HONEYCODE/LATEST/USERGUIDE/DEVELOPER-TOOLS-AND-APIS.HTML](https://docs.aws.amazon.com/honeycode/latest/userguide/developer-tools-and-apis.html)
- Amazon SageMaker is a fully managed machine learning service. With SageMaker, data scientists and developers can quickly and easily build and train machine learning models, and then directly deploy them into a production-ready hosted environment.
- Start scripting for training and deploying models, create a Jupyter notebook in the SageMaker notebook instance. Using the Jupyter notebook, you can conduct

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<sup>4</sup> Michon, R. (2019) *The Complete Guide to Software as a Service*.

<sup>5</sup> NIST (2011) *NIST Special Publication - The NIST Definition of Cloud Computing*. 8000.145. Sept 2011.

machine learning (ML) experiments for training and inference while accessing the SageMaker features and the AWS infrastructure.

- It also provides common machine learning algorithms that are optimized to run efficiently against extremely large data in a distributed environment. With native support for bring-your-own-algorithms and frameworks, SageMaker offers flexible distributed training options that adjust to your specific workflows.

**Partners:**

- Key Division: **Social Sciences** (Education, Continuing Education)
- Humanities partners: Theology, Centre for Intellectual History
- Key Collections: **Bodleian** and **Ashmolean**
- GLAM partner institution: Centre for the Study of the Book, Bodleian Library
- Existing projects: a huge list here - see fuller proposal

**Participants (tbc):**

- Humanities PI (History): [Howard Hotson](#), Professor of Early Modern Intellectual History, and Academic Director, Digital Scholarship @ Oxford
- SS Co-I (Education): [Niall Winters](#) is an Associate Professor of Learning and New Technologies, and joint convenor of the [Learning and New Technologies Research Group](#);
- GLAM Co-I (Bodleian):



## Justification of Resources

PI: Prof Howard Hotson, Professor of Early Modern Intellectual History (History Faculty) and Academic Director, Digital Scholarship @ Oxford (Humanities Division), Convenor of History Special Subject 14: The Scientific Movement of the Seventeenth Century. **No-cost, named PI.**

Co-I: ???? 5% FTE staff cost £1200??

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Staff cost: 5% / 20% / 50% / 100%.... value: £??? For senior researchers, research assistants £3200

Professional services provider for scanning, storage and data retrieval optimisation, application development, AI/ML, user experience, £8,200

Platform proof-of-concept and ML tool demonstration contractors (e.g. Cloud Mantra or Cirrus HQ who worked with GLAM IT already), £5000

AWS cloud provision and solution architect support (e.g. James Grant), £5000

Total: £25.000.

## Outcome and Impact<sup>6</sup>

### Targeted outcomes

Enterprise-scale application modernization requires a holistic approach (assess, modernize, manage) to bind multiple dimensions to provide completeness at an accelerated pace. The framework recommended by AWS envisions modernization across five technical domains: automation, developer workflows, self-service data, architecture evolution, and organization for value. These domains are discussed in more detail in the [Strategic dimensions of modernization](#). The framework in AWS Professional Services and AWS Partner engagements includes a knowledge base with solutions, self-service technical patterns, playbooks, and templates.

A successful modernization / digital transformation project helps produce the following business outcomes:

- **Business agility** - The effectiveness within the business to translate business needs into requirements. How responsive the delivery organization is to business requests, and how much control the business has in releasing functionality into production environments.
- **Organizational agility** - Delivery processes that include agile methodologies and DevOps ceremonies, and support clear role assignments and overall collaboration and communication across the organization.

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<sup>6</sup> AWS (2022) Prescriptive Guidance. Strategy for modernizing applications in the AWS Cloud. Accessed on 16 February 2022. Available at <https://docs.aws.amazon.com/prescriptive-guidance/latest/strategy-modernizing-applications/targeted-business-outcomes.html>

- **Engineering effectiveness** - Improvements in quality assurance, testing, continuous integration and continuous delivery (CI/CD), configuration management, application design, and source code management. Achieving these business outcomes requires a holistic approach and a modernization process that's based on a set of strategic dimensions.

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### **Holistic approach to modernization**

The journey to application modernization is an incremental effort that involves:

- Making data-driven decisions to analyse legacy and cloud workloads.
- Evaluating processes to move to the cloud.
- Integrating new functionalities such as containers, serverless technologies, and modern databases to support emerging technologies such as artificial intelligence (AI), Internet of Things (IoT), and machine learning (ML).

Today's organisations might be unable to adapt to new and changing business models if their legacy systems include complexities and inefficiencies that result in the following:

- Lack of agility, where they cannot react quickly to changing business and market demands.
- Lack of flexibility, where they cannot make necessary changes to applications.
- Lack of scalability, where they cannot introduce new application features or extend existing features that involve new users or capacity.
- Performance issues, when the application doesn't perform to desired standards and metrics.
- Lack of data insights, when too many data silos exist and slow digital innovation.
- Heightened security risks, when applications have gaps and vulnerabilities that don't exist within newer application frameworks where security is built in and integrated throughout.
- Inability to add new applications and services, which impedes the adoption of new technologies and modern architectures.
- Higher costs, because legacy applications and application frameworks often consume more resources, and often create more redundancies and inefficiencies than modernized applications.

### **Strategic dimensions of modernization**

Modern applications provide multi-dimensional benefits to customers when they're developed and managed effectively. You can establish a process for continuous modernization based on a set of strategic dimensions to accelerate innovation by increasing agility, resiliency, and engineering efficiency. By continuously following and building on these proven patterns and techniques, you can deploy existing application components to a modern deployment platform, make existing functionality accessible to new applications, and update application architecture to a fully modern stack.

### **Impact**

- **Organization for value** - Realign organizational structures, governance, and processes to center around small, full-stack product teams that can deliver business value through customer outcomes.
- **Architectural evolution** - Build digital product platforms by moving core business capabilities out of monolithic applications and into a decoupled collection of independently maintainable, evolvable, reusable services that developers can use as building blocks to innovate.
- **Ubiquitous access to data** - Combine modern data architecture, storage, and access patterns with AWS services to allow developers, data scientists, and business users to easily tap into the organizational data stream.
- **Builder springboards** - Bring together a collection of agile software engineering practices (such as DevOps, test automation, CI/CD, and observability), associated tooling, and application layer services into an integrated developer workflow. This workflow defines a path for development and reduces the amount of time to move code from idea to production.
- **Infrastructure automation** - Use a combination of AWS services to create a lightweight infrastructure foundation. Make use of containers and AI/ML to abstract and automate often used infrastructure primitives. This frees up development resources so you can focus on delivering business value through the creation of new products and services for your customers.

By applying these strategic dimensions of modernization, your organization can become more productive and can deliver measurable and sustainable outcomes. Your organization will be able to:

- Improve and create a differentiated customer experience.
- Accelerate innovation, reduce time to market, and release new products frequently.
- Optimize and avoid costs by spending less on IT infrastructure.
- Increase agility, add new features and functionalities at scale.
- Increase staff productivity by deploying new features faster.
- Improve service-level agreements (SLAs) and reduce unplanned outages.