Concepts of campus design and estate management: case studies from the United Kingdom and Switzerland

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Many higher education institutions are ancient and have been altered, expanded, changed in architectural terms over centuries. Others are extremely young and have been built as whole concepts from scratch. What unites them all, whether old or more recent, is that they are places of debate, experiment, creativity and learning. Research, teaching and learning are usually united in one or more sites, all of which need maintaining and should ideally enable teaching, learning and research processes to work in the best manner possible. This paper discusses concepts of campus design and how higher education estate is being managed in three different institutions.

1 Introduction

The university is an ancient and successful concept which, until very recently, has usually been associated with a particular locus, at a single, fairly homogenous site, or as a collection of buildings in a town or city. Some universities such as the University of Lausanne which was relocated from its former city centre location to Dorigny on the outskirts, have been planned in their entirety from predominantly one architectural drawing board. Some have started out with one central axis of teaching and learning spaces, which have been expanded over time and by different architects e. g. École Polytechnique Fédérale de Lausanne. The University of Oxford started out as a small locus of students and their teachers which would grow over the centuries into nearly 40 colleges, a Science Area, university hospitals etc. The three above-named institutions will form the main area of interest in this paper.

Architectural trends have played major parts in much university construction – e. g. neo-Gothic (19th century), Classicist (19th century), or Modernist (20th century). They have all involved university leaders, planners, financiers (through state coffers or private donations), constructors, architects and end users. Regardless of style, university buildings are loaded with meaning and, as is the case with buildings for other purposes, influence our wellbeing (Lockwood, 1972). Our surroundings, which are not fixed, change to become objects of *"(re)interpretation, narration and representation […]"* (Gieryn, 2002, p.35). This is a sense-making process as we negotiate how to act within them (Weick, 1995). Buildings impact on our well-being and how we thrive, which should be of key importance to the academic world in which creativity and innovation

are of such importance (Marmot, in Temple (ed.) 2014). Yet we frequently take them for granted and do not consider how they might impact on our capacity to learn and teach. When higher education estate fails, and there are many examples of this, it is as much *"a failure of psychology as of design"* (de Botton, 2006/2014, p. 248), which has direct consequences on research, teaching and learning. Therefore, it seems only logical to consider campus site function and management if we want to improve academic outcome. However, we do not have much data on the strategies and ideas behind the management of higher education estate (cf. Bligh, in Temple (ed.) 2014; den Heijer (2011) for Dutch campus management). Although there is a fair amount of literature which describes different types of university campus design (Boys, 2015; Coulson et al, 2015; Temple, 2014), to date little empirical evidence has been gathered on how the management or planning of higher education estate is actually conducted. For example, to what extent are the numerous stakeholders – planners, architects, site managers, faculty staff and students, maintenance staff, and university leaders who are ultimately responsible for deciding upon new building projects and/or the demolition or alteration of existing estate – involved and how (Bal et al., 2013)? There is even less research that examines institutions from an internationally comparative angle. This paper therefore intends to expand upon existing research on university campus design as part of higher education estate management and fill in some of the gaps, although more work still needs to be undertaken before we can claim to have a global understanding of planning processes around the world.

In what follows these questions are addressed:

- Which cares and concerns do those involved in the decision-making in the construction and maintenance of higher education buildings have?
- What is the financial context in which they operate and is this of consequence?
- Which design choices are being made and why?
- Are some universities arguably doing a better job of campus design, and if so, how?

This paper draws on three case studies (Yin, 6th ed., 2018) undertaken in different campus types in Great Britain and Switzerland, all of which are institutions of high status where we might imagine estate management to be working particularly well and in alignment with overall university strategy. Alongside documentary research and online data-gathering, interviews have been conducted onsite with a range of stakeholders, including leaders, planners, faculty and students. The paper starts with an historical overview which serves to contextualise different campus designs, their functions and which aspects estate managers need to be aware of. Following a brief theoretical discussion and one example of best practice, the paper then moves onto the three case studies taken from the University of Oxford, the University of Lausanne

and the École Polytechnique Fédérale de Lausanne, revealing how their campuses have developed, how they are financed, managed and maintained. The role of philanthropy in fundraising for higher education estate will also be discussed. The paper concludes with a discussion on which aspects need taking into account if institutions are to design and maintain their estate strategically, for the benefit of end users and indeed for the longer term.

2 Concepts of higher education estate – an historical overview

As soon as students and their educators walk onto any campus they find themselves in a form of dialogue with their physical environment – the buildings and spaces between them that have, in some cases for centuries, been given the role of providing seminar, auditorium, laboratory, library and other spaces. According to Klauder & Wise (1929) *"the college scene is impossible to think without its setting of architecture"*. The *setting* of higher education has been of major concern to planners and architects throughout the ages (Keast, 1967).

Bologna, Oxford and Paris form the three earliest universities in Europe and were founded in medieval times, although they cannot lay claim to being the earliest places of higher education learning. The Platonic Academy in Athens originated, for example, ca. 387 BC, while Nanjing's roots in China go back to at least AD 258 when a Confucian centre of learning was established. A unifying point being made here is that a particular *place* served as a gathering point for discussion and learning. The three above-named European examples all originated in existing and prosperous towns (later cities). In Oxford this started as a loose gathering of students around a *magister scholarum* (cf. Coulson, et al, 2015, p. 5), which later became more orderly following the physical foundation of halls (e. g. St. Edmund Hall[1]) and of colleges to house and educate undergraduates. Oxford is notable for its numerous individual colleges which are similar in that many would eventually become enclosed ("cloistered" places) following the example set by New College (founded 1379), where the first purpose-built quadrangle was built (Old Quad) (Tyerman (ed.), 2015). In section 4.1.2. we will see how its university estate is managed in greater detail.

[1] See https://www.seh.ox.ac.uk/about-college/history-hall (accessed 02.08.2018) for further details of its history. A first reference to the hall dates from 1317.

Figure 1: Old Quad, New College

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Although the *collegiate* idea of higher education as best typified by Oxford and Cambridge was not necessarily emulated, their courtyards as a design element were. The four-sided courtyard was copied in Italy and Spain and transferred as an idea across the Atlantic Ocean to many south-American universities founded in later ages by colonialists (Coulson et al, 2015, pp.6–7). Bologna's first dedicated place for higher education – the Palazzo dell' Archiginnasio – was only built following an exodus of students and staff to Sienna in 1321.

Figure 2: Palazzo dell' Archiginnasio

Bildquelle: www.archiginnasio.it

Many medieval universities grew out of architectural seeds that were sown usually fairly close to the centre of town and clustered buildings for particular disciplines in close proximity with one another. Good examples of this in Germany, for example, are Tübingen (1477) and Marburg (1527) which were both founded by wealthy individual patrons who provided four faculties each in purpose-built buildings. Many of these were built using materials of the highest quality which reflected the eminence that founders such as bishops, kings or other members of the aristocracy placed in these new institutions of learning. In contrast with the collegiate system where students and their teachers lived and learned under one roof, student needs in Europe did not play so great a part in university design as students were left to organise their own

accommodation rather than belonging to a tight-knit community that lived, learned and studied together.[2]

Although many American universities founded in the 17th century drew on Anglo-Saxon ideas, many moved purposefully away from the sequestered enclosed collegiate design to be more open places, but, in contrast with central European counterparts, they embraced the idea of being places that incorporated teaching, research, living and social activities (cf. Coulson et al. 2015, p. 13). Thomas Jefferson's Academical Village at the University of Virginia is a good example: high quality and aesthetically-pleasing architecture in an expansive parkland environment. The importance of bringing nature into the academic world came to the fore at this time as it was thought that being part of a natural and green environment would lift the spirits and encourage creativity. Frederick Olmsted was a major force in this. He stated that *"the enjoyment of scenery employs the mind without fatigue and yet exercises it, tranquilizes it and yet enlivens it; and thus, through the influence of the mind over the body, gives the effect of refreshing rest and reinvigoration of [the] whole system"3* Olmsted suggested less regimented designs that reflected nature's more meandering and sometimes haphazard shapes and flows. How nature and campus open space design affects our health and wellbeing has since been researched more extensively (cf. Lau et al. (2014), Matloob et al., 2014).

In the 19th century many continental universities that had originally been founded in the Middle Ages expanded into surrounding buildings which they appropriated for university purposes, but this phase also saw the construction of numerous purpose-built and usually very grand buildings, many of which look similar and were built in a neo-Classical style: e.g. central university buildings in Innsbruck (Austria), Würzburg (Germany) or University College, London (United Kingdom) (Birks, 1972). A nod to erstwhile Gothic architecture followed, with numerous institutions constructing in neo-Gothic style, including so-called red-brick universities in the United Kingdom (Whyte, 2015).

Since the end of the Second World War with the huge expansion of higher education world-wide we have seen many new institutions built and older ones expanded. The 1960s/70s saw an international wave of university design, much of which was Modernist and in marked contrast with the impressive and ornate university architecture of former eras. One example of highly contrasting university architecture in close proximity could be seen in the modernist Maths Tower in Manchester, which was built in 1967–68 by Scherre & Hicks architects directly opposite the neo-Gothic Whitworth

[2]The rise of fraternity-type associations (*Studentenverbindungen*) in Germany which provided living quarters and fostered notions of life-long community and alliance formed a later counterpoint to this (Biedermann, 2007).

[3]See https://www.uchicago.edu/features/20100907_botanic_garden/ Accessed 27.11.2018.

Building, which was built between 1895–1902 (Fig. 3). Following the 2004 merger of the Victoria University of Manchester and the University of Manchester Institute of Science and Technology when two maths faculties needed merging, the 39-year-old Maths Tower was deemed no longer fit for purpose and has since been demolished to make way for the Alan Turing Building, which was designed by John McAslan and Partners and completed in 2007.

Figure 3: Former Maths Tower, Manchester

Modernism as an architectural style took root in higher education in the 1960s/70s, either in the creation of individual university buildings within an existing campus, or the development of whole campuses, such as the University of Regensburg in Germany (1967/1974). This is a good example of an entire campus designed and built more or less in one go, making significant use of concrete as a construction medium and located on a single dedicated green site close to the city centre (Zirra, 2017).

We can summarise various main concepts of university campus as follows:

- collegiate (e. g. Oxford or Cambridge, Great Britain)
- multi-site civic universities comprising faculties spread across town, which can consist of various designs and ages, containing more or less green spaces in between (e. g. Heidelberg or Würzburg, Germany);

- one-site civic universities (e. g. Manchester, Great Britain);
- green field universities usually built in entirety during one main construction phase (e. g. Regensburg, Germany; University of East Anglia, Grear Britain);
- green field universities that were relocations from existing civic locations and which have have been developed over time (University of Lausanne or École Polytechnique Fédérale de Lausanne, Switzerland).

New 'green field' campuses were designed with a different concept in mind from preceding scattered multi-site universities of the past. In Great Britain, for example, the seven 'new' universities built in the 1970s were all to be built on dedicated expansive 200 acre sites (Birks, 1972, p. 12).

Although many campuses were purpose-built, due to sometimes pressing expansion needs, e. g. when research grants are awarded and project staff need speedy accommodation, other existing properties have been acquired, some of which may not, or no longer, be fit for purpose (Boys, 2015, 4). Various departments in Oxford are located in Victorian buildings (e. g. Department of Education; Department of Computer Science). Working and learning in these buildings is often far from ideal (interview with Department Director and own experience).

Campus designs inspire or challenge their users in different ways and there is no one design that suits everyone. Each will display various advantages and disadvantages to staff and students alike and it is beyond the limits of this paper to empirically prove how much academic learning, for example, is enhanced by particular environments. However, the locus and kind of environment undoubtedly influence individual selection of learning space, learning behaviour, frequency of academic exchange, and extent of interdisciplinary discourse etc. Students and staff in a multi-site civic university may not have as many opportunities for interdisciplinary exchange, for example, than if they were studying in a one site campus where all disciplines are in close proximity. If planners do not provide informal or formal spaces in which students/lecturers can gather for academic exchange, a campus may feel unwelcoming rather than remaining a hub of ongoing learning activity.

It is important and more economic to involve stakeholders in campus management decision-making. If end user needs are fully understood, then the architectural competition will be closer to realising that which is required. End users do, in general, have a fairly clear idea about what works for their needs and their opinions should therefore be sought during design and construction phases, not merely post-occupancy (Riddle & Souter, 2012; Carnell, 2017). Higher education estate planners are becoming increasingly aware of how much the environment is of direct influence on student and staff well-being (Vidalakis et al., 2013) and have been building to create, where possible,

the most appropriate buildings in suitable surroundings, which will then ideally form a physical manifestation of overall institutional ideals. We are reminded that "the world's most enduring campuses have been shaped by a common faith in the built environment and the realisation of this tenet in the partnership between institutional ideology and their physical form" (Coulson et al., 2015, p. 259). In the following section, the paper explores how institutional values are reflected in its campus management.

3 Strategic capacity and notions of care in higher education estate management

In past centuries, most university buildings enjoyed high status and were built using excellent materials. Founding fathers frequently had clear notions of how the physical representation of a campus should reflect and promote values they held dear and wished their graduates to adopt, in particular liberal ones. Coulson et al. (2015) subtitled their seminal work on university planning and architecture *"A search for perfection"*, which aptly reflects the overall care that has been invested in higher education sites. Philanthropists, sponsors and landowners investing in higher education architecture were fairly unrestricted in what they could buy and what they could build upon an assigned site. If land and sufficient funds were available, it was usually enough for a group or individuals to obtain permission from the founding father or from those responsible for the development of the institution.[4] Many institutions benefited from the financial support of one main patron, leading to designs and layouts of buildings which reflected a patron's own values and idea for an institution. Today it is less common to see universities enjoy patronage from one main sponsor. The way in which campuses are constructed and maintained, therefore, has come to rely on other aspects which include university leadership, institutional goals and financial possibilities which links directly with an institution's values and mission on the one hand, and its ability to function according to these on the other. This can be called its strategic capacity which has been defined as *"how an institution lines up its internal components to achieve some common ends. It refers to a collective and on-going action-oriented process"* (Thoenig & Paradeise (2016, p. 299). If we assume that an institution of high status such as those in the case studies has strong strategic capacity, then its goals are clear, stakeholders are involved, and the institution will remain agile as and when it needs to change. The extent to which internal components of estate management and maintenance 'line up' is therefore of key interest in the context of our discussion. While responsibility for planning cannot be separated from the surrounding legislation which influences how campus management operates (e. g. numbers of staff involved, financing of new buildings), this 'lining up' touches on issues of ownership and responsibility. From a constructivist perspective, this paper, which is part of ongoing interna-

[4] Harvard, for example, came into existence shortly after Massachusetts was colonised. Following an endowment of £400, those in the Great and General Court decided to build a place of learning which would support early settlers (cf. Coulson et al., 2015, 83).

tional comparative research into higher education estate management, therefore investigates notions of value, care and identity among those involved in estate construction and maintenance (Tse et al, 2015).

Although architects provide the designs for buildings, it is only when the builders commence their work that the 'nuts and bolts' of the process literally come to the fore. Construction processes require agility as modifications are frequent. This may be due to material requirements or other necessary adjustments during construction. In her examination of Dutch university campus management, den Heijer (2011, p.37) suggests that campus management processes work best if stakeholder perspectives are examined sufficiently well. However, estate managers or those overall responsible for construction are not necessarily expert evaluators. Even when stakeholder analyses have been undertaken in advance of a project, it is not always the case that the right questions have been asked (Stockmann, 2006, p. 271). In the past notions of value, care and identity have not always been given sufficient attention in construction processes and there are numerous examples of buildings which the architectural profession may have found ground-breaking, but which end-users found insufficient in various ways.[5]

Therefore, in advance of choosing a design, university leaders and their planners should ask the following questions: Who should be involved in building projects and to what extent? What are the needs and expectations of future users? What do they value? Are academic identities taken into account? How well will estate be maintained once a new building is inaugurated?

An example of 'careful' construction

Considering that many university sites around the world contain architecture of the highest quality that has stood the test of time, then we might assume that anyone involved with planning processes of modern buildings for higher education today should be thinking about longevity, future fitness for purpose and/or flexibility of use, quality of materials, empathy for existing buildings and how the new site reflects the identity of the institution (and/or faculty) overall. In the words of Sir Hugh Casson – a major architect of university campuses: "*Unless the architect is clear about the academic and social policy of the university for which he is working; if he fails to believe in it, and then to contribute imaginatively to its achievement, then that university will surely find its aim crippled or unfulfilled"* (Birk, 1962, p. 45). Planners need to think not only

[5]James Stirling's buildings in both Oxford and Cambridge, the Florey Building (Queen's College) and the History Faculty in Cambridge are two prime examples. The History Faculty building was strongly criticised for its departure from and lack of engagement with existing surroundings, while the materials used in the Florey Building were of poor quality, leading to leaks, drafts and other unpleasant side effects. That said, the Florey Building has since become popular with students.

about the initial expense of construction, but consider also future costs and uses. Buildings erected for the previously mentioned seven British new universities were "intended to last" and "if flexible, [should] pay for themselves over and over again" (ibid., p. 22).

One precedent that exemplifies what an academic community should incorporate is New College, Oxford, which was founded by William of Wykeham (Bishop of Winchester) in 1379 and included from 1403 a *dining hall* (located back to back with the college *chapel*), the Founder's *library*, *chambers* for masters and students and the Warden's lodgings, all of which are located in what is now termed the Old Quad, which was completed in 1386. All needs, including religious ones, were met in a small compact physical environment. Williams concept of higher education included for the first time living and teaching space for undergraduates *and* graduates. To this day the college bears witness to his original ideas and honours statutes that he established.

If we fast forward college history to the present with the redevelopment of its Savile Road site (a few steps from the main college buildings) we can identify a new scheme which is highly sympathetic to the founder's original ideas – the Gradel Quadrangles (David Kohn Architects) which cost 35 Million GBP, part of which was provided by a principal donor, hence the name. Here the idea is *"to create a development in keeping with the grand exemplar buildings of the rest of the College, modern and timeless yet with the 'feel' of an Oxford quadrangle, and necessarily of the highest architectural quality"*[6]. Three themes underscore the above excerpt: first we identify the notion that the new development should stand up to comparison with former, admittedly 'grand' architecture. This implies that the former architecture has, over centuries, been fit for purpose and remains worthy of emulation. Second: the architecture should allow room to be something new and have its own unique identity, yet, the design should be timeless, which means meeting future expectations. Third: there should still be a recognisable nod to former designs, and in Oxford that is predominantly the quadrangle, although the Gradels are actually open on one side. As with the Old Quad, they incorporate teaching, living and learning spaces: lecture theatre and seminar rooms, living quarters, a music hall, part of New College School, a gatehouse and a tower. The selection of the Gradels design was reached following an international architectural competition and extensive discussions with various stakeholders, including students and the wider public in general. An internal college committee was put together to work on the project, overseeing the competition and all further stages of development. The final architectural design was selected following end user consultation and took all of their voices very much into account, not always the case in institutional planning (cf. Jamieson et al. 2000, p. 225).

[6] See https://www.new.ox.ac.uk/gradel-quadrangles for details of site. (accessed 15.07.2018)

Although the financing of the Gradels has not yet been procured in toto, New College has nonetheless decided to choose more expensive building materials of higher quality which will hopefully endure numerous generations. The College Bursar who oversees the finances of the project said in interview that one of the main problems with providing new buildings for higher education in Oxford is that "nerds get lost in decision-making". This hits on a key point: not all of those involved (e. g. faculty, students, administrative staff) will be familiar with construction processes, building materials, detail of architectural design, or the costing of projects, and this can become an issue when decisions need to be taken. However, the getting lost in decision-making exemplifies on the other hand the non-triviality of higher education construction and the importance of getting things right, in other words, constructing a building and its environs that reflects the institution's values, is solid and long-lasting, flexible of purpose *and* sympathetic to end users.

However, some may be restricted by the number of staff available for estate management, which will have an effect on how construction is managed or how infrastructure is maintained overall. In order to exercise due care in construction and maintenance, there is need to sufficient resources available. Let us therefore now turn our attention to the case studies to examine how estate is being managed in each.

4 Campus management

4.1 Oxford University

4.1.1 Financing

In the United Kingdom and following a Royal Charter that enables institutions of higher education to award degrees, most British universities take on the status of charitable trusts which are owned by a Council of Trustees. They are not allowed to make profits commercially, but are autonomous and can manage their estate more or less independently. They can apply for funding for capital (estate and maintenance) from the Higher Education Funding Council for Education (HEFCE)[7], which reported that 13 per cent of total higher education expenditure was distributed upon capital in 2017–2018[8], although at this time universities in the United Kingdom were borrowing far more in order to expand and rejuvenate their sites (pre-Brexit)[9]. Sponsors can play a major part in financing new higher education buildings. All cases of private funding need not go through EU procurement processes and at Oxford University private

[7] HEFCE ceased operating in March 2018. Construction funding will now be organised by the Office for Students (OfS). It acted formerly in accordance with the Further and Higher Education Act 1972 http://www.legislation.gov.uk/ukpga/1992/13/part/II. (accessed 07.08.2018).

[8] See http://www.hefce.ac.uk/funding/annallocns/1718/ for further details (accessed 07.08.2018).

[9] The Financial Time noted in July 2016 that spending on construction would increase by 43 % as universities raced to build new facilities in order to attract lucrative international students. See https://www.ft.com/content/03522a1c-4a9b-11e6-8d68-72e9211e86ab for details (accessed 07.08.2018).

funding exceeds 50 per cent of the entire campus (interview, Head of Estates). The *Campaign for Oxford*, a fundraising campaign investing in students, posts, programmes and buildings, is aiming to raise three Billion GBP for the preservation and enhancement of landmark architecture.[10]

British campus leaders usually apply for HEFCE funding and actively engage the financial support of alumna and other donors to help finance special projects. At time of writing, public estate in Great Britain is subject to EU law: projects are put to tender, which usually results in an international competition. Even where good experiences of work with local architectural firms have been made in the past, the procurement process remains open and competitive (interview, Bursar, New College, Oxford). Tenders in Oxford will usually work according to 30 per cent price, 70 per cent quality, which reflects the University's aim to provide a high quality environment. The University can apply for funding for its shared facilities (e.g. faculty buildings), while each college can apply for separate funding for any of its own developments (e.g. student accommodation; expansion of teaching/research space etc.). All planning applications are submitted to respective Councils or City Councils (here: City of Oxford) which can accept or reject proposals. In recent years *"planning regulations have tightened"* (interview, Head of Estates, Oxford). Stakeholder analyses are required for all new projects, which takes their wishes and expectations into account (Royal Institute of Chartered Surveyors, 2013).

4.1.2 Managing Oxford estate: juggling centuries of architecture

Oxford has become synonymous with world-class excellence in teaching and research, and according to Thoenig & Paradeise's (2016) model of strategic capacity and organisational ability we might imagine it to be an example of a "top of the pile" institution, with excellent governance processes in all areas, including its estate management. Results from this research reveal that fairly recent changes in the way its estate is being managed have certainly enhanced the professionalization of estate management, so that we can now suggest the University be placed in the above category.

Oxford is a small city of medieval origins, completely surrounded by high conservation value watermeadows and ancient woodland. It possesses a medieval sewage system and electrics that were not designed with the capacity needs of the present city in mind. A walk around town will take you past medieval (e.g. Merton) and far more recently-built colleges (e.g. St. Catherine's). As independently-run entities, colleges are responsible for their own site maintenance and the funding of ongoing develop-

[10] See https://www.campaign.ox.ac.uk/the-campaign/buildings for details (accessed 08.08.2018).

ments.[11] Other parts of town will take you through areas which contain predominantly publicly-financed buildings, notably those in the University Science Area or the Radcliffe Observatory Quarter. From its humble beginnings, the university has expanded over the centuries and according to changing needs to include, for example, more student accommodation or faculty buildings. The following table summarises the present estate situation of the University:

Table 1: Oxford Estate in figures (own illustration adapted from University website)

4	Academic Divisions
25 %	Stock on Preservation List
38	Colleges, separately governed
40 %	Estate built before 1840
90 %	Owned as freeholder
235	Buildings
1424	Age of oldest building (Divinity School)
30.000	Individual spaces
590.000m^2	Space, excluding colleges

As many sites and buildings are listed (those of national historic interest such as the Radcliffe Camera), any changes such as extension, demolition or alteration proposals must be forwarded to the local planning authorities (notably its Design Review Panel). The height of buildings is regulated, as none should exceed the 23 meter of the medieval Carfax Tower in the town centre, although some exceptions have recently been allowed. 350 staff members are involved in the University's estate management, reporting to the Director of Estates, who is responsible for the teams that deliver maintenance and capital projects through to facilities management. HEFCE (now Office for Students) formerly stipulated that all British universities establish and publicise strategies on the use and maintenance of estate, reporting on their planning and development. In consultation with other stakeholders, the Director of Estates at Oxford (appointed 2012) redesigned the estate strategy plan for all buildings, which now includes consideration of utilization (% frequency x % occupancy), energy efficiency (to meet government targets of 65,900 tonnes CO^2 emissions by 2020–21), and fitness for purpose and allocation (Murphy, 1994). Present priorities are described thus:

- *To meet the changing patterns of research and teaching activity that result from changes in the size and shape of the University*
- *To improve the utilisation of space through new buildings designed for flexibility and shared use, and the effective sharing of existing teaching and research facilities*

[11] In the past college matters of estate were usually managed by an Estates Bursar (project leadership) and the Domestic Bursar (financial controlling). They now regularly come together across the University to exchange information and experiences, which increases the professionalization of estate management.

- *To improve the condition and functional suitability of the estate by re-purposing existing buildings which are vacated when new ones are built*
- *To reduce running costs and carbon emissions across the estate.*[12]

This has been integrated into the University's wider Strategic Plan. One specific point of interest mentioned above is improving use of shared learning spaces where we can see a direct concern for how and where students learn. All such plans need to remain agile and are not necessarily served best by being placed in rigid five year plans or the like. As of December 2016 Estates were beginning to adopt a rolling rather than fixed approach, although it maintains a five-year repair and maintenance programme.[13]

Estates reports to the University of Oxford Buildings and Estates Sub-Committee, which provides independent in-house scrutiny of its work. In recent years the Sub-Committee has drawn on external expertise and the experiences of consultants who have worked for similarly structured universities (policy-borrowing), in particular to advise on the sequencing of major projects. In the words of the Sub-Committee's chairman: *"It's a bit like being an air traffic controller, in that you can see all these projects and line them up in a nice sequence so that they don't smash into each other and so that we have got a proper supply of capital funding coming in and a proper supply of sites and that the governance process will have time to process them all so that they can all proceed in an orderly direction towards completed buildings."* Since 2012 with the introduction of an externally appointed and highly experienced Director of Estates the management of Estates has been greatly professionalized, thereby avoiding 'collisions'. However, in interview the Director mentioned that the maintenance of ancient architecture and sites remains a particular challenge. Occasionally, projects which underwent the usual stakeholder analysis went on to cause greater irritation in the community[14].

4.2 The University of Lausanne

4.2.1 Financing

Switzerland provides a different example of how university estate is funded and maintained. The Swiss Conference of Higher Education Institutions stands at the top of the decision-making pyramid co-ordinating activities of both the Confederation and

[12] See website for details: https://www.admin.ox.ac.uk/estates/strategiesandpolicies/strategy/universityofoxfordestatestrategy/ (accessed 06.07.2018).

[13] Estate plans are made available to the public via the university website.

[14] The Castle Mills student residence on the edge of Port Meadow is a case in point, see https://en.wikipedia.org/wiki/Castle_Mill. Accessed 11.12.2018.

its Cantons. Essentially, it has its own budget.[15] Under Art. 47 of the 2011 Federal Act on Funding and Coordination of the Swiss, the Confederation is responsible for *"contributions to cover expenditure and use of buildings"*. The Federal Assembly debates and passes requests for funding commitments if they meet the following main criteria, among others: construction costs in excess of five million CHF, cost-effectiveness and ability to meet stringent environmental and energy efficiency standards.[16] Especially with regard to environmental concerns we can see that the Confederation is leading the way internationally, making these a legal requirement. In Great Britain the reduction of carbon emissions, for example, as promoted by HEFCE, remains a non-legal requirement.

Almost all of Switzerland's universities receive the majority of their funding from their respective canton and they therefore do not stand in funding competition with one another. The following table from the University of Lausanne illustrates a typical breakdown of funding sources:

Table 2: Funding sources University of Lausanne 2017, adapted from University website[17]

Canton Vaud	52,6 %
Intercantonal Agreement on Universities (AIU)	10,3 %
Law on University Aid (LAU)	15,5 %
Swiss Research	8,5 %
European Research	1,4 %
Students and Continuing Education	2,5 %
Other	9,1 %

4.2.2 Estate management at the University of Lausanne: A tale of relocation, expansion, sheep and parkland

Lausanne in the Swiss canton Vaud on the banks of Lake Geneva was granted university status in 1890 by which time it could boast numerous faculties, but its origins are far older as it started as a theological academy in 1537.[18] By the 1960s over forty university buildings were in use across the city and student numbers had reached a

[15] See Section 2 Swiss Conference of Higher Education Institutions in Federal Act on Funding and Coordination of the Swiss 30 September 2011, Higher Education Sector, for details: https://www.admin.ch/opc/en/classified-compilation/20070429/index.html. (accessed 07.08.2018).

[16] Ibid. Art.

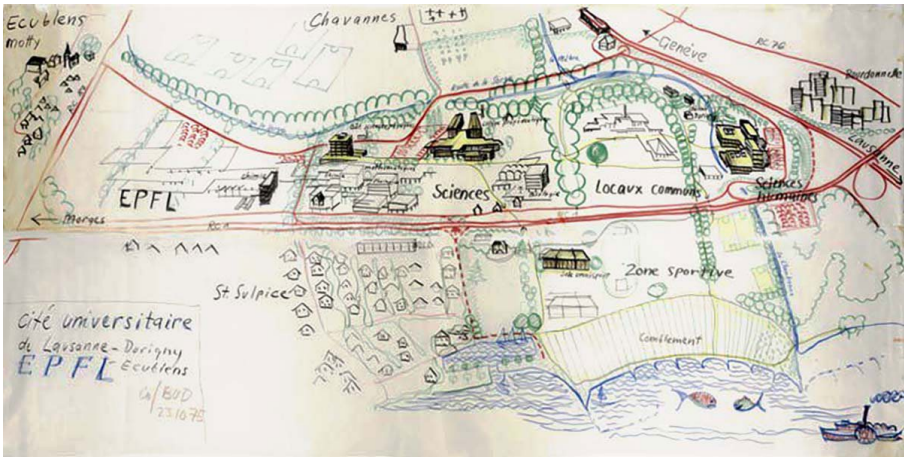
[17] See https://www.unil.ch/central/home/menuinst/unil-en-bref/en-chiffres.html for details (accessed 19.11.2018).

[18] See university website for details https://www.unil.ch/central/en/home/menuinst/unil-en-bref/hier-et-aujourdhui.html (accessed 06.07.2018).

capacity that completely overstretched existing possibilities (Maillard, 2013, p. 39). The need for alternative space was identified by both the Swiss Federation and the canton of Vaud and in September 1963 a large site in Dorigny on the edge of Lausanne was acquired (354 179m^2). This was to provide sufficient room for the University in its eastern section. The west would provide space for the École polytechnique de l'Université de Lausanne, which would later become the École Polytechnique Fédérale de Lausanne.

Following his success in earlier projects for the canton, the Swiss architect Guido Cocchi (1928–2010) was tasked with creating a master plan for faculty and administrative buildings for the entire site, although he would not necessarily be responsible for the design of each building, as there were usual competitions for projects. Cocchi's vision for the university can be seen in a scribble which he prepared for a presentation in 1975 and which more or less represents the University of Lausanne today (Fig. 4).[19]

Figure 4: Cocchi's scribble of UNIL site



Cocchi was personally responsible for the design of the first building, the Amphipôle (1969–1970), which cost over two million CHF and contains seminar rooms, laboratories, a cafeteria and two institutes (Maillard, 2013). He was thereafter made architect-in-chief for all later projects, unusually holding an office onsite. In addition to the Amphipôle, Cocchi designed the Law Faculty building, the Unicentre and the Unithèque (library).[20] When asked about how his campus vision came into being, Cocchi replied that he literally let his feet do the talking by walking the entire site to get a feel for its

[19] See also Maillard (2013), pp. 96–97.

[20] A brief summary of Cocchi's contribution to the university is kept in the university archive, see https://uniris.unil.ch/pandore/notice/guido-cocchi-architecte/ (accessed 09.08.2018).

geography, vistas etc. (Maillard, 2013, p. 64). Some site details such as footpaths connecting individual buildings were left purposefully until end users themselves first started using the site. Footpaths may therefore seem idiosyncratic, however, they reflect the choice of route taken by actual users. Cocchi wished to maintain the expansiveness of the general parkland atmosphere, and there is a marked sense of calm and openness present. Each faculty building has its own unique design, which promotes identity among its users. From the inauguration of the Amphipôle in 1969–70 until that of the Géopolis building in 2013, the University of Lausanne has seen the inauguration of a new building every three years. The quality of building materials and finish is evident onsite, and there are hardly any signs of weathering, which is an indication that the selection of high quality materials was a high priority during planning. Time has been given to allow the campus to be developed in a considered and consecutive manner with faculties steadily relocating from the city centre whenever their new buildings became available. In interviews with staff responsible for estate management (e. g. Director of Estates, Unibat – service des bâtiments) and Vice President for Durability and Campus) it became clear that the spirit of Cocchi remains omnipresent. The selection of architects for subsequent projects has been kept in line with his overall vision – a close association with nature, open spaces in which to walk, discuss and relax, and communal spaces within buildings. The extension of the university library is the next major construction project and will expand to the rear of the existing building – Unithèque – so that the original vista remains unspoilt: another sensitive and clever use of existing, but so far unused space.

In order to disguise possibly more unsightly aspects of university needs such as chemical tanks, heating, water supplies etc., which might impinge on the overall beauty of the parkland environment, these were located from the outset in an underground shaft which runs for almost two kilometres beneath the site and links with the École Polytechnique Fédérale de Lausanne (Maillard, 2013, p. 46). In a further nod to the parkland and also as an environmentally-friendly means of site maintenance, sheep have been brought onsite to graze and ensure that green spaces are kept at reasonable height.

Today the university's estate management – Unibat – manages a total of 18 buildings on a 61,5 hectare site, some of which are multi-storey (e. g. Physics; Anthrôpole), although elevation does not usually exceed six storeys. The Director of Unibat manages a team of 13 staff in three main sections: utilization, administration and planning. Communication channels between the university's leaders and those responsible for projects are frequent and in close physical proximity. Liaison with the neighbouring École Polytechnique Fédérale de Lausanne is also maintained via joint participation in project committees.

4.3 École Polytechnique Fédérale de Lausanne

4.3.1 Financing

In contrast with the financing of the University of Lausanne, only two Swiss institutions, the Eidgenössische Technische Hochschule Zurich and the École Polytechnique Fédérale de Lausanne, are state-funded. The latter receives 66 per cent from the state and 33 per cent from third party funding[21]. All Swiss higher education buildings that are designated as being of national relevance, such as the Rolex Learning Centre at the École Polytechnique Fédérale de Lausanne, which was opened in 2010 and cost 110 million CHF, receive 50 per cent funding from the state (Jodidio, ed., 2015, p. 38). At the École Polytechnique Fédérale de Lausanne the former rector, Patrick Aebischer, was highly influential in approaching a variety of sponsors who would go on to finance the remaining 50 per cent of the Rolex and indeed other buildings. The Rolex´ name exemplifies the role of private donors in major new university constructions without whose support financing would be far more difficult.[22] [23]

4.3.2 École Polytechnique Fédérale de Lausanne campus management: a rector's vision

If physical development at the University of Lausanne has been largely influenced by one architect, a significant development of the École Polytechnique Fédérale de Lausanne, in both strategic and estate terms, was brought about by its former rector, Patrick Aebischer (2000–2016). However, before his impact is explored, we need to briefly reflect on the institution's history.

Starting out as a special school in the centre of Lausanne in 1853, with subjects including architecture, physics and chemistry, the school developed into an academy and was granted university status in 1869 as part of the University of Lausanne in the city centre. Following a National Council "Law on Federal Institutes of Technology" (9th October 1968), the École Polytechnique Fédérale de Lausanne was founded on 1st January 1969 and, as was the case with the University of Lausanne, started relocating to the Dorigny site. Sébastien Oesch was the architect in chief responsible for ensuring a "unity of construction". His remit was to create a flexible modular structure which could easily be expanded as and when needed. Indeed, it is hard to identify where extensions have been added as they blend in with original ones. The first build-

[21] See https://information.epfl.ch/facts for breakdown of third-party funding (accessed 19.11.2018)

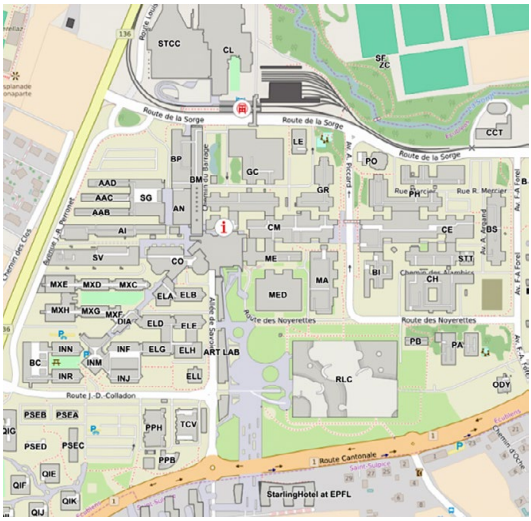
[22] Other main sponsors of the Rolex include Nestlé, Novartis, Credit Suisse and SIPCA (Jodidio, 2015, p. 38).

[23] By contrast, most providers of higher education in Germany are federal states. The Federal Government provides financing for research projects and the construction of research facilities (15%). However, due to serious underfunding of basic financing (*Grundfinanzierung*), which includes buildings and campus maintenance, it is a well-known fact that many German universities are in a state of chronic disrepair (Stibbe & Stratmann, 2014, p. 3).

ings were ready for occupation in 1978 and used state-of-the-art methods that were revolutionary at the time, such as greenery of the roof, self-cleaning façades, and modern heating arrangements.[24] The nucleus consisted of Centre Midi (CM) and Centre Est (CE), which were designed along an east-west axis and consisted mostly of teaching spaces (lecture theatres, seminar rooms, communal and flexible areas). Mechanical Engineering (ME) and Chemistry (CH) were the first two faculties to be relocated from the city centre to this central part. In the second main phase of construction another main axis to the south-west expanded to meet up with the Science Park and Innovation Lab areas. Inner courtyards bring nature into the campus and provide communal resting places.

Following further construction work, all of the École Polytechnique Fédérale de Lausanne's former city-based faculties were onsite by 2001.[25] The buildings are of high quality and have lasted well, in spite of severe winters and sometimes hot summers.

Figure 5: EPFL campus map



The above map reveals a very different concept of campus in contrast with its direct neighbour, the University of Lausanne. The École Polytechnique Fédérale de Lausanne's buildings rarely exceed three storeys in height. The majority of central teaching space located at the heart of the site means that disciplines are encouraged to come together regularly, although this can also be said of the University of Lausanne with its Amphipôle teaching hub. Faculty buildings may not have quite as much individual identity as

[24] See online interview with Sebastian Oesch. (accessed 09.08.2018).

[25] See website for details https://information.epfl.ch/history. (accessed 09.08.2018).

do those at the University of Lausanne, however, they were designed to inspire end users (interview with one of its architects Dominique Perrault).[26] The central university administration building, with its new rainbow-coloured façade, is a case in point. It is situated at the heart of the campus and has been modified from its former use as the Mechanical Engineering Building. It has a different feel from the rest of the campus, which is predominantly maintained in various nuances of grey. Although green space has been reduced as the site has expanded, there are still many large spaces which give the campus an intentional sense of openness. Instead of expanding upwards, the École Polytechnique Fédérale de Lausanne has expanded outwards. One onsite observation (February 2017) revealed that although there were seating arrangements outside cafés, for example, students in other areas were sitting on the ground in areas where seating was not provided. This might be a suggestion to be followed up.

The previous rector has already been mentioned. His experience of American campus life influenced his thinking about how he wished his institution (and its campus) to be. Aebischer wanted the École Polytechnique Fédérale de Lausanne to adopt similar characteristics to become a 24/7 liberal place for living, learning and researching that would encompass the world's main technological and natural sciences, but not be siloed by excluding others (Delaye, 2015). Since 2000, the École Polytechnique Fédérale de Lausanne has added the Life Sciences in its subject canon and some students can now live onsite in dedicated accommodation. Shops, restaurants, museum space (ArtLab), and the iconic Rolex Learning Centre, which has gathered all faculty libraries in one place, are further key developments. In contrast with the *Campaign for Oxford*, which mobilised present students to approach alumni for financial support, Aebischer used his *own* international networks to personally mobilise three million CHF for various building projects (Delaye, 2015, p. 9). When walking around the campus at different times of the day and night it becomes clear that its lights never truly go out. Buildings, lecture theatres and other spaces are kept open 24/7 to be accessed for creative processes. The recent opening of the Discovery Labs building (opposite the Rolex, see Fig. 6) is an example of space specifically created for interdisciplinary and flexible use.

Figure 6: Discovery Labs, École Polytechnique Fédérale de Lausanne

[26] See https://www.youtube.com/watch?v=sPvfC8ta6Lc for interview. (accessed 09.08.2018).

Estate and maintenance at the École Polytechnique Fédérale de Lausanne is overseen by a Campus Development Manager, who is responsible for ensuring the smooth interaction between new projects and the site's ongoing maintenance, while the overall responsibility for strategic estate decisions lies with the Vice President for Human Resources and Operations. New buildings include state-of-the-art environmental and material technology, reflecting research and scientific fields of the institution that houses them.

5 Discussion

Each institution of higher education can decide how it organises its estate management. Depending on campus size and faculty numbers, there will be greater or fewer numbers of people involved. The above case studies cannot be taken as being exhaustive and they have specifically been drawn from institutions that can possibly lay claim to being "top of the pile" in terms of their strategic capacity. The oldest of the three – Oxford – has recently taken great steps forward in its estate management and has become far more professional as a result, both at central University level, but *also* among the group of college administrators responsible for estate. Estate management in Oxford is a highly complex and costly undertaking which costs 100 million GBP per year[27]. Numerous factors need consideration: the institution's ancient history and values, the surrounding physical environment, its spatial limitations, and ongoing and challenging needs in state-of-the-art technology. For example, all buildings, ancient or otherwise, needed internet provision in recent decades. Energy supplies for research projects and the improvement of existing sites for modern purposes required attention. Following HEFCE guidelines, carbon footprinting and emissions have come into focus with recent attempts to reduce emissions and make users more environmentally aware. Choice of building materials has usually been sound and long-lasting, and the notion that buildings may only last for only a few decades in an institution of this kind is foreign. However, the Zoology and Experimental Psychology Tinbergen building (opened 1970) was suddenly closed on 17th February 2017 when significant levels of asbestos were discovered, forcing 1600 staff and students to move. A University steering committee has since decided to demolish the building. This raises an interesting point for estate management overall. Buildings, for whatever reason, can suddenly become unfit for purpose. If buildings house experimental research, as in this example, and need to be taken out of action, researchers may enter a highly-precarious phase of uncertainty in which their ongoing (and possibly very costly) research may even be ruined. University estate managers therefore need to have some kind of plan of action in place should a building suddenly become defunct and ensure due care for such eventualities.

[27] See https://www.ox.ac.uk/about/building-our-future/planning-and-consultation?wssl=1 for details. Accessed 12.12.2018.

Specifically, and as a result of research findings on how environments impact upon learning, the University is paying close attention to the spaces in between buildings and how they are used, in addition to other details such as user flow at certain times of the day (interview, Head of Estates). Higher education research into learning spaces conducted by the University's own Department of Education has been consulted, making good use of in-house expertise. The University released a detailed document on the Planning Procedure in February 2018, which provides a transparent overview into the entire process of new construction[28]. Recent star architect projects such as Zaha Hadid's Investcorp extension of St. Anthony's College[29] or Herzog & de Meuron's Blavatnik School of Government[30] are two examples of notable modern architecture which blend in with existing, much earlier architecture, although admittedly only the latter is part of University-owned estate. Although radically different in architecture, the Blavatnik was specifically designed to *"represent the values of openness, collaboration and transparency that are key to the School's overall mission of improving public policy"*[31]. Although undoubtedly stunning, my most recent onsite visit in December 2018 revealed that the building was already showing some early signs of weathering (Mostafavi & Leatherbarrow, 1993), which will inevitably require attention in due course.

The University of Lausanne is an example of steady site development over time. Under the watchful eye of its main architect it reveals how building designs by different architects can be carefully made to fit into a 'grander scheme'. The notion of individual faculty identity has been strongly upheld here, however, shared themes such as communal spaces for discussion and relaxation are common to all. Creative thought processes demand effort, and sites that provide places of rest and tranquillity alongside buzz areas such as cafés and eateries or teaching spaces seem to be providing the right kind of balance. At the University of Lausanne it is completely acceptable for students to be seen taking a nap on a sofa between teaching/learning time, as the author witnessed in the most recently-built Géopolis building as in its oldest building: the Amphipôle. At the École Polytechnique Fédérale de Lausanne, meanwhile, and in addition to its normal catering areas, we can find numerous independent pubs and cafés onsite that provide different kinds of environment for discussion and relaxation.

From the Swiss example of two institutions that developed their physical identities on a shared common parkland site at roughly the same time, we see different concepts

[28] Available via https://www.ox.ac.uk/about/building-our-future/planning-and-consultation?wssl=1 Accessed 12.12.2018.

[29] See http://www.zaha-hadid.com/architecture/middle-east-centre-st-antonys-college/ for details. Accessed 29.11.2018.

[30] See https://www.bsg.ox.ac.uk/ Accessed 29.11.2018.

[31] See https://www.bsg.ox.ac.uk/our-building. Accessed 29.11.2018.

for their campuses that meet in the middle of the Dorigny estate, where boundaries between the two merge. Indeed, some buildings such as the Batochemie building are now shared, as chemistry is studied in both institutions. Estate management here requires close liaison between the two above-named Swiss institutions. Discussions with planners and leaders in both institutions revealed that they are keeping well informed of each other's building plans and projects. Indeed, the University of Lausanne is now taking first steps to 'open up' its campus to become available to its students on a 24/7 basis, emulating the lead already taken by the École Polytechnique Fédérale de Lausanne.

Although many parts of both institutions were built in the 1970s, when some campuses elsewhere were being built of materials of lesser quality that is now leading to considerable maintenance/renovation costs, the high quality of building materials is evident when walking around the two sites. The ongoing maintenance of estate is important and in both cases efforts are being made to ensure that buildings are kept in good repair. Nonetheless, even the untrained eye can see that some parts of original École Polytechnique Fédérale de Lausanne buildings may soon need some attention.

With regard to estate funding, additional money can be generated from private donors, and this may depend on an individual charismatic leader (e. g. Patrick Aebischer) or the collective charm of present students who approach alumni and other possible sponsors for funding (Campaign for Oxford). However, this remains a challenge as the funding of maintenance for window replacement, for example, as in the words of an Oxford staff member, appears of far lower interest to donors than plans for possibly spectacular new developments, even if they might be able to say they have provided financing for new windows, roofing, etc. Estate management therefore needs to work closely with Development Offices to think of innovative ways of making maintenance donations attractive.

Private donations remain rare in state-financed institutions and investment in higher education estate from state coffers may be too low to maintain high standards. However, and in spite of our digital age where communication can be conducted irrespective of physical place, higher education remains a long term concept that is linked to an actual locus. Investing in quality, exercising due care in considering present and future stakeholder needs, attention to the quality and longevity of building materials which can lead to a reduction in maintenance costs, are all examples of strategic capacity and organisational ability. Higher education leaders that think in such terms will be doing their institutions good service. As in the Oxford example, estate management work needs to be agile, fixed on the one hand in a longer-term strategy, but flexible enough to address unexpected eventualities and needs. Fifty years from now the landmark Rolex Learning Centre could possibly become a 'protected' building. Its

managers of today need to keep its maintenance in mind to protect its future status. Close attention needs to be placed in the functionality, economy and maintenance of any building that serves higher education purposes, not merely the short-term fulfilment of particular needs. It may be the case that those university estate managers that strategically consider long-term impacts will be serving their institutions for generations to come long after they themselves have left.

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