

## 5 UNDERSTANDING THE RESEARCH ENVIRONMENT

### 5.1 Overview

Research supervisors, as a result of their own undergraduate and postgraduate experiences, should already have a good working knowledge of the university and the encompassing university system. However, the overall picture is very complex and, quite often, those starting out in academic/research positions have not been fully exposed to the complete structure of the university or the system in which it operates. For these reasons, it is worthwhile to cover/review the basic elements that exist to support academic/research activities.

One of the problems in covering these issues is that each nation/region has its own distinct set of operating principles for universities and, within those national/regional principles, each university tends to have its own structures and procedures. Nevertheless, there are sufficient commonalities – or, at least comparable structures – within the global university system to make this examination worthwhile.

Understanding the university/research environment is important in the context of supervision because, beyond its academic/research constructs, a university is a complex organization with complex business structures and processes that are essential in order to enable it to function. Notwithstanding the higher educational purpose to which supervisors need to aspire, it is important to recognize that these constructs and responsibilities are a consequence of being in a large organization which has

responsibilities for:

- Funding/finances which are, at a minimum, in the hundreds of millions or, at the larger end, billions of dollars
- The safety and wellbeing of thousands of staff and tens of thousands of students
- Reporting and accountability to funding agencies, governments, etc.

Moreover, universities are a global phenomenon and, while each operates in its own nation and region, the reality is that its performance needs to be considered relative to global best practices, rather than just parochial measures and standards.

## 5.2 A Perspective on Global University Numbers

A common question that many academics and students have relates to how many universities there are in the world. The answer to this question depends upon the specific definition of the word *university* and, with numerous possible interpretations, unsurprisingly, the number of reported institutions also varies.

One of the most extensive evaluations of tertiary institutions is undertaken by the Cybermetrics Lab, a research group belonging to the *Consejo Superior de Investigaciones Científicas* (CSIC) in Spain. This group creates the Webometrics Ranking of World Universities and includes some 24,000 institutions in its assessment of university web activities (*Webometrics.info*, 2015). These 24,000 institutions include research intensive universities; teaching-only universities; institutes of technology and community/technical colleges.

The Shanghai Jiao Tong University's Academic Ranking of World Universities (ARWU) is a respected assessment tool which examines the relative performance of universities around the world. However, the ARWU only examines universities which have a significant element of research activity, according to the following criteria (*Shanghairanking.com*, 2015b):

*"ARWU considers every university that has any Nobel Laureates, Fields Medalists, Highly Cited Researchers, or papers published in Nature or Science. In addition, universities with significant amount of papers indexed by Science Citation Index-Expanded (SCIE) and Social Science Citation Index (SSCI) are also included. In total, more than 1200 universities are actually ranked and the best 500 are published on the web."*

So, for the purposes of those undertaking postgraduate research supervision, the answer is that there are nominally around 1,200 universities in the world which have a significant element of research, and tens of thousands of institutions which operate at a tertiary level but have no research (or limited research) activities.

The total number of postgraduate research students globally varies significantly from day to day, as new universities are formed, or older ones broaden from teaching activities into research. Suffice to say that there are hundreds of thousands of active postgraduate research students at any one time, enrolled in degrees ranging from Master's to Doctoral, to Higher Doctorates, Industry Doctorates, Doctorates by Publication, and so on.

The number of tenured academic positions available annually in

research-active universities is also difficult to determine accurately, but is low relative to annual postgraduate graduations. The implications of this are profound for the research supervisor's approach to his/her task. Specifically, because there is a large annual shortfall in tenured academic positions relative to the number of postgraduates who may ultimately wish to fill them – and the shortfall is annually cumulative – the likelihood of a postgraduate student achieving a tenured university academic position in a research-active institution is likely to be very low. It is important for supervisors to keep this in mind in terms of what sort of skills will be relevant to the postgraduate student for his/her future career.

## 5.3 International Rankings

### 5.3.1 General Issues

Postgraduate research supervisors need to understand that their performance is not only being scrutinized by their direct line managers, faculties and universities but also, increasingly, as part of a global assessment of universities and their performance.

In recent years, a number of international assessment schemes have been put into place in order to determine the relative performance of universities at a global level. Needless to say, the performance of an institution can vary significantly depending upon the assessment parameters/metrics that are deployed in the ranking scheme.

The major rankings which are deployed in universities include the:

- Shanghai Jiao Tong Academic Ranking of World Universities (ARWU)
- Times Higher Education (THE) University Rankings
- Quacquarelli Symonds (QS) University Rankings
- Leiden University Centre for Science and Technology Studies (CWTS) Rankings
- Consejo Superior de Investigaciones Científicas (CSIC) Webometrics Rankings.

Each of these has a different focus and, of course, some institutions perform better on some rankings than others. For example, the Webometrics Rankings look primarily at an institution's web presence and content. The Leiden Rankings examines university publications on the Thomson Reuters *Web of Science* database (Thomson Reuters, 2015).

In general, university rankings tend to focus on research activity rather than teaching activity. Teaching is inherently difficult to measure, and statistical data that is derived from information such as:

- Pass-rates
- Attrition-rates
- Student-satisfaction surveys,

can all be interpreted in a range of different ways. For example, high attrition-rates and low pass-rates can arise because an institution has rigorous and demanding educational programs, or because the institution

has poor educational attributes. A high student satisfaction result can arise because an institution has lax teaching requirements or because it has outstanding educational staff.

For these reasons, international rankings agencies tend to focus upon research outcomes, where there are numerous, semi-objective research metrics available in order to provide relative measures of institutional performance. Despite these measures, there is always debate about which measures should be included or excluded, and what weighting each measure should have when it is included. So, there is seldom universal agreement on rankings methodologies, and one needs to treat each of them with caution because they each have strengths and limitations.

University rankings schemes lose their significance, however, if:

- The assessment methodology changes from year to year or is generally inconsistent
- The metrics deployed in the rankings include subjective assessments of institutions (e.g., perception surveys)
- Institutions can readily *game* the rankings to achieve rapid improvements in their relative positions.

With these points in mind, one set of assessments which provides breadth, consistency, objectivity and intrinsic inertia (which reduces gaming of the system), is the Shanghai Jiao Tong Academic Ranking of World Universities (ARWU). For these reasons, the ARWU is used extensively as an indicator of overall institutional performance in a relative context.

The ARWU assessments of institutions are based upon four criteria and six indicators, as shown in Table 5.1 (*Shanghairanking.com, 2015b*). The notable attributes of the ARWU are its:

- Focus on high-end research – publications in prestigious journals and with high citations
- Intrinsic inertia to prevent short-term gaming – an institution needs to perform well in terms of alumni achieving international distinctions – this needs to be achieved over decades
- Focus upon globally transformative research – as indicated by the number of awarded Nobel Prizes, Fields Medals, etc.
- Focus on engineering, medicine, science and technology rather than humanities.

<i>Criteria</i>	<i>Indicator</i>	<i>Weight</i>
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	10%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	20%
	Highly cited researchers in 21 broad subject categories	20%
Research Output	Papers published in Nature and Science*	20%
	Papers indexed in Science Citation Index-expanded and Social Science Citation Index	20%
Per Capita Performance	Per capita academic performance of an institution	10%
Total		100%

*Table 5.1 - ARWU Ranking Criteria (Shanghairanking.com, 2015b)*

The ARWU favors long established institutions because, in order to perform at the high end of the rankings, an institution needs to have a demonstrated track record of having created a world-class alumni.

The alumni metric within the ARWU is therefore important in the context of the inertia it provides to prevent *short-term gaming* of the system, but also because alumni are an indicator of teaching performance. If an institution is to be deemed to be the best in the world, then it needs to demonstrate that its graduates have achieved the international pinnacle of their respective fields.

The strengths of the ARWU approach are reflected in the top-end rankings of institutions. The limitations of the ARWU are reflected in the middle and lower ends of the ranking scale, because the metrics that are employed are far too coarse for small (or newly-established) institutions to interpret. For example, metrics pertaining to the number of Nobel Prizes or Fields Medals are not particularly helpful to the majority of institutions around the world who would have no entrants in these fields.

There is also the issue that ARWU doesn't necessarily consider newer

prestigious awards – for example, the Kavli Prize for scientific research (*Kavliprize.org, 2016*) and The Breakthrough Prize for fundamental physics, life sciences and mathematics (*Breakthroughprize.org, 2016*). It also needs to be noted that the Nobel Prize is not awarded across a broad range of research categories – for example, biology is excluded.

The problem with updating ranking scheme metrics from year to year to reflect emerging trends in academic/research achievement is that such changes create inconsistencies when comparing institutional rankings across the years. The choice then becomes one of consistency or relevance – and generally consistency wins out, albeit meaning that those using the rankings need to understand the intrinsic limitations.

Nevertheless, the implications of the ARWU and its broad international acceptance are profound for research supervisors. The fact that all research-intensive institutions are assessed by ARWU metrics means that research supervisors need to focus on quality and not quantity. That is, quality of published work, quality of graduates, etc. There is little to be gained from supervisors simply trying to increase their metrics, because the over-arching assessment of institutions is on quality with a very high international benchmark.

### 5.3.2 How International Rankings Affect Research Supervisors

There are numerous points which should become apparent from any investigation of university rankings, specifically:

- The highest ranked institutions are those which have had sustained contributions to transformational change at a global level, over decades or centuries – this is generally measured in internationally renowned alumni; major breakthrough discoveries, etc.
- The world's most highly ranked institutions are those with enormous financial and physical resources, and generally large academic/research staffing levels
- The highest caliber academic staff are naturally drawn to the highest ranked institutions
- Highly ranked institutions draw the best staff and students from all over the world, rather than from just their own local regions



- High caliber staff and students tend to push each other upwards to achieve sustained levels of excellence
- The bulk of the global resources required in order to become a world leading institution (e.g., Nobel laureates, Fields Medalists, etc.) are already located within the world's leading institutions – so university rankings become self-fulfilling, and the order is difficult to change because of intrinsic inertia in the system
- It is generally not feasible for small, poorly-resourced institutions to make dramatic improvements in their rankings because of the systemic inertia – and the fact that improvements to rankings generally require large injections of funds and resources across a wide array of subject areas.

A research supervisor therefore needs to be aware of the constraints that are imposed by the institution in which he/she is operating. For a fortunate few, there will be the luxury of working in a world leading institution, and the ability to attract the highest caliber research students from around the world. For all the other supervisors, an assessment needs to be made of what it is feasible to achieve in the existing environment considering:

- The number and caliber of the research students which the institution is able to attract
- The resources and technical support within the institution
- The intellectual caliber/environment of the institution in which the research student will work (will it inspire the student upwards or drag the student downwards?)

Clearly, an individual research supervisor will have little or no control over the institutional setting. However, this should not be used as a rationalization for tolerating under-performance. The university environment is global, and a research supervisor always needs to think of himself/herself as part of a global research effort, and not just part of one isolated institution. Supervisors therefore need to collaborate with world leaders in the field if their research is to be meaningful in an international context. Such collaborations don't need to be costly and neither do they necessitate travel. At the very minimum, they can be undertaken through internet-based technologies.

To this end, each and every supervisor needs to be looking at his/her supervision and research relative to the world's best players in the specific field – and not relative to internal standards within his/her home institution (unless of course that institution is an independently recognized world-leader in that field).

Part of a supervisor's role is to monitor the activities (i.e., publications,

theses, etc.) of the world's best institutions, in his/her field, and ensure that, notwithstanding obvious resource constraints, outputs from the home institution measure up favorably.

There are many aspects of postgraduate research which are not constrained by resources, including:

- Academic rigor
- Systematic approaches to investigation
- Detailed, comprehensive analysis of data/information
- Balance and impartiality in presentation of results
- An accurate depiction of reality – including self-assessed limitations and strengths of presented research.

It also needs to be noted that resources are not the solution to every research problem, and that they can equally become an unforeseen impediment because they sometimes override the need for systematic and careful consideration of issues prior to synthesis or experimentation.

There may be any number of reasons why a supervisor's home institution cannot duplicate what exists in a world-leading institution. However, to do less than strive for world's best practice in a given field is to do a disservice to the research student.

## 5.4 Institutional Funding Arrangements

In any university, in any country in the world, there are only a limited number of possible sources for institutional funding, and so universities around the world tend to have similar funding models. The major differences between institutions are the relative contributions from each source. The sources include:

- (i) Direct national/regional government institutional funding grants
- (ii) Student tuition fees
- (iii) Benefactorial donations
- (iv) Investment income from endowments
- (v) Commercial income from contract research and development; royalties; intellectual property (IP), asset sales, etc.
- (vi) Competitive (merit-based) research grants from government agencies and private benefactorial organizations.

The key point to note from this is that, in general, although institutional funding may all be held in a central repository, the funding regimes for research and education can be treated separately in an accounting sense.

In most countries, universities aggregate funding sources (i) – (v) into a recurrent budget which is used to fund human and physical resources as per Figure 5.1. Competitive research grants, on the other hand, are funds that are *earned* by academic/research staff in a competitive national or regional process – and those funds are ear-marked for the specific projects for which funds were derived.

When academics/researchers are working on research projects funded by competitive research grants, they are effectively working in a specific cost-center for the university. However, research grants generally only cover the costs of new resources, new research staff (e.g., postdoctoral researchers), and postgraduate research students. They often do not cover the costs of the regular academic staff who are also working on the research. For these reasons, a university often has to cross-subsidize (i.e., *leverage*) funds from competitive grants with its own recurrent funding in order to make many research projects viable in cost-centered accounting terms.

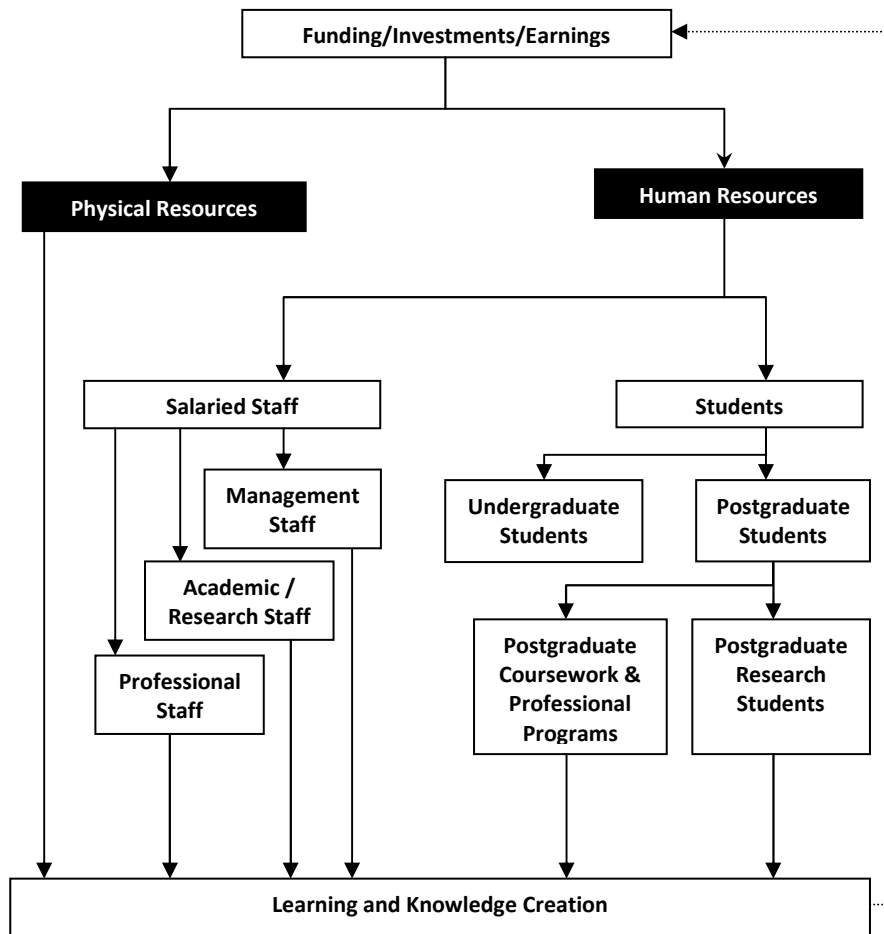


Figure 5.1 – Basic Elements of the Modern University

When a university *leverages* its research funding, it is effectively transferring recurrent funds, which would normally be used for undergraduate and graduate education, to specific research projects. This is often referred to as an *in-kind* contribution to a research project, because academic/research salaries and technical support/infrastructure costs are awarded to a specific research cost center.

For this reason, it is particularly important that all academic staff,

including those purely involved in research, understand that they are not isolated research entities but, rather, part of the larger university educational process.

In many countries, the funding provided for specific research projects, through competitive grants, is devolved through two primary entities/agencies – one for medical/health research and one for all other areas of research. For example, in the United States, the two agencies that provide these funding mechanisms are the:

- National Institutes of Health (NIH) (*NIH.gov, 2015*)
- National Science Foundation (NSF) (*NSF.gov, 2015*).

One reason for this globally widespread anomaly is that it is often difficult to separate research in medical science from national health and wellbeing issues – hence, these two areas tend to be combined into a single funding model, and the remainder of research activities are funded through another model. Needless to say, in the modern world, this becomes somewhat muddled because there are researchers in scientific/engineering fields who impinge upon medical research, and medical researchers who are predominantly conducting scientific research.

In addition to government funding for research, each nation generally has a collection of private benefactors and benevolent commercial organizations who also fund university research projects – although these tend to be primarily in areas of medical science.

Government and private/commercial research grants can also be competitive in nature and so, by definition, there are winners and losers. In any given year, academics and researchers seeking to move their research forward can only do so when they are successful in their grant applications. The problem with this is that it makes it very difficult for institutions to maintain systematic programs of research investigation because they are subject to the idiosyncrasies of competitive research funding providers.

For these reasons, the world's leading research universities tend to be those that are able to maintain a high and consistent level of base-load research funding for staff, which is independent of external competitive grant processes. This sort of funding is typically provided from investment income derived from university endowments.

Invariably, those institutions which have the highest research endowments are those that are able to maintain the highest levels of internal research funding – and thereby become a magnet for leading research staff from around the world– and thereby become leaders in research.

There is a *chicken and egg* scenario in this process because, in order to

attract large endowments from benefactors, an institution has to have a track record of research excellence over decades or centuries. And, of course, in order to achieve research excellence, a university needs to have an internal income stream from endowments. Hence, the global university system has considerable inertia, and the disparities in endowments from the world's leading universities to the world's poorest universities is immense.

Those institutions at the bottom of the international ladder therefore need to work extremely hard in areas of research which have a very low cost base in order to improve their lot in life. A task made all the more difficult because there are so many institutions around the world seeking to undertake low-cost research which has significant impact, and which may potentially boost the standing of the institution. The task is made even more onerous when one considers that many of the world's universities – from wealthiest to poorest – all tend to identify low-cost-base research as an efficacious approach.

## 5.5 Institutional Structures

Each university has its own unique structural attributes, but there are common elements which exist in all institutions – in one form or another. Figure 5.2 shows some of the typical elements. In addition to the academic elements shown therein, there are of course a large number of corporate elements including personnel, finance and accounting, legal, information technology (IT), library, marketing, etc.

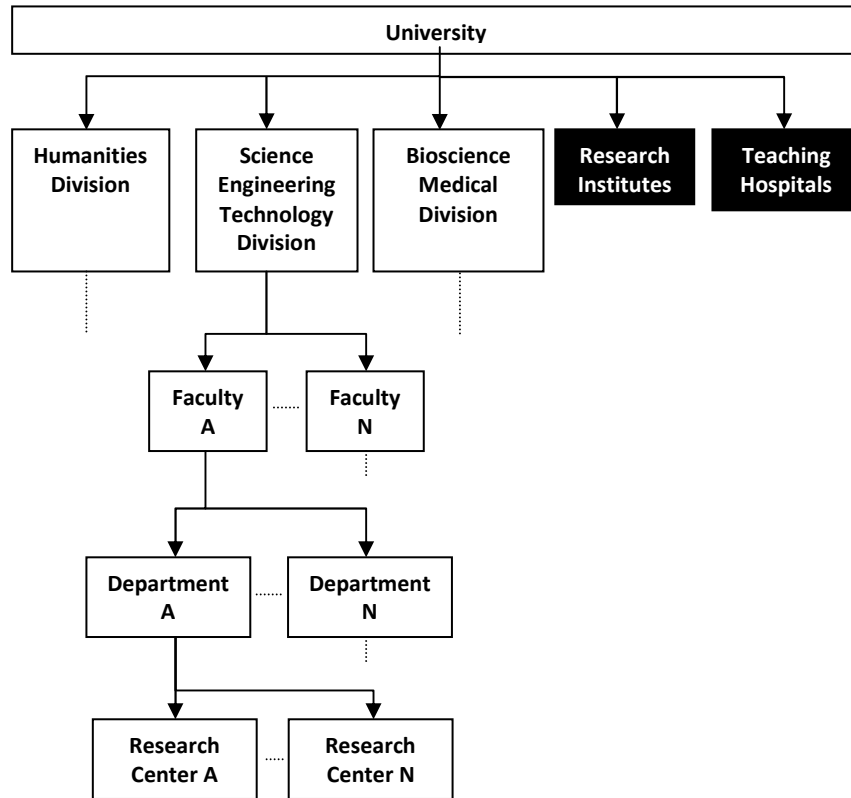


Figure 5.2 – Typical Elements in Modern Universities

## 5.6 University Governance Structures

Universities, by definition, tend to adopt a collegial style of management in which significant decisions are made by groups of experts. This is partly for historical reasons and partly because universities have a very broad mix of products (i.e., courses, areas of expertise, activities, etc.) that are inherently difficult to manage by individuals working outside their area of expertise. Figure 5.3 shows the various elements typically found within an institution. The nomenclature for each position – particularly at the senior level – varies from country to country but the basic attributes are similar across institutions.

Universities are similar to many large organizations in the sense that they operate three levels of management:

- Strategic
- Tactical
- Operational.

The strategic group is composed of a Chief Executive Officer (CEO) and a board who act in concert to map out the long-term future directions of the institution over coming years or decades. Additionally, the CEO generally has executive oversight of areas of corporate responsibility, which are each headed by professional managers, including financials, information technology (IT), library, etc.

The tactical group in a university is that collection of senior academics that examines the long-term strategic directions of the institution (i.e., the *where*) and determines what specific actions need to be taken (i.e., the *how*) in order to achieve those objectives.

The operational group is that collection of academics whose focus is on managing structures that deliver short term outcomes (e.g., staff and resource allocations, degree completions, pass-rates, attrition rates, etc.) that incrementally move the university towards its long-term objectives.



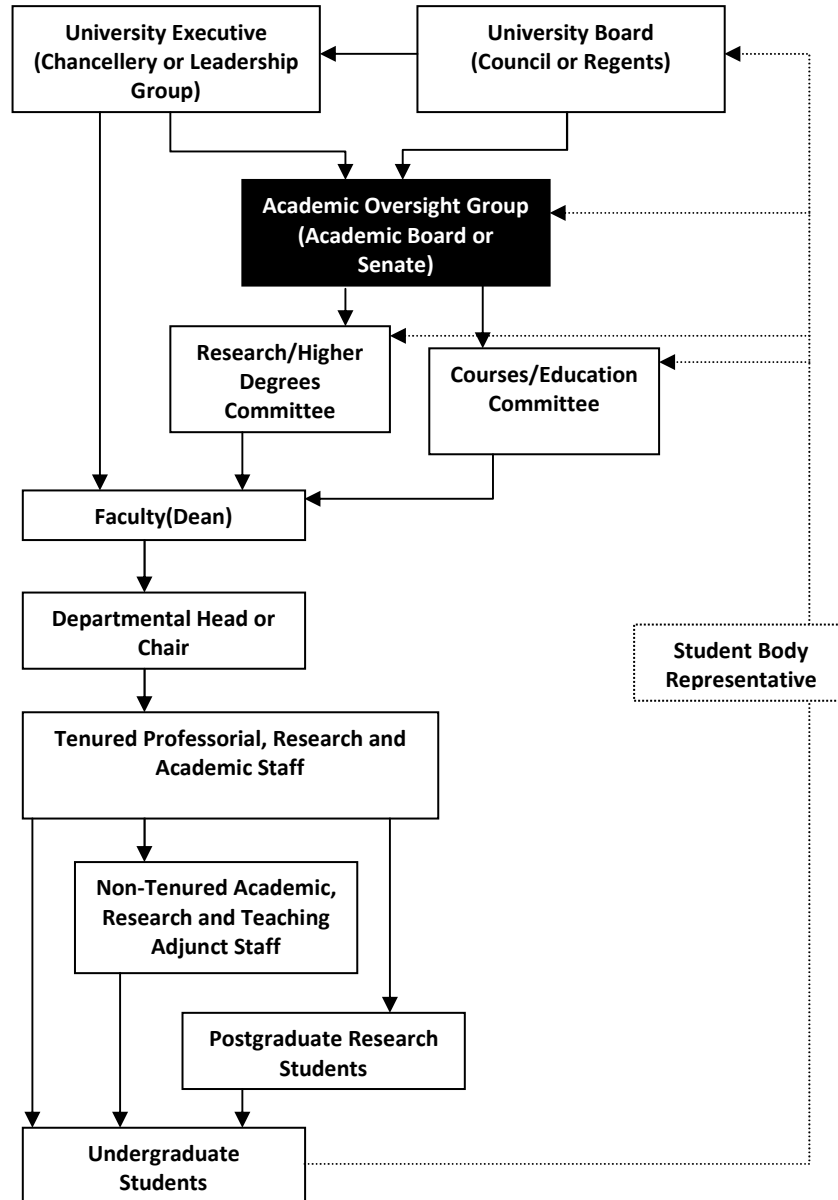


Figure 5.3 – Typical University Governance Structure

In among these three management structures there are overlapping levels of functionality. Some strategic staff may do operational management and some operational managers (e.g., faculty deans and institute directors) may do strategic planning for their sphere of operations.

Of particular note in Figure 5.3 are the collegial elements of university governance. Specifically, these are a collection of committees that provide collegial management of a range of academic and research activities. Typically, these collegial bodies (e.g., academic board, higher degrees committee, etc.) are composed of representatives from each academic/research unit within the institution, and they serve as critically important oversight mechanisms for various aspects of education and research.

The collegial governance bodies within a university also provide consistency across the university in terms of standards, ethics, procedural fairness, etc. In some cases, they may also serve to provide a more efficient operating model for the institution – for example, preventing two departments from two different faculties each running a similar degree program.

From a research supervisor's perspective, the combined corporate and collegial structures that are in place in institutions have consequences. Firstly, a supervisor may ultimately be directly accountable to his/her *line managers* (e.g., departmental head, faculty dean, etc.) as well as to the collegial governance entities (e.g., higher degrees by research committee) for the supervisory process. Secondly, in the event of a dispute, a research student may have the option of by-passing a supervisor and his/her line managers altogether, and seek to have disputes resolved by the relevant collegial bodies.

## 5.7 Internal Performance Metrics

University governance bodies regularly scrutinize international rankings mechanisms to gain an insight into how universities are assessed in a relative sense. In addition, university management may also have performance obligations imposed by national/regional governments and other regulatory bodies. The sum total of these considerations will be devolved down to a series of performance metrics (either implicit or explicit) which will, by necessity, impact upon staff undertaking research supervision. In general, universities will have a statistician, or team of statisticians, constantly monitoring performance across all regionally, nationally and internationally recognized metrics – in order to understand how the institution is performing on a relative basis.

In a research context, there are numerous performance metrics that are in common usage. These include:

- Competitive research grant income
- Current Doctoral student numbers
- Doctoral completions
- Research publication numbers
- Research publication citation numbers
- Publications in internationally esteemed publication vehicles (e.g., Nature)
- Patents and other intellectual property (IP) tools arising from research
- Royalty income
- Prestigious international awards/recognition (e.g., Nobel Prizes, Fields Medals, etc.).

High caliber research students have the potential to contribute to all these areas of performance. However, it is important to remember that a research student's task is to learn the process of systematic investigation and discovery – not to merely provide horsepower for an academic supervisor to improve his/her performance metrics.

One metric which is seldom considered is the gratitude that a research student has towards his/her supervisor after graduating from the university. This may manifest itself in large benefactorial donations to the institution if the alumnus becomes financially successful – and may prove to be of considerably greater value to the supervisor than any short-term gaming of internal performance indicators. It will certainly be of far greater value to the institution itself.