Chapter 2

Research Universities

Characteristics and Classification

Teaching and research have been the two main missions of a university. However, depending on the need and demand, as well as other governing factors, universities may emphasize the two missions differently and be teaching-focused universities, research-focused universities, or balance the two. It is important to recognize that not all universities need to engage with research at the same level as research universities. Indeed, it is desirable to have more universities focusing extensively on education, and only the select few which can cultivate a strong culture and capacity for research proceed along a more research-intensive path.

Most large HE systems naturally evolve as differentiated systems with some universities being research-intensive and others focusing more on teaching; this segregation of emphasis is inherent in their evolution itself. In some cases, as in the California system, HE organization may be designed with some universities specified as research universities, while others focus on teaching. It should be noted that both research-focused and teaching-focused institutions are required for a vibrant HE system.

In this chapter, we will discuss research-focused universities, which we refer to as research universities or research HEIs. We will discuss, among other things, why research universities are important for a country, which characteristics differentiate a research university from the rest, classification of such universities and how such universities can be created. In order to contextualize these issues, it is important to define what we mean by research, and to assess its importance.

2.1 RESEARCH AND RESEARCH UNIVERSITIES

Scientific research has traditionally been an open endeavour, where research findings are published and available to all. Under these circumstances two obvious questions spring up: Should all nations engage in research? Why can't some developing nations simply use the knowledge that is generated by scientists in the developed world for their own purposes? These types of questions are particularly relevant for a country like India, where resources are scarce, and sometimes research is viewed as an unaffordable luxury or an esoteric engagement which may only be supported if funds permit. In this section, we address this question largely in the context of a developing country, though some of these arguments are more general. Before we discuss the need for research and research universities, let us take a look at the nature of research and its relationship with innovation and development.

2.1.1 Research, Innovation and Development

Research is an activity that leads to generation of new knowledge. This new knowledge may help in our understanding of some phenomenon, or may be useful in developing useful products and services for mankind. Generating 'new' knowledge is the main purpose of the research activity and it can only happen if the scientist or researcher (we will refer to someone doing research, as a scientist or a researcher, even if their main job may be of an engineer, student, teacher, etc.) understands the prevailing trail of knowledge that already exists in the subject area.

Let us also understand how new knowledge created by ongoing research is recognized and accepted as knowledge, and how it is shared. A claim for new knowledge is accepted as valid generally only after it has gone through a process of peer review by expert scientists in the field, following which it is published in a suitable journal (or conference proceedings) through which the knowledge is further scrutinized by the global scientific community.

This process has some subtle implications. Not all new knowledge will be accepted by scientists and journals. Only findings that are scientifically relevant or promising are likely to pass through the filter. A scientific contribution is often assessed by its significance and impact. Significance of the work is largely about how useful the research results are to the wider scientific community, to the industry or to society. 'Impact' is how the new knowledge affects or influences the scientific community in particular and the society as a whole. Impact is time-dependent and there are examples of scientific work whose impact was felt decades later. When a new research finding is submitted, it is largely assessed based on the significance of the work, its accuracy and/or reproducibility and potential for impact.

2.1.1.1 Basic and Applied Research

Research is often considered as basic or applied. This categorization was clearly articulated in Bush's seminal work (Bush 1947) which was highly influential, particularly in the USA where it impacted the Science and Technology (S&T) policy. Basic research is largely concerned with generating new knowledge that will help in understanding the laws of nature. The key characteristic is to expand the understanding of the fundamental phenomenon in an area of science. OECD defines it as 'experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts' (OECD 2015). As understanding is the goal, basic research may be seen as an endeavour that does not set a target of practical usage or application-based use of the knowledge generated.

On the other hand, applied research seeks to create knowledge which can be utilized by society. The knowledge spawned through applied research can help in developing actual uses by reducing the degree of exploration or experimentation needed (Stokes 1997). Development is the activity of applying available knowledge to create new products or solutions for challenges or problems faced by the individual or the society. It should be pointed out that these roles are not limited to each of these categories: it has been found that basic research may also have application-based uses and applied research may also provide understanding of certain phenomena.

One way to view research is as a continuum between applied and basic. Another, perhaps more appropriate view, is to locate 'use' and 'understanding' as two distinct characteristics of research, and any research work may make a contribution to one or both of these. So, using both these dimensions, we can see research as being located in four possible quadrants (Stokes 1997), as shown in Figure 2.1.

In this quadrant model, the nature of research question being asked or the type of problems being worked on decides which quadrant the research will fall in. If deep fundamental questions are being asked without any specific use in mind, the research falls in Bohr's quadrant. If it is driven largely by some applied problem and consideration for use, then it falls in Edison's quadrant. If

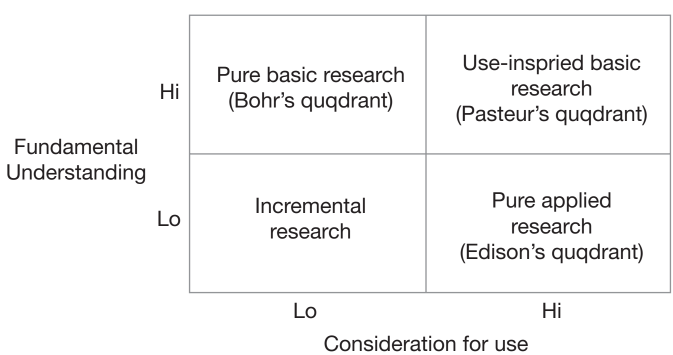

Figure 2.1 *Quadrant Model of Research*

Source: Stokes (1997).

instigated by both, it is in Pasteur's quadrant. It should, however, be added that it is often not possible to foresee the use of some basic knowledge in future—as many examples have shown that their uses may be uncovered decades later.

While it may appear that Pasteur's quadrant is where the best research may fall, as it combines the best of both worlds, this view is too simplistic. There are some fundamental questions about the world and nature to which human curiosity demands answers; these can be given by scientists working in the Bohr's quadrant. Indeed, the work of Bohr and many other top scientists, including Einstein, which has helped humankind better understand the nature of world, falls in this quadrant. And such work is clearly among the best scientific works. Similarly, some of the research that falls in Edison's quadrant may be as impactful as any. We will continue using the terms 'basic' and 'applied' research, while keeping in mind that either type of research may contribute in the other dimension as well.

2.1.1.2 Research and Development

The traditional view of research and its benefits reaching the society is a linear progression of basic research leading to applied research, which in turn leads to development and then to production. This is shown in Figure 2.2 (Stokes 1997). It is implied that basic research generates knowledge, (some of) which is used by applied scientists. The goal of basic research

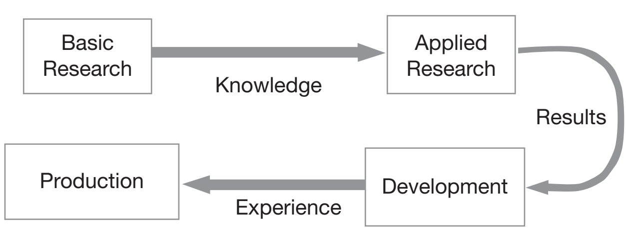

Figure 2.2 *Research, Applied research, Development and Production*

Source: Modified from Stokes (1997).

remains an understanding of some phenomenon, while applied research essentially generates knowledge that is directed towards betterment. Applied research generally aims at evolving new approaches for achieving targeted goals. This applied research may be completely for the benefit of humanity and may provide solutions for problems not articulated so far. Or it may provide new approaches which are better than existing approaches—in terms of cost, duration, feasibility, etc. Much of applied research is about finding better approaches.

Development is the next stage in which the research findings are leveraged to develop useful materials, devices, systems, procedures or other solutions (Stokes 1997). Development also involves limited research, as research rarely provides 'ready-to-use' findings. Adaptation of the research is also often considered part of the research enterprise and that is why the generic phrase 'Research and Development' (R&D) is widely used. This type of development can be considered as an extension of applied research and generates knowledge about how best to use existing information and findings to produce useful products or services. Development leads to production, which is largely a commercial activity carried out by business organizations.

2.1.1.3 Research and Innovation

Currently, innovation is a buzz word across the world. Innovation is concerned with creating value through novel applications of knowledge in practical and feasible ways. So, the goals of the research and innovation endeavours are different—one is about generating knowledge and the other is about generating value. There is, however, a strong synergy between innovation and research, as innovation creates new value, often by using new knowledge in innovative ways to generate value. In other words, research results often provide the basic fodder for innovation.

Innovation often combines results from different disciplines for innovatively addressing some problems in the human domain. Combining knowledge from multiple fields provides a fertile ground for innovation, as often human and societal problems require sound knowledge of various aspects which may come from research in different disciplines. Often gaps emerge in existing knowledge as it may have been created by a researcher who was completely unaware of this potential use. This needs further research. In other words, innovation, while it uses research results, also throws up problems which need further research.

In other words, research is needed to promote innovation—both to generate knowledge to be used for innovation and to address knowledge gaps that come up in the innovation process. One can safely say that without strong research capabilities to rely upon, the scope of innovation will be limited. Research and knowledge creation help in adoption of the innovation, support and expansion of the innovation ecosystem (Hawkins et al. 2006). This is shown in Figure 2.3.

It should, however, be pointed out that not all kinds of innovations require new or latest research results—old and well-established knowledge can also be used for innovation. For example, many e-commerce companies providing new services to specialized groups often use existing knowledge about products and technologies, but innovate in providing better consumer experience or user satisfaction.

2.1.2 Need for Research

The above discussion has shown that research is necessary for development and innovation—both fundamentally rely on

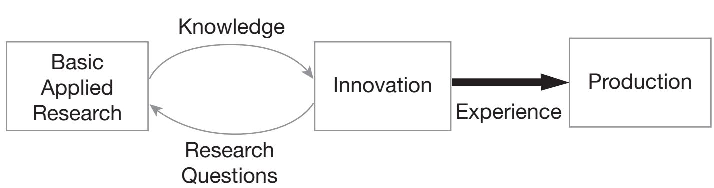

Figure 2.3 *Research and Innovation*

Source: Hawkins et al. (2006).

knowledge created by the research endeavour. It still does not fully address the question why even a developing country like India should engage in research, rather than just relying on the research published in the public domain. Here we briefly discuss some of the other reasons why research is necessary even in a developing country. We do not do any analysis of research in India—for this, we refer the reader to Aggarwal (2018) which discusses various aspects of research in India such as output, impact, comparison with other countries, past, future prospects, research personnel, research productivity, as well as the importance of research for economy and innovation in India.

2.1.2.1 Generation of Knowledge and Membership of the Global S&T Fraternity

Knowledge creation is the fundamental goal of research. Knowledge can also be considered as an intrinsic need of mankind to satisfy its curiosity. There are always some people in a country who are passionate about finding the unknown and contributing to global knowledge and have the capability and drive to do it. Research needs to be supported in a country so that such people can contribute to it and reach the heights they are capable of.

A country cannot be just a consumer of knowledge created elsewhere. It should participate in the global knowledge creation endeavour—at least to the level of its resources and capabilities. Active participating in knowledge creation also provides benefits to the global network of scientists. These networks can be leveraged effectively only if one is a part of that network (Altbach 2009).

Further, given that some of the major research challenges of current times, like pollution or climate change, are inherently global in nature, they require global collaboration to study and address them. This requires an apt system of research in a country which can collaborate with the global network to evolve solutions for such problems.

2.1.2.2 Capacity to Absorb Research

While most research is in the public domain and freely available to anyone, in practice, the knowledge is not really 'off the shelf' for use by all. Many researchers have shown that using knowledge developed elsewhere or externally itself presupposes certain conditions—it requires prior knowledge, an understanding of the field, the ability to qualitatively assess the importance and usefulness of knowledge, etc. Furthermore, there are often details, implicit knowledge and understanding that are missing from the published works, making it hard to use the knowledge if one is not an active researcher in the field. In other words, there is some 'tacit knowledge' which is required to fully leverage the knowledge being shared through research papers, and which active researchers often possess.

Hence, even the effective leveraging of the global research ecosystem producing knowledge requires a strong research ecosystem within the country. Capacity to absorb research therefore requires researchers working on the forefront of knowledge, particularly in areas that may be of importance to a country.

2.1.2.3 Economic Growth

As discussed above, research is intricately tied to development and innovation. As the pace of change of knowledge and technology has increased, and as we move towards a knowledge economy, knowledge becomes an engine of innovation and economic growth. Earlier research results were considered to be a 'resource' for the economy—knowledge produced by research was available as a resource to the industry to help solve its problems. In today's world, innovation is seen as a way to start new companies and create growth, and not just help existing industries in solving their problems. In this model, research plays a much more active role in the economy (Berman 2012). So, earlier where the focus of applied research was to help existing companies, an additional and more compelling dimension has been added—to act as a catalyst for growth of new industries and companies that are based on innovation.

New economic opportunities may emerge which will require research to tap them. This is not well appreciated, but countries that have a research culture and a sizeable pool of trained researchers are clearly going to be better prepared to reap the benefits from such new opportunities. Overall, one can say that while global knowledge is available for general use, development and innovation in a country will critically depend on its own research ecosystem which has the capacity to leverage global knowledge and global knowledge networks to their full potential in order to develop more relevant knowledge as well as to produce solutions for national as well as global challenges.

2.1.2.4 Signalling to the World and Soft Power

Global stature and voice at the international platform of deliberations and decision-making is the key marker for a progressing nation, which can be supported by a strong research potential. Research universities dominate the global R&D scene. Hence, it has a signalling value, which is sometimes also associated with national pride. Research universities can be the institutional umbrella that can support scientists who can achieve global fame, thereby providing icons for the country.

Nations are also respected in the world for their contributions to different aspects of life, as to the communality and health of our planet. As contribution to knowledge is one such aspect, nations that contribute adequately, through the scientific network, get recognized and respected in return.

2.1.2.5 Strategic Reasons and Self-Reliance

It is well established that research that is of strategic value to the nation may not be shared publicly. In other words, while the endeavour of science is to uncover the truth and disseminate it, nations routinely engage in proprietary research, results of which are not available in the public domain. Often this knowledge is in strategic areas of defence, national security, space, etc., and a country may share such knowledge (probably at a huge cost) only to partner or friendly countries. So it is not uncommon for countries to deny access to their knowledge and technology to others.

Clearly, a nation cannot rely only on public domain research for its strategic goals. It must therefore have sufficient R&D capability to address its strategic needs. There are also critical technologies for which a country may not want to depend on other countries. To be self-reliant in such areas also requires research. This need is vital for survival of nations and provides in itself a strong justification for having research capability within the country.

2.1.2.6 Addressing Local Problems

Engaging with particular topical issues is relevant and vital. Global research, done mostly in developed countries, focuses on their issues and problems. This is justified as those research studies are funded by their government and industry. Even academic researchers who have the freedom to engage in any research topic will normally choose to work on problems relating to their country or society as they are more familiar about those; their agendas are also often driven largely by the availability of research grants.

Hence, research problems that may be particular to a country, for example, the health problems of inhabitants of specific regions of the country and the challenges of developing low-cost products without advanced features for the poorer sections are not problems that are likely to interest global researchers. These problems can only be addressed by researchers from within the country. To address these research problems, it is imperative for a country to have research manpower which is well trained not only in research methodology but also in the current state of knowledge who can confidently take up unique research challenges from the society and country and even embark on collaborations with researchers in other countries if required.

2.1.3 Need for Research Universities

We have discussed the need for research even in lesser developed countries. Research can be carried out in focused research labs as well—an approach many countries, including India, have taken particularly for mission-oriented and focused research. In this section, we discuss why research universities are needed, particularly in poorer or developing countries. It is important to be clear on this fundamental question; otherwise, the 'relevance' issue keeps creeping up, either explicitly or implicitly, in discussions and conceptualizations about research universities and the need to allocate sufficient resources for them. The new NEP of the government of India has given due importance to research universities and considers them as a different type of universities which will lead the country in R&D and PhD production. It envisages about 100 strong research universities in the near future in the country and more than double this number in two decades (NEP 2019)

There are many reasons for having top class research universities—we discuss some of the key ones in this section. It should, however, be pointed out that only some of the universities in a country need to be research-intensive, commensurate with the needs of the research ecosystem of the country. In a large HE system, often less than 10 per cent of the universities may be research institutions.

2.1.3.1 The Core of the Research Ecosystem

As discussed above, even for developing countries, it is important to have research capability. Research in a country is largely conducted in universities, research labs and corporations. Research universities form the core of the research ecosystem in a country as they not only produce research but also researchers for other research organizations. Ongoing development of a new generation of researchers in itself makes research universities the core of the overall research ecosystem of a country. (Theoretically, the research manpower can be trained in universities overseas, but reliance only on that approach for developing the needed research manpower is clearly not desirable for a large country like India.)

In earlier centuries, much scientific research was conducted outside the universities. However, in the past decades, the centre of gravity for research has clearly shifted to universities. For example, a quick analysis of the Nobel laureates in the past 25 years show that the vast majority of the recipients are from universities—about 80 per cent for chemistry and physics, and about 70 per cent for medicine. Even in areas like computer science and electrical engineering, where industry R&D investments are huge, the recipients of the top awards are mostly from universities—in the last two decades, about two-thirds of Turing Award (top award in computer science) winners and about 60 per cent of IEEE Edison Medal (top award in electrical engineering) winners were from universities.

Universities provide a unique space which is highly conducive for research. There are many reasons for it. First, they bring together the wisdom and experience of the professors and the young, fresh ideas of PhD students. This mixture is extremely potent as young minds often have very new and innovative ideas which can be tempered with rigor under an experienced professor. Further, universities have engendered a hierarchy-less culture of open expression which encourages collaboration among people from different disciplines, making synergies feasible for new knowledge creation. As university researchers need not be tied to any goals or missions, the university provides intellectuals with the option of exploring uncharted avenues in order to investigate the not-so-well understood areas and develop something new. This unencumbered environment fosters creativity and true innovation.

New areas of importance emerge globally from time to time, which are important for economy and society (e.g., solar power, battery technology, artificial intelligence [AI], etc.). Often for new areas, researchers from existing related areas shift to address the problems in the emerging fields. For this, research capability in a wide range of disciplines is necessary, and that can only be done in the research universities in the country (as labs and companies will mostly focus on their mission needs). For example, AI has been identified as an important area of research for India, as its applications are immense. Most of the AI researchers today are ones who used to work on related problem areas such as image processing and analysis, algorithms and mathematics. Some of these areas were not considered very relevant in the country when these researchers were working in them. It is important that research capability in a wide range of areas be built to global levels, even if some of these areas are not too relevant in the current scheme of things. And this can be done only in research universities.

Research universities also are the most effective engines for research (Altbach 2009). Due to the education component of research universities, the investment in universities has a multiplier effect. It can be safely said that, except for strategic and mission-oriented research which are best carried out by focused research groups or labs, research universities are now accepted as the most efficient way to conduct research. Due to this, many countries are shifting from having separate research-only labs/ institutes to embedding them within research universities (Altbach 2009). The NEP also observes the centrality of research and innovation in universities and that universities must support a culture of research and innovation while encouraging multidisciplinary research (NEP 2019).

2.1.3.2 Development of the Overall Education System

The HE system can be broadly divided as having institutions in three tiers:

- Colleges which provide education mostly at baccalaureate level (tier III);
- teaching-focused universities, which provide education at all levels, with emphasis primarily on bachelor's and master's programmes, but with decent PhD programmes (tier II);
- research universities, which have programmes at bachelor's and master's levels, but their main focus is on research and the doctoral programme (tier I).

It is a broad paradigm in teaching and learning that if one wants to teach at some level, he/she should have training up to higher levels. This is almost universally practised not only to ensure that the teacher knows more than the students but also because a deeper understanding of the subject is expected as one goes higher in expertise, which is often provided by higher degrees. To ensure that the faculty member has a higher level expertise in the subject, it is desirable if they are graduates from the higher layer. So teachers in colleges are expected to have postgraduate degrees from universities, and teaching-focused universities hope to have graduates from research universities as their faculty. The exception is, of course, the research university tier—faculty for this layer also come from the same level.

In other words, the overall education system can be seen as a pyramid with research universities at the top of the structure as shown in Figure 2.4. The research university layer fundamentally powers the HE system. It provides the faculty not only for the research universities themselves but also for the large number of other universities which then educate people and provide faculty for colleges. This type of tiering takes place in most developed HE systems—the universities get grouped into different layers naturally due to their mission, or due to their performance. The NEP also proposes a three-tier model like this.

Violation of the unstated principle in education—that a teacher is generally expected to possess a higher degree from a higher layer—has an impact on the quality of teaching at these levels. The lowering of education quality in colleges and

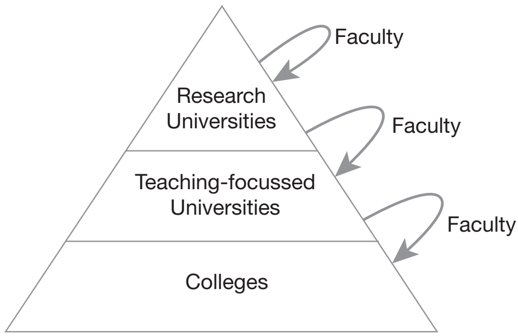

Figure 2.4 *Overall HE System and Role of Research Universities*

Source: Author.

universities then gets reflected in the lowering of teacher quality in schools. It should be evident that for the health of the overall education ecosystem and to ensure that good quality education is provided at all levels, it is essential to have a vibrant and high-quality research university layer, or else education at both the college and university levels, and at the school level, will suffer.

In India, effects of a relatively small research university layer are already visible. A vast majority of teachers in colleges do not possess a PhD and are the products of the layer in which they join as faculty. With a vibrant research university system which produces PhDs in requisite numbers to meet the demand, the availability of qualified candidates for faculty positions will help improve the quality of the overall education system. A research university also plays a key role in the overall quality of education in the HE system by designing new courses, improving course curriculums, providing teaching material and in many other ways. We will discuss this further in Chapter 3 on education. The NEP recognizes the importance of research universities in the overall education system, including the impact of university education on school education, and has made recommendations to enhance the PhD programme as well as teacher education for schoolteachers (NEP 2019).

2.1.3.3 Attracting and Retaining Talent

Often the best scientists are not only fine researchers but also creative innovators. Such talented people hugely value the freedom to explore (Arora et al. 2017) and are willing to work even at reduced compensation if such freedom is provided. So, gifted researchers are often attracted to organizations that provide such freedom as well as adequate support for research, along with an environment and culture for doing good work. World-class research universities inevitably provide an environment to attract and retain talent.

Talented researchers are global citizens who, regardless of their country of origin, have multiple opportunities across different countries. For a developing country like India, often the best and brightest scholars go to top universities across the world to pursue higher studies and PhDs, and after completion of their degrees, choose to stay in the same country. Such research talent can be attracted to work within their home country only if there are world-class research universities that can provide them the desired environment which is somewhat comparable to global standards. This can be seen empirically: top universities (e.g., IITs, IISc) that have a decent reputation and provide a decent research environment are far more successful in attracting as faculty those who have received PhDs from notable universities across the world. In other words, research universities are the organizations that can attract and retain the global talent for research, including the top indigenous minds which may otherwise migrate to foreign lands.

2.1.3.4 Global Cooperation in Science

Big problems are increasingly global in nature, where countries have to cooperate and work together. Examples are climate change, pollution, alternative energy, etc. It is important to have researchers in a country who can participate in these global collaborative efforts. Often research universities are at the forefront of knowledge in these areas. Researchers in universities have a long tradition of collaboration. Research universities also have mechanisms to support visiting faculty, invite scholars for short visits and seminars and organize student exchange programmes. As most research universities have somewhat similar systems for research, the global scholars find it easy and comfortable to visit a research university in another country and collaborate with students and faculty there. Many research papers come out of these visits, which also facilitate exchange of ideas on education and research. Overall, research universities provide a unique platform for global exchange of scientists and collaboration for science. No other type of organization can match what research universities from countries across the world have done for collaboration in science.

2.1.3.5 Having Neutral Experts

Policymaking is increasingly becoming more complex, particularly relating to use of new technology and services. Often corporations have their interests involved in this, and they have ways to influence decision making. It is therefore critical in these matters to get a non-biased view from experts, who are most commonly found in research universities.

Similarly, often for large works in specialized areas or technologies (e.g., selecting a new technology for the state or country), governments will receive proposals from vendors. These can be quite technical and evaluating them requires sound technical expertise besides commercial and other concerns. Often these experts are from research universities; not only are they well versed with developments in the field and technology, but they also provide a neutral view of advantages and pitfalls which can truly help in decision making.

2.1.3.6 World-Ranked Universities

Research universities are generating excitement across the world (Altbach 2007). So, even though research universities tend to be expensive—much more than teaching-focused universities—it is important for a country to have research universities, some of which should be operational at international levels.

World-class universities generally refer to those universities that are in the top 200 (or 500) as per the accepted global rankings of universities. Global rankings have become extremely visible in this century despite their limitations and certain criticisms levelled at them. Most global rankings depend on the research output and impact of the universities, though some weightage may be given to the teaching aspect as well. Consequently, all world-class universities are classified as research universities, though clearly not all research universities may be ranked highly.

A clear implication of this is, if a country aspires to have some universities ranked as world class, it must have good research universities. As only some of these research universities can make it to the world rankings, it will improve the chances if there are a reasonable number of research universities in the country which compete for research funding and talent with each other, while cooperating for research.

2.2 KEY CHARACTERISTICS OF A RESEARCH UNIVERSITY

As mentioned earlier, a research university is one whose mission and vision place a strong emphasis on research. While education remains a key objective of a university, a research university focuses sharply on research in its thinking, planning, culture, operations, policies, resource allocation, etc. What does this emphasis and focus on research actually mean? In this section, we discuss some of their key characteristics—many of these have also been discussed in Altbach (2007, 2009). These characteristics can also be guidelines for a university that aspires to be a research university.

2.2.1 Faculty Recruited and Promoted Primarily on Research

A research university must necessarily have faculty which is actively engaged in research, as faculty forms the core of the research capability of a university. This implies that only candidates with PhD in an appropriate discipline are considered for regular faculty positions. Focus on research potential during recruitment is a key characteristic of a research university. While a teaching-focused university will give importance to scholarship, ability to communicate and teach, and may look at research record only as an additional attribute, in research universities, it is the reverse. While communication and teaching are necessary in a candidate, the main assessment is on research record and potential. Due to this focus, the faculty recruitment process is rigorous with inputs from faculty of the relevant departments as well as from peers from across the world (in form of letters).

To keep the focus on research, it is not just important to recruit faculty with great research potential. To actually realize their potential, it is essential that promotion policies and practices be clearly tied to research output and impact. This means that faculty research performance is assessed on contributions such as research projects and funding, research publications, impact of research work (including reputation in peer community), PhD student supervision, etc.

Research universities must support meritocracy, where the research record and impact are the most important parameters for promotion as well as other rewards or benefits that may be given. The issue of faculty recruitment and promotion is discussed further in Chapter 7 in the book.

2.2.2 A Substantial and High-Quality PhD Programme

In many ways, the strength and quality of its PhD programme define a research university. Many other parameters can actually be subsumed in this. Having a large PhD programme is a significant investment. A PhD student is essentially an employee who is to be paid a fellowship or an assistantship, as well as provided support for their work in terms of facilities, travel, etc.

To ensure that the PhD programme aligns well with the overall objective of good quality research work, it is important to have good systems and processes in place for doctoral programme. Universities that are not serious about research will have lax systems, leading to average PhDs (and, of course, average research output). The PhD programme is discussed in detail later in Chapter 6.

2.2.3 Active Research Programme

Most research universities motivate their faculty to get research projects to support PhD students as well as other costs of research. Most of the funding for research in research universities comes through research grants. Besides bringing in funds for research, success in getting these often indicates that the research in question is relevant and worthy of support while simultaneously serving as a benchmark against others. So, even if other funds are available, a research university should ensure that a thriving sponsored research programme exists, and faculty vie for getting these grants. For this reason, it is important that the faculty, as well as universities, have strong incentives for seeking such funds. These incentives can be in terms of overheads to the university, travel and other support for faculty members, support for hiring research staff or PhD students, summer salaries or some compensation for faculty, among others. The research funding that a university gets indirectly defines the level of research activity.

To support research, a university needs to provide support such as labs, library, R&D office, suitable IT infrastructure and other necessary facilities. This is important and expensive. While a library in a teaching-focused university needs mostly books, a research university library needs other additional facilities like subscriptions to journals and digital libraries, high-end IT infrastructure, etc. These are often very expensive. Similarly, labs for research, as compared to labs for instructions, are often much more expensive.

In modern times, it is believed that for good research output, it is important to have research groups with multiple faculty (with PhD and postdoctoral students) working long term on problems.

Such groups are able to make the most impact. Similarly, for interdisciplinary research, it is important to have structures that will encourage faculty from different disciplines and departments to work together for some common research theme. A research centre is a commonly used structure for this. Centres and research groups do not form on their own, they have to be actively supported and nurtured. A research university must have policies and funding to encourage formation of such research groups and centres.

A culture of curiosity and scientific exploration driven by self-motivation and peer recognition is an attribute difficult to define, but seminal for a vibrant research university. It is easy to publish research papers with insignificant contributions (sometimes even with incorrect results) in average conferences and journals, given the unholy proliferation of these forums. A strong culture of research will motivate faculty and students to aspire acceptance in venues that are known for quality work.

Such environments conducive to academic vitality also motivate faculty to stay active in research and continue contributing till late in their career. This is hard to achieve as often there is a propensity by faculty to give up or scale down research after becoming Full Professor, and perhaps seek administrative avenues. Since a majority of faculty members spend most of their time in the rank of a Full Professor (often a faculty member can become a Full Professor in about 10 years, while still having another 30 years till retirement), it is important that the motivation to remain active in research is sustained. This will depend to a large extent on the culture and systems of the university.

While a research culture generally develops organically, suitable policies for rewarding excellence in research in form of grants, awards, bursaries and such like, giving visibility and respect to research achievements of faculty and students, etc. can help the evolution of this culture. It can also be strengthened by having research seminars, conferences and workshops, supporting faculty to attend international conferences, and extending similar support to ensure participation in active research. Later

Chapter 4 will discuss various aspects of research management and promotion in a research university.

2.2.4 High-Quality Education

Almost all research universities have vibrant UG education programmes; often, two-thirds or more of the student population may be UGs. (UG tuition is a major source of revenue even for research universities). In the fast-changing technical fields, the best universities for UG education are often the best research universities, as there is a strong synergy between teaching and research for such fields. Due to the active research engagements of faculty, most research universities have some advanced courses whose syllabus is not only the established body of knowledge, but also the most recent developments in an area. Such courses may also lead to research projects and are available to both graduate and UG students. This unique aspect of education in a research university differentiates it from regular education and teaching.

It is often assumed that in research universities, only research matters and teaching are secondary. However, that is far from the reality—in most research universities, UG (and masters) education remains an important aspect. In fact, as we will discuss further in Chapter 3 on education, research universities are expected to take leadership in education, and they actually do so. Education is discussed further in Chapter 3.

2.2.5 Institutional Autonomy and Academic Freedom

Research is dynamic and complicated and requires academic freedom to operate. For these and other reasons, it is imperative that a research university has almost full autonomy of operation (with, of course, some expectations on its output and contributions). In many countries, this is a challenge as there is a strong political or bureaucratic control, and research universities are treated within the same framework as those which are more teaching-oriented. Autonomy is often difficult to obtain and sometimes universities have to struggle to obtain or maintain them, particularly when part of the financial support for these universities comes from public exchequer. Research universities need almost complete autonomy of operations and in selecting its governance team. In particular, they need the ability to select a suitable chief executive officer who remains accountable to the university.

Autonomy, however, comes with responsibility. Research universities need to be accountable to the society or the government, particularly if they take public funds. Safeguarding institutional autonomy while ensuring responsibility and accountability, particularly when the university may be funded in part by public funds, is a challenging issue, but one which has to be negotiated so that clear expectations are set from research universities, and in return, almost complete autonomy is supported.

A basic tenet of a research university is academic freedom, which ensures that a faculty member can pursue any line of research she wishes. Not only is it a key premise of a research university, compromising this opens risk of external intervention or stifling certain avenues of research. This is often not fully appreciated outside the academia—people and agencies fail to understand why a dean or a director cannot direct the faculty to take up some line of research, as, for example, the head of a research lab in a corporation can do. Academic freedom distinguishes a research university from a government or a corporate research lab, which may have some specific research mandate controlling the nature of research problems which can be worked on. We will discuss these issues further in Chapter 8 on governance of research universities.

2.2.6 Sufficient Financing

The high cost of research universities is very often underestimated. Frequently, plans are made for establishing a campus and for running expenses, but costs for research, which are often not clearly visible, are not incorporated. Sufficient finances are needed not only for the establishment of faculty and staff and running the campus but also for supporting research—labs, equipment, PhD students, travel support for conferences and meetings, digital library, etc. In a strong research university, the expenditure per faculty may be two times as much as in a teaching-focused university, and the number of faculty required for the quality of education that they provide may be twice as much as in teaching-focused places (as the teaching load has to be modest and the range of courses offered is large). It is safe to assume that the cost per faculty in a research university will be multiple times the cost in a teaching-focused institution. Clearly, without strong financial support, a research university cannot function effectively.

There is an increasing trend to charge the student closer to the actual cost of education, as subsidies seem to be declining world over. While separating education cost from research cost is complicated, it should be clear that the student tuition fee should go only towards covering education cost and supporting research through it is not fair. What this means is that even if the student is charged tuition fee to cover education cost, there needs to be financial support for research from the sponsor of the university. It should also be mentioned here that while research project funding can indeed provide some of the funds for research, the university still needs to invest considerably in PhD programme, labs, library and other infrastructure to maintain an active research programme. Financing of research universities is discussed later in Chapter 9.

2.3 CLASSIFYING RESEARCH UNIVERSITIES

A natural way to organize the HE system is to consider it as comprising of three tiers. In a three-tier system, at the top are the research universities—the main object of this book—which in addition to having education programmes at all levels, have a strong emphasis on research and perform research at an international level. They have strong PhD programmes and play a critical role in the research ecosystem of the country. At the next level are the master's universities (which we will refer to as universities), and they focus on providing high-quality UG education and master's programmes. To ensure that its education indeed is 'higher' and includes latest developments, they need to engage in research to some extent and so should have a small doctoral programme also. At the third level are baccalaureate institutions, whose focus is mostly on the UG programmes, though they may have some masters programmes also. Their programmes may also be based more on well-established body of knowledge. While a country needs and must have vibrant research universities, they cannot be institutions that satisfy the HE demand alone; otherwise, the cost to the students and society will simply be exorbitant.

The purpose of classifying universities is to group universities with similar objectives or mission (Carnegie 2000). A key goal of classification is to help understand complex systems with a heterogeneous population by grouping entities into subgroups such that entities in one subgroup share some common features, while differentiating them from entities in other subgroups (McCormick and Borden 2017). Classification can help separate the three tiers in a HE system. Here, we discuss some approaches for classifying universities with a focus on classifying research universities.

Classification is different from university rankings which, by definition, rank order the universities. Most rankings are based on multiple criteria, with different weightages assigned to each criterion for obtaining the final score for purpose of ranking. Ranking thus reflects a weighted sum of performance in teaching, research, service, perception, etc. This is different from classification, which is to categorize universities based on the characteristics they share. The class of research universities will get defined by characteristics relating primarily to research.

2.3.1 Research University Classification Frameworks

Carnegie classification is the oldest and most influential classification framework. Started in 1970, it classifies HEIs into a few broad categories: doctoral/research universities, master's colleges and universities, baccalaureate colleges, associate colleges, specialized institutions and tribal colleges and universities. Of a total of over 4,500 HEIs considered in the 2015 classification, the number of research universities is about 7 per cent of the total. (Carnegie 2016)

For classifying research universities, a two-stage process is used. A university is defined as a research university if it has graduated more than 20 PhDs per year in the recent past (in an earlier classification, this number was 50 PhDs per year). Based on this basic criterion, 335 universities are classified as research universities in the 2015 edition.

This basic classification separates research universities from the rest. However, this class itself contains a range of universities; for example, this set of research universities includes Massachusetts Institute of Technology, Caltech, UC Berkeley, University of Illinois, Georgia Institute of Technology, Carnegie Mellon University, etc. where the number of PhDs graduated per faculty per year is 0.5 or higher, and where sponsored research is in hundreds of millions of dollars, as well as many universities where the number of PhDs graduated per faculty per year is less than one-tenth of this. Hence, these are further sub-classified in the second stage of classification, in which the research universities are grouped into three subcategories: R1 (highest research activity), R2 (high) and R3 (moderate). The following features related to their research activity are considered while grouping the RUs into the three subcategories, namely R1, R2 and R3:

- Number of faculty members;
- research manpower;
- number of PhDs granted; and
- research funding.

These features are considered to be the most defining features of a research university and, therefore, used for the purpose of classification. In addition to research faculty, a research university also requires research manpower, so this factor is also included.

Globally, the main research manpower (besides faculty) is the PhD students. In advanced countries such as the USA, however, research universities also employ a considerable number of postdoctoral staff for research. (In Carnegie Classification postdoctoral fellows are counted as research manpower.) A large PhD programme is clearly needed for a research university. Finally, funding is needed to conduct research, including funds to support PhD students or employ research staff as also to develop and maintain lab equipment. Globally, while universities do provide limited support for research, much of the research funding comes in the form of externally sponsored research grants. The amount of research funding is a strong indicator of research activity.

For grouping into the subcategories, Carnegie does a clustering analysis using these features to form three subcategories. The clustering approach first combines the features into two indices—aggregate (i.e., based on the values) and per capita (i.e., features normalized by faculty strength). The values of these two indices for each university are used for clustering the research universities into the three subcategories termed R1, R2 and R3. Each subcategory has approximately one-third of the 335 research universities identified. More discussion about the methodology can be found in Kosar and Scott (2018); some ideas behind the Carnegie classification framework and challenges it faces are discussed in McCormick and Zhao (2005).

While Carnegie classification is the oldest and the most influential, there have been classification efforts in other countries also. A two-step process for separating research universities was undertaken to classify Korean universities (Shin 2009). For basic classification, the criteria used was (a) the 'number of PhDs produced is more than 20 per year' and (b) the 'number of papers published each year in indexed journals is more than 100'. Using these basic criteria, 47 universities were identified. These were then grouped into different categories using a hierarchical clustering approach through key parameters such as faculty size, publications, research funding and PhD students graduated—the last three performance parameters being normalized with respect to faculty size. As a result, the universities were grouped into five clusters based on their research performance.

In the Chinese classification framework, four features were used (Liu 2007). These are: (a) total number of degrees awarded at different levels, (b) ratio between doctoral and baccalaureate students, (c) annual research income and (d) per capita of research articles in indexed journals. The universities are classified into a few different categories, with research universities being grouped into two subcategories: research universities I (7 universities) and research universities II (48 universities).

The EU classification framework aims to map the characteristics of universities to capture their diversity (Vught 2010). It does not group universities into a set of labelled categories. Instead, it categorizes them through a range of different characteristics. For mapping these, they have identified six dimensions: (a) teaching and learning profile, (b) student profile, (c) research involvement, (d) involvement in knowledge exchange, (e) international orientation and (f) regional engagement. For each of these dimensions, a few indicators are identified, with a total of 23 indicators. Based on the data for universities, they are grouped for each indicator into categories such as: major, substantial, some, none, small, medium, large, very large, etc. This type of classification across multiple dimensions allows universities to determine similarities and dissimilarities with each other along these dimensions.

2.3.2 Classifying Research Universities in India

For classifying research HEIs in India, a two-step approach, similar to the Carnegie framework, was proposed by Jalote et al. (2019). In the first step, a simple basic criterion is used to separate research HEIs from the rest. Then, in the second step, a more involved sub-classification is done using research activity measures and applying a clustering technique to separate research HEIs in two groups—ones with higher research activity and those with modest research activity.

Clearly, an HEI that is focused on research must have research faculty. The world over, research faculty predominantly hold doctorates. In fact, a hallmark of research universities is that they mostly employ as full-time faculty those that hold PhDs (Altbach 2007). Most classification approaches assume that all or most faculty in universities hold doctorates. In India, that is not the case; there are a large number of HEIs that have many faculty members who do not have doctorates. Consequently and necessarily, in order to identify research HEIs, the framework requires that at least 75 per cent of the faculty have doctorates before an HEI qualifies to be considered as a research HEI.

A fundamental difference between a research HEI and teaching-focused institution is the size and importance of its PhD programme. In fact, Carnegie considers this feature alone for classifying a HEI as a research HEI. In India, since focus on research in many universities is a recent phenomenon (as discussed in Chapter 1), and many of the HEIs that are focused on research have been created only in this century, for such a growing system, it is better to consider the strength of the PhD programme in terms of the total full-time PhD student population, rather than the number of PhDs graduated in a year. Since almost all full-time PhD students in India receive some form of scholarship, the number of full-time PhD students enrolled is a strong indicator of research activity as well as research investment. This criterion can be easily converted to number of PhDs graduated in a steady state.

A reasonable expectation for a research HEI is that each faculty member has on an average one full-time PhD student working with them. This should be the case for a research HEI regardless of whether it has a focus on social sciences, physical sciences, engineering or any other discipline. Hence this general criterion can be applied to both the categories of HEIs under consideration. This is used as part of the basic measure for defining a research HEI in India.

With this, the basic criteria for an HEI to qualify as a research HEI in India is:

- percentage of faculty with PhD >75 per cent of total faculty and
- ratio of number of full-time PhD students to number of faculty is >1.

This basic criteria is similar in spirit to the basic criteria used by Carnegie, in that it focuses on PhD students—except that an additional test on percentage of faculty with PhD has been added—an assessment necessary for HEIs in India.

This criteria was applied to the top 100 institutions in two categories of HEIs identified by the NIRF (NIRF 2015)—universities and engineering institutions. These two types of HEIs not only have the largest number of HEIs, but they are also the two main categories from governance perspective in India—universities generally have a Vice Chancellor as the Chief Executive while engineering institutions have a Director as the Chief Executive. The roles and powers of the two are somewhat different. The academic programmes also are often different—universities generally focus on offering 3-year bachelor programmes in natural Sciences, social Sciences, humanities, etc, while engineering HEIs predominantly offer 4-year BTech or BE degrees. They also have different regulating bodies: UGC for universities and AICTE (All India Council for Technical Education) for engineering institutions.

The NIRF site provides data of the 100 top HEIs in each of these two categories (for its 2018 exercise). As a result of applying the criteria, 40 universities and 32 engineering institutions were classified as research universities. The total number of HEIs that satisfy the basic criteria is 68—with 4 of these listed in both categories. This number of research universities seems reasonable—most academics in India will agree that the total number of HEIs that can be considered as research HEIs is definitely not very large. The number is also comparable to the number of research universities in China and Korea (as per their classification). The list of HEIs in the two types of institutions that satisfy the criteria, along with relevant data on total number of faculty, number of faculty with PhD and the number of full-time PhD students, is given in Jalote et al. (2019).

Of the HEIs that did not satisfy the criteria to be classified as a research HEI, the vast majority did not satisfy both the components of the criteria, though there were some which did not satisfy one or the other basic criteria. It is also worth noting that all the HEIs that satisfy the criteria for a research university are public institutions—23 universities and 28 engineering institutes are centrally funded, while the rest are funded by state governments (or a combination of state and centre). This is mostly due to the fact that private institutions are self-supporting and depend solely on revenue from tuition and other student fees. Consequently, they are not able to support research at any reasonable level, nor provide for at least one full-time PhD student per faculty. It is worth pointing out that private institutions are sometimes not eligible for research grants from some research funding agencies, making it harder for such institutions to support research.

For sub-classification of research HEIs using clustering, the main features considered are sponsored research grants, number of full-time PhD students, number of faculty and the number of publications in indexed journals. The features are combined into two indices—one for aggregate, and the other for normalized—based on the number of faculty. Given that the number of research universities is not too large, they are sub-classified in two clusters—R1 which represents the HEIs with higher research activity and R2 which represents those with modest research activity. The approach identified six universities and eight engineering institutions with the highest research activity. The list of research institutions that are in R1, along with the values of the features, are given in the paper of Jalote et al. (2019).

2.4 CREATING A RESEARCH UNIVERSITY

Let us briefly discuss how a research university may be established. For establishing a university, a common approach now being followed in many countries is through a legislative act—either of the central government or a state government. The legislative act establishing a university grants it powers for giving education, conferring degrees, conducting research, etc. In India, as explained earlier, besides being created through an act, an HEI may become a deemed university through a process which is executed by the UGC. However, in the recent past, the latter path had been taken less frequently, and most of the universities are now created through an Act. For the rest of our discussion, we will assume that a university is created through a legislative act. The NEP also recommends that universities be created through this route (NEP 2019). There are three main approaches for creating a research university.

2.4.1 New Greenfield Research Universities

Creating a research university from the ground up as a new university is something that is widely prevalent in India, which has a young and still rapidly growing HE system. IIIT-Delhi is an example of this—it was created by an Act of Delhi Government in 2008. India may have created one of the largest number of new universities in this century—more than half of its universities were established in this century.

A new university cannot be truly considered a research university for a decade or more, as only after a performance in research for a few years can a university be classified as a research university. However, a new university can be created with the 'intent' of being a research university, and then with the right policies and support and suitable execution, it can be considered a research university after a decade or so. While there are advantages in starting a new university in that new ideas may be easier to implement, starting such a university requires 'extraordinary leadership and abundant resources' (Salmi et al. 2018).

For a new university to eventually become a research university, the foundations have to be supportive—it is very easy otherwise to become a university with dominant focus on education. For a new university to become a research university, it should, right from the start, develop the key characteristics discussed above—recruit strong research faculty, build a high-quality and large PhD programme quickly, ensure, through policies and other mechanisms, that there is an active research programme, ensure to provide high-quality education and have a high degree of autonomy and academic freedom and sufficient financial resources. Some other factors for creating a world-class university, such as being a niche and interdisciplinary institution and favourable governance, are discussed in Salmi et al. (2018). In addition to these, there are a few essential aspects that a new university needs to focus on if it aims to become a research university.

- **Dynamic leader and a strong board.** There is no doubt that the initial leader of the university has a huge and lasting influence on its subsequent trajectory. The initial path taken and foundations laid have a long-lasting impact on a university and the direction it takes. Governance and leadership are discussed further in Chapter 8. The importance of a dynamic leader and strong board for a new university cannot be overstated—without a strong board and a visionary leader who is a respected researcher and has a good understanding of the research ecosystem, the chances are that the new university will become a teaching-focused university, as teaching can easily become the dominant goal, consuming much of the administrative cycles, particularly since there is the likelihood of many challenges in establishing the education programmes.

  Ideally, a few senior faculty from different disciplines should be taken on board soon after inception, who can then take leadership in planning and developing the discipline. However, it is important not to have senior people from other universities who cannot think beyond the existing systems and will only be able to develop the systems much in the same manner as in the institutions they are from. Due to this essential requirement, it may be a challenge to get the senior leaders, and the university may have to rely on external experts to develop its systems.

It is also desirable to take inputs from external experts from across the world, given that there are likely to be very few senior faculty. This is particularly important for designing the systems for the new university and its academic programmes. A new university must learn from the good practices, as well as from the bad or missing practices, of other institutions. It must learn to build upon what is good and in practice and avoid what may be in practice but is not desirable. To do this, consultations and help from experts are essential. It will be beneficial if committees with experts from the country as well as outside the country are formed for planning and designing systems and policies. This is facilitated if there is a strong vision for the university, along with a dynamic and open leadership and governance.

- **Faculty-led growth.** This is a critical planning factor which is often not given due attention. The plans for a new university are almost always student-led, that is, how the student population will grow. With the student numbers in mind, the faculty numbers are suitably computed. However, research faculty availability is very limited in India. As a result, if the student numbers continue to grow and faculty recruitment does not keep pace, then a strong pressure is created to recruit faculty, often leading to lowering of standards. There is another issue involved—for a new university, the plans typically focus on intake of students in various programmes. Taking a larger number of students initially has low impact, as in their first year, they need to be offered only a limited number of courses. However, when this same set of students reach later years of their programme, they require a range of specialized discipline courses to be taught by expert faculty. When the faculty recruitment does not happen in a satisfactory manner, the situation becomes challenging and then various approaches have to be employed to handle the situation. It is therefore better to start with a smaller intake and increase the student number slowly based on 'actual performance' of faculty recruitment, which may be different from the planned numbers.

> It is essential not to relax faculty standards for recruitment, as the initially employed faculty can set the bar for future intake. If needed, it is perhaps better to start with visiting or contractual faculty (even if they have to be paid extra) while keeping the faculty recruitment bar for regular faculty at the desired level.

Even if these are in place, there are tremendous execution challenges like in a start-up. A new university has a huge advantage of having a clean slate without any historical baggage. This allows suitable policies and programmes to be conceived and implemented. However, newness also brings tremendous administrative challenges as almost all decisions are new with no past guidelines and with little policy and frameworks to help until they evolve over a few years.

2.4.2 Converting Existing Higher Education Institutions into Research Universities

It is possible for a teaching-focused university to convert itself to a research university with considerable effort and funding. Clearly, this transition will take time, perhaps decades, as it may require the current generation of faculty who are teaching-focused to be gradually replaced by research-focused faculty, and for some existing faculty to develop research capability. It should be clear that a college, which does not have the authority, and hence has not developed capabilities to design education programmes and courses, or do assessment for them, cannot directly move from being a college to a research university. Hence, for converting an existing institution to a research university, it will have to be an existing university, probably one which has some tradition of research.

From the set of universities, we need to group universities using some clear criterion for research activity (e.g., size of PhD faculty, PhD programme, research output), to identify research universities and other universities which are close to satisfying the criteria for research universities. The classification approach discussed earlier can be used for this purpose. From these universities, some universities which have a potential to ramp up their research can be supported for research strengthening. They should be provided multi-year block grants for research based on research performance and impact in previous years. PhD programmes should be supported heavily in these places.

It is neither desirable nor feasible to try to convert all universities into research universities. While over time some teaching-focused universities can move to being a research university by suitably enhancing their research activities and some universities can be supported every few years for this migration, most of them should remain education-focused and their mission should be to improve the quality of education at bachelor's and master's levels, keeping the educational programmes in line with new knowledge emerging in different subjects and disciplines.

Examples of converting teaching-focused institutions to research universities can be found across the world, as most universities created in the 19th century started with teaching as a focus. The USA has many examples of how teaching-focused institutions were converted to research universities once the movement for research universities was started. A more recent example is that of NTU. It started with a charter to train engineers and initially had programmes in three engineering disciplines—civil and structural, electrical and electronic and mechanical. It is now a broad-based research university with colleges in Engineering, business communication and information, education, biological sciences, humanities, social sciences, physical and mathematical sciences, and art, design and media. Recently, they established a new medical school. It has now a host of research centres and institutes, many in partnership with the industry.

The NEP recognizes that, in India, there are many very narrow-focused universities and that this is a hinderance to the evolution of high-quality research universities. It proposes to convert most of the central government universities and some state government universities into multidisciplinary research universities of decent size and envisages that in about two decades, there will be up to 300 such universities in the country (NEP 2019).

2.4.3 Mergers of Existing Higher Education Institutions and Organizations for Creating Research Universities

Merging of HEIs has been done in many countries such as Australia, South Africa, Europe, China, and USA. (Azziz et al. 2017). While reasons for mergers can be many, creating a large multidisciplinary research university is clearly one of the main drivers. China has perhaps had the largest number of mergers in recent times—in the last 25 years, it has had about 400 mergers involving about 1000 public HEIs in its attempt to move from specialized HEIs to having larger, globally competitive comprehensive universities (Azziz et al. 2017). We briefly discuss examples from Australia and France.

In 1987, Dawkins reforms took place in the Australian HE system. Under these reforms, amalgamation of colleges and institutes of education was done, some with the existing Australian universities, and some by creating new universities. One of the clear goals was to create larger, more comprehensive universities formed out of the amalgamation of various more narrowly focused HEIs with different goals.

Griffith University is an example where many HEIs were merged with Griffith over a few years to create a large research university. First, in 1990, Mount Gravatt Teacher's College and Gold Coast College of Advanced Education became official campuses of Griffith. Soon after, the Queensland Conservatorium of Music became a part of Griffith University. Finally, in 1992, the Queensland College of Art (QCA) became a part of the university. As a result of these amalgamations, Griffith, which was a small narrowly focused university of about 4000 students and a single campus, was transformed into a multi-campus university with more than three times the number of students and with a range of academic programmes within 4 years. Currently, Griffith has five campuses in three cities and over 50,000 students with UG, postgraduate and research degrees in almost all fields including engineering, science, business, law, education, environment, architecture, humanities, music and creative arts. It is also ranked in the top 300 universities in THE ranking. There were other such amalgamations, for example, with the University of Sydney and UNSW.

Queensland University of Technology (QUT) is an example of where mergers facilitated the creation of a new university. It was formally established as a university about three decades ago by merging two main educational institutions—Queensland Institute of Technology (QIT) and Brisbane College of Advanced Education. QIT itself had evolved over a century from various institutions—Brisbane School of Arts and Sciences, Brisbane Technical College and Central Technical College. Brisbane College of Advanced Education was a combination of multiple predecessor institutions such as Brisbane Teachers College, College of Advanced Education and a few other colleges focusing on teachers' training and advanced education. QUT is currently one of the top research universities in Australia with more than 40,000 students, two main campuses in Brisbane offering hundreds of degree programmes at all levels, and strong research in most fields. It is ranked in the top 200 universities in THE ranking. In the same manner as QUT, at least four other technical universities were created from amalgamations—Curtin, University of South Australia, University of Technology Sydney and RMIT University.

A recent example is that of the University of Paris-Saclay in 2014. It is an ambitious project to create a large university that will be among the top universities in the world. It brought together 2 universities, 10 Grandes Écoles (professional schools in engineering, agronomy, telecommunications, life sciences and management) and 7 national research institutions, fully or partially. All of them were previously autonomous and most of them are prestigious in their own right. They include the University of Paris-Orsay, the École Polytechnique, the École Normale

Supérieure de Cachan, the HEC business school, laboratories of the Centre National de la Recherche Scientifique (The French National Centre for Scientific Research). The university plans to focus on innovation and is linked to the technology cluster in Saclay. The campus is on the outskirts of the French capital and the government has allocated more than €6 billion for the project. The project has been in planning for many years and was also in response to relatively poorer performance of French HEIs in the global rankings. For planning, they had the ex-President of Caltech as the advisor for this project. The Université now has about 65,000 students from over a hundred countries, and has over 9,000 research professors.

2.5 SUMMARY

This chapter discusses research universities and their value to their countries and the world. The importance of research and the role of research universities in the research ecosystem of a country are explored. The key characteristics of a research university are enumerated, which not only help in the classification of an institution as such but can also be used to guide any university aspiring to be a research university. Classification frameworks for research universities are then discussed briefly, including the well-known Carnegie classification and its recent adaptation for India. The chapter concludes with a discussion on the multiple ways in which a research university can be created in India.

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