

**ADVANCING INTEGRATED RESEARCH AT THE UNIVERSITY OF
THE WITWATERSRAND:
AN INVESTIGATION USING INTEGRAL THEORY**

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DECLARATION

I declare that this Research Report is my own, unaided work. It is being submitted for the Degree of Master of Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

(Signature of candidate)

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ABSTRACT

The challenges facing humanity are presenting at an unprecedented scale and complexity. Climate change, biodiversity loss, land degradation, ocean depletion, poverty, inequality, and failing health care and educational systems are among the problems that have come to be defined as “wicked” because of their spread and interconnectedness. At the same time, there has been an increasing realisation that multi-, inter- and transdisciplinary (MIT) research is critical to addressing these complex global challenges. This research identified some of the barriers and enablers to MIT research at the University of the Witwatersrand (Wits), based on interviews with researchers and research managers at the University who have been involved in conducting or facilitating MIT research. The results were analysed using the AQAL (all quadrants, all levels, all lines, all states, all types) framework under Integral Theory, which is an emerging meta-philosophy that was developed by American philosopher, Ken Wilber (Esbjörn-Hargens, 2015). It holds that every phenomenon contains four perspectives, each of which must be in alignment with the other three for a successful outcome to occur (Wilber, 2005). Using this principle, suggestions were formulated for overcoming the barriers to MIT research at Wits (misalignments) and better leveraging the enablers (alignments).

The results indicated that the interviewees perceived the most significant barriers to be related to both “hard” issues (structural, financial, regulatory, etc.) and “soft” issues (psychological, relational, cultural, etc.). In particular, the hard issues included traditional institutional structures that were uncondusive to MIT research, finite and/or inaccessible financial and other resources, and a lack of tangible incentives. The soft issues included resistance to change, competitiveness and disciplinary arrogance, and uncertainty about the meaning and legitimacy of MIT research. In some instances, these perceptions were found to be supported by the literature. For example, the perception that MIT research involves personal risk and vulnerability has been well documented by Amey and Brown (2004). Suggestions to overcome this barrier include personal development courses and professional coaching to improve self-awareness and interpersonal skills. There were also some perceptions that could be seen to contradict the available evidence, such as the perceived bias against MIT research in academic ratings assessments and institutional culture. These discrepancies were discussed and suggestions for overcoming both problematic perceptions and actual barriers were put forward. Such suggestions included increased international exposure and a performance management system that rewards MIT research.

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CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

Our world is changing at a pace that is unprecedented (Thompson Klein, 2010). The major problems of today, including environmental degradation, climate change, failing health care and education, financial volatility, religious fanaticism and existential alienation (Esbjörn-Hargens, 2010), are presenting on a scale that is also unparalleled in history (Thompson Klein, 2010). This is complicated by the fact that, in many instances, these issues are part of a set of interconnected, overlapping challenges (van Breda, 2007).

Problems that exhibit this kind of complexity have come to be defined as “wicked”. Rittel and Webber (1973) first identified wicked problems (so-called because they are diabolical in their frustration of attempts to solve them; Brown *et al.*, 2010) and differentiated them from “tame” problems. They described tame problems as those that science was originally developed to deal with (Rittel and Webber, 1973), whereas wicked problems are more complex in three important ways: firstly, they cannot be clearly defined; secondly, they defy resolution, because each solution generates a further problem; and thirdly, they can only be dealt with in ways that cannot be said to be right or wrong but simply the best that can be done with the knowledge that is available at the time (Brown *et al.*, 2010).

Rittel and Webber (1973) were writing about social policy during a Zeitgeist that was newly concerned with equity, and they argued that solutions that were based in traditional science were bound to fail because firstly, contemporary policy problems cannot be definitively described, and secondly, in a pluralistic society with differentiated values, there is no one “right” way of doing things. They predicted that the role of a “professional” who is hired to solve a well-defined problem by eliminating specific conditions that are undesirable to the whole of society would become outdated in the face of the contemporary conceptualisation of systems as open and interacting (Rittel and Webber, 1973).

Indeed, today, the scope of a profession with its clearly defined cognitive and occupational boundaries is no longer broad enough to be able to deal with our most pressing problems (Pedler and Trehan, 2008). As first observed in the second half of the twentieth century (Rittel and Webber, 1973), changing societal conditions are increasingly calling for different modes of intervention, including alternative action strategies, but also alternative ways of perceiving and enabling possible solutions (Termeer *et al.*, 2013).

These changing societal conditions include the advent of global challenges such as inequality, poverty, and climate change – all examples of wicked problems. There is a global and growing awareness that our economic systems (the interface between human and biophysical systems) are unsustainable in ways that impact our societies and ecosystems, and that these socioeconomic systems need to be rethought and restructured (Dixon, 2004). On the societal front, the unequal distribution of wealth is leading to pervasive and increasing inequality which is threatening socio-political stability (Piketty, 2014). On the environmental front, our extractive and exploitative relationship with ecosystems is leading to an increasing scarcity of the natural resources that are critical to human existence (Dixon, 2004). The spectre of climate change looms over these threats as a potentially catastrophic multiplier (Oswald Spring *et al.*, 2014).

These wicked problems require a new approach to aspects of societal organisation such as jobs, governance and lifestyles, but they also require a new approach to the ways in which we conduct research and implement the findings of that research (Brown *et al.*, 2010). Academic teaching, learning and research have traditionally existed in disciplinary silos, with university departments, schools and faculties organised around disciplinary problems and methods. These silos have even extended to libraries, publications and professional associations (McGregor and Volckmann, 2011). According to Alfonso Montuori (2011, in McGregor and Volckmann, 2011) our organisation of universities still reflects the reductionist way in which we pursued knowledge during the first half of the twentieth century when it was considered “good thinking” to take things apart to understand how they worked and to eliminate any messy variables. This approach to research has had a significant and, according to Stock and Burton (2011), tremendously positive impact on the development of scientific methods and technologies, shared frames of reference, and the epistemological and ontological foundations that are required to progress science without constantly having to review the nature of science itself (Stock and Burton, 2011).

However, there has been an increasing realisation that the compartmentalisation of disciplines and the resulting fragmentation of knowledge have undermined the ability of universities to respond to broader systemic problems, especially those that exist at the vast areas of intersection between human and biophysical systems (Stock and Burton, 2011). These areas of intersection require simultaneous attention to diverse disciplines, since unidirectional research often fails to describe the full picture (Vandermuelen and van Huylenbroeck, 2008). In fact, as Montuori (2011) writes, many academic programmes that claim to offer relevance

to the “real world” draw from a variety of disciplines (for example, MBAs often include courses in social sciences such as psychology, sociology and philosophy; McGregor and Volckmann, 2011). Montuori (2011) suggests that this may be because the real world itself does not fit into neat disciplinary categories (McGregor and Volckmann, 2011). At the same time, disciplinary integration is being driven by politics, since politicians are increasingly reluctant to accept solutions that are too simple for the problems that they purport to address (Jackson, 2006).

These two trends have generated interest – within scientific communities and among funding institutions – in how to break down barriers between academic disciplines and encourage a multiplicity of perspectives and shared approaches to complex issues (Stock and Burton, 2011). According to Brown *et al.* (2010), in order to solve the complex, global problems of today, we will need to find new ways of thinking that utilise the full spectrum of our intellectual resources, incorporating the contributions of all our academic disciplines and epistemological traditions. According to Geary Schneider (2010, in Thompson Klein, 2010), the most cutting edge research in the world today has already broken free of disciplinary frameworks.

1.1 Multi-, Inter- and Transdisciplinary Research

It is possible to draw a distinction between three different types of collaboration that take place across disciplines, referred to as multi-, inter- and transdisciplinary (MIT) research. There are many similarities between these three approaches, with the most obvious being that they all involve crossing the boundaries between disciplines in order to solve complex problems, but there are also many important differences and these are worth noting in order to emphasise why the terms should not be used interchangeably (Stock and Burton, 2011).

Stock and Burton (2011) assessed the literature from a wide range of studies that crossed disciplinary boundaries and arrived at definitions for each of the three tiers of MIT research. They found that multidisciplinary typically refers to the most loosely integrated, but arguably the most attainable form of cross-disciplinary research. It arises when two or more disciplines come together to better reveal the features of a problem by offering an aggregate of assumptions, methods, results and insights, but pursue separate outcomes using separate methodologies and remain unchanged in their specific, disciplinary perspectives (Zaman and

Goschin, 2010). Essentially, multidisciplinary refers to separate studies coexisting within the same thematic context (Petts *et al.*, 2008). An advantage is that these studies can then be compiled into the same report (Max-Neef, 2005). For example, Hopton *et al.* (2010) used a multidisciplinary approach to develop a tool for assessing regional sustainability. They asked researchers from different disciplines to identify metrics for measuring the environmental quality and prosperity of a regional system (Hopton *et al.*, 2010). They then combined these metrics into a single, multifaceted tool that was able to measure a range of indicators for regional sustainability (Hopton *et al.*, 2010). An important point to note is that, because multidisciplinary does not involve iterative research (passing the problem from one discipline to another to reduce discrepancies and explore commonalities), it is limited in its effectiveness to solve problems. Rather, it presents the groundwork for others to develop solutions (Stock and Burton, 2011).

Interdisciplinarity involves a tighter melding between disciplines. It requires the boundaries between disciplines to be bridged in such a way that the methods and insights of each discipline are not only combined but also integrated (Zaman and Goschin, 2010). It emerges when researchers from different disciplines (usually the natural and social sciences, since it is the interface between human and biophysical systems that tends to generate the most complexity) are convened to jointly identify and formulate a specific, real-world systems problem (Stock and Burton, 2011). These researchers then articulate a common research goal (Hinrichs, 2008), decide on a methodology, and analyse the data (Hammer and Söderqvist, 2001). For example, Irvine *et al.* (2009) used a combination of environmental psychology, ecology and acoustical analysis to investigate the relationship between decreasing green space in urban areas and increasing sound pollution. They adopted the theoretical framework of environmental psychology, which asserts that green space is important to wellbeing, and their methodology involved conducting interviews with park users, measuring green habitat, and recording sound levels to describe both the subjective and objective measures of sound in three different green spaces. Their results suggested that improving ecological quality could enhance access to quiet spaces (Irvine *et al.*, 2009).

The term “interdisciplinary” is the one that is the most commonly referenced in scientific literature. However, much that is labelled interdisciplinary in theory is actually multidisciplinary in practice, since it involves parallel and not truly integrated endeavours (Hinrichs, 2008).

Transdisciplinarity is the most desirable and yet the most difficult to achieve form of integrated research (Stock and Burton, 2011). It is similar to interdisciplinarity in that it attempts to get around existing methods altogether by using the problem as its starting point (Zaman and Goschin, 2010). According to Montuori (2011), the intention is not to lead with a discipline but to lead with the problem and let the full spectrum of disciplines serve the outcome (McGregor and Volckmann, 2011). This approach requires a different mindset and different competencies, and it is what makes inter- and transdisciplinary research so exciting, but also so daunting and, for some, threatening (McGregor and Volckmann, 2011). Focussing on the problem prevents any single discipline from gaining dominance and in the absence of a disciplinary framework to guide the research, personal relationships become more important (Giri, 2002). Researchers must open themselves to different perspectives and build common understandings, and this requires effort and trust (Naveh, 2005).

However, transdisciplinarity differs from interdisciplinarity in that it aims to include not only multiple academic perspectives, but also multiple non-academic perspectives (Hinrichs, 2008). Involving non-academic partners in the production of knowledge requires researchers to seek the input of stakeholders such as land users, land managers, and government and civil society representatives (Tress *et al.*, 2006). These non-academic stakeholders benefit from the process by receiving increased decision making capacity (Walter *et al.*, 2007). Indeed, one of the primary goals of transdisciplinary research is to provide accessible and easily implementable outcomes for decision and policy makers (Stock and Burton, 2011). Transdisciplinary research is thus contributing to a redefinition of intellectually rigorous research as that which is less concerned with traditional criteria, such as validity and reliability, and more focussed on societal usefulness (McGregor and Volckmann, 2011).

1.2 MIT Research at Universities

Traditionally, research activities at universities have followed the unidisciplinary approach, resulting in the fragmentation of knowledge as academics specialise further and further within their chosen fields. However, a realisation of the importance of bridging disciplinary boundaries when addressing complex challenges, particularly those that exist at the interface between human and biophysical systems, has resulted in the boundaries between disciplines and methods becoming more permeable, and collaborative approaches becoming more common (Somerville and Rapport, 2000). MIT research is now widely regarded as essential

in understanding and addressing the environmental, health, educational, legal, governance, cultural and other issues that coalesce to create wicked problems (Stock and Burton, 2011). A decade ago, Somerville and Rapport (2000) wrote that this represented a brand new insight that constituted a revolutionary change. Nowadays, an emphasis on MIT research is a significant feature of every modern university (Aldrich, 2014).

1.2.1 Barriers to MIT Research

Despite the theoretical emphasis on MIT research, there are still a number of substantive barriers that inhibit the actual implementation and success of MIT research projects (Taylor *et al.*, 2015), and these projects therefore do not typically deliver on the high expectations with which they were initiated (Stock and Burton, 2011).

According to Stock and Burton (2011), there are three primary reasons for this. Firstly, there is a lack of human capacity and infrastructural support, such as researchers who are trained in MIT research (Massey *et al.*, 2006), peer groups with which to identify (Kueffer *et al.*, 2007), and academic journals in which to publish (Evans *et al.*, 2008). According to McGregor and Volckmann (2011), scarce funding is a further infrastructural barrier, since researchers who move beyond the traditional operations of a university are breaking new ground and struggle to obtain grants that support integrated research and embrace the participation of non-academic stakeholders. Researchers who operate outside the academic norm must also contend with resistance when they are perceived to be threatening disciplinary purity (Wilshire, 1990). Maintaining loyalty to one's school of thought is sometimes considered to be more important than openly exploring which explanation provides the greatest value in a given context (Lélé and Norgaard, 2005). Part of this challenge is overcoming the reluctance of the ego to step outside one's area of expertise and endure the discomfort of no longer being an expert (McGregor and Volckmann, 2011).

The second significant barrier to MIT research that is identified by Stock and Burton (2011) is the lack of well-formulated and consistent understandings about the origin and nature of MIT research. Studies that attempt to cross disciplinary boundaries are immediately encumbered by epistemological questions such as: "What counts as knowledge and legitimate modes of knowledge creation?" (McGregor and Volckmann, 2011: p.14). Differences in ideas about what passes as adequate proof, and other fundamental assumptions, are

particularly evident during collaborations between scientists who believe in absolute truths and social scientists for whom there is no absolute truth (Lélé and Norgaard, 2005).

The third barrier that is identified by Stock and Burton (2011) is a lack of consensus on the terminology that is used during integrated research. According to Buller (2009), standardised language is important in enabling the translation of wide-ranging disciplinary knowledge and the articulation of that knowledge both within MIT research teams and beyond, into diverse policy communities. This is hampered by the fact that scholars rarely read outside of their disciplines in search of the broadening of understanding that would decrease their automatic reliance on jargon, and increase their ability to communicate with other disciplines (Stock and Burton, 2011).

A final significant barrier is the fact that values (behaviours, principles and attributes that one holds in high regard) are embedded in every stage of scientific enquiry, from the formulation of questions to data collection, and the theories that are generated (Lélé and Norgaard, 2005). Individuals and communities perceive the world through the lenses of their particular set of values, which are informed by their specific beliefs (an internal feeling that something is true, despite the fact that this belief may not be proven or even rational; Anderson and Da Silva, 2009). Values are an indication of what one ascribes worth to, and are reflected in the way in which one lives one's life (Anderson and Da Silva, 2009). Scientists are reluctant to acknowledge the existence of these value judgements or potentially erroneous beliefs in their research because it undermines their claims to objectivity and ethical neutrality (Lélé and Norgaard, 2005). A failure to recognise the hidden assumptions that stem from normative positions can make it difficult to arrive at the collective judgement that is required by MIT research (Lélé and Norgaard, 2005).

The cumulative effect of all these barriers is that most academic institutions are unsure how to go about planning, implementing and sustaining multi-, inter- and transdisciplinary research (Thompson Klein, 2010). However, there are a few exceptions, primarily from the developed world, where integrated research has been to a greater or lesser extent successfully institutionalised.

1.2.2 Arizona State University

Arizona State University (ASU) in Phoenix, Arizona is an example of a university that has embraced MIT research as an institution-wide endeavour. In response to increasing global complexity, ASU started questioning the historical standing of a university as a place where research takes place mostly independently of society. In their efforts to break down the barriers between the university, industry, and corporate and civil society, ASU focusses on applied rather than pure research, with the understanding that it is necessary to use disciplinary knowledge to solve real-world problems in order to address the complex challenges of today's world. In order to accommodate their emphasis on innovation and creativity, they are willing to redraw traditional university structures and encourage movement across disciplinary boundaries. They seek to encourage and value the interdisciplinary and transdisciplinary thinking that they assume to be innate in all people, and define themselves according to the kinds of students they produce rather than those who they enrol (McGregor and Volckmann, 2011).

The President of ASU, Michael Crow, lists eight design principles that should be adopted by universities seeking the sustainability, social immersion and global engagement (ASU, 2015) that he believes are prerequisites for conducting the kind of research that will address the major challenges of our time. These include embracing the cultural, socioeconomic, and physical setting of the institution; becoming a force for societal transformation; pursuing a culture of academic enterprise and knowledge entrepreneurship; conducting use-inspired research; focussing on the individual in a milieu of intellectual and cultural diversity; transcending disciplinary limitations in pursuit of intellectual fusion; socially embedding the university, thereby advancing social enterprise development through direct engagement; and advancing global engagement (Crow, 2009).

1.2.3 Newcastle Institute for Energy and Resources

The Newcastle Institute for Energy and Resources (NIER) at the University of Newcastle in Australia is an example of a research entity located within a university that is facilitating MIT research. NIER's primary research agenda is to address the rapidly emerging issues around the sustainability, productivity, competitiveness and transformation of energy and resources (OECD, 2014). Their mandate is to develop a model for addressing these challenges using

integrated research that brings together multidisciplinary research and industry (OECD, 2014). They cite their commitment to collaborating with non-academic partners and developing collective capacity as a critical part of their success because it enables them to facilitate technological improvements that are in line with national reform agendas while still maintaining economic and environmental stability (NIER, 2015).

Examples of NIER's collaborative projects are improved models for community participation in decision-making about land use, coexistence and the sustainability of local industries; the involvement of small and medium-sized enterprises in creating a market for clean and efficient energy innovations; and the impacts of the coal industry on groundwater and aquifer systems in the Sydney Basin (NIER, 2015).

1.2.4 Stockholm Resilience Centre

The Stockholm Resilience Centre (SRC) at the Stockholm University in Sweden is a further example of an entity located within a university that is facilitating MIT research. The Centre emerged through extensive collaboration between ecologists and economists (West *et al.*, 2014), and is a joint initiative with the Beijer International Institute of Ecological Economics at The Royal Swedish Academy of Sciences.

The SRC's "resilience approach" is a distinct transdisciplinary framework for understanding and responding to sustainability challenges (West *et al.*, 2014). Its research efforts are founded on the premise that social and ecological systems are truly interdependent (SRC, 2014), and it aims to advance the global understanding of social-ecological dynamics, and to address the impacts of human management and exploitation on the functionality of social-ecological systems (West *et al.*, 2014). It seeks to enhance the degree of connectivity and dialogue between policy-makers, academics and citizens through transdisciplinary research on social, ecological and technological complexity (West *et al.*, 2014), and in this regard, its research has implications for management and governance practices (SRC, 2014).

Avoiding the trap of predictable mainstream research is seen as fundamental to these endeavours, and the SRC aims to create a research environment in which creativity and innovation can flourish, and new scientific understanding can be generated. Giving room for curiosity to develop and allowing temporary MIT constellations or teams to self-organise around research problems is held to be more important than pushing productivity. In this

context, there is a high tolerance for ambiguity in concepts and methodologies, and leadership is less about control and more about creating an enabling environment that supports exploration (SRC, 2014).

While it is useful to consider NIER and the SRC to understand the approaches and policies that have made them successful in the integrated research space, it must also be taken into account that these research entities are located within traditional university structures. These broader contexts may have offered varying levels of support or resistance to the efforts of the research entities.

1.2.5 MIT Research at the University of the Witwatersrand

The University of the Witwatersrand (Wits) in Johannesburg, South Africa positions itself as an internationally leading, research-intensive university located in Africa. The Wits Vision 2022, a strategic document that outlines the University's priorities over the next decade, commits the University to increasing its postgraduate numbers and growing its research activities. The Wits Vision 2022 also emphasises the strengthening of partnerships across sectors (University of the Witwatersrand, 2015a). According to the Vice-Chancellor and Principal of Wits, Professor Adam Habib, the University should be responsive to a variety of stakeholders, including business and labour, government and citizens, South Africans and immigrants (Habib, 2013). Habib (2013) has also emphasised that Wits will pursue both global competitiveness and national responsiveness, based on the understanding that these are not mutually exclusive goals. In fact, according to Habib (2013), being proactively responsive to contextual specificities is what enhances an institution's ability to make a unique contribution to the global corpus of knowledge.

The University's explicit commitment to these three goals – growing its research footprint, partnering with a variety of stakeholders across sectors, and remaining simultaneously globally competitive and nationally responsive – reveals that many of the principles advocated by Crow (2009) have already been incorporated into the University's strategic objectives. However, Crow's (2009) sixth principle, which stipulates the need to transcend disciplinary limitations in pursuit of intellectual fusion, does not form part of the Wits Vision 2022, nor does it feature in Habib's (2013) rhetoric around the University's priorities.

A possible explanation for this is that the difficulties involved in pursuing MIT research are simply too arduous for an institution that – unlike the ASU, NIER and the SRC – must also deal with the challenges of operating in a developing world context. Some of these challenges are described by Habib (2013) who says that the building and managing of any university in the 21st century is difficult, but it is even more onerous in a country like South Africa where structural poverty and inequality, in a climate of severe underfunding for higher education, mean that a university's executive are constantly forced to confront problems such as starving students and overcrowded residences (Habib, 2013).

However, it could also be argued that it is exactly because Africa faces such critical and complex challenges that the continent needs to engage in integrated research. In addition to longstanding problems such as poverty and inequality, Africa is expected to be the hardest hit by the effects of climate change, since it has high vulnerability and low adaptive capacity (IPCC, 2014).

The Global Change and Sustainability Research Institute (GCSRI) is one of the Wits entities that does explicitly recognise the need for the University to engage in MIT research, and seeks to involve academics, postdoctoral fellows and postgraduate students in cross-boundary thinking. According to the GCSRI website, the institute aims to develop new knowledge pathways based on the understanding that historical knowledge may not provide the best foundation for future predictions. It also aims to implement a research and public advocacy agenda that is driven by and highly responsive to the needs of local sustainability imperatives, and tightly linked to the requirements of end users, including decision and policy makers. A key part of the institute's strategy is to structure research so that it involves partnerships rather than becoming the isolated activities of a standalone unit (GCSRI, 2015).

The GCSRI's focus on sustainability makes it a natural home for MIT research. Sustainability is not a science by the usual definition, but rather a plethora of sometimes contradictory ideas that originate from diverse disciplines. It is thus inherently multi-, inter- and transdisciplinary (Hadorn *et al.*, 2006). However, if Wits is to make a significant contribution to addressing the wicked problems that confront the world today, it will be necessary for the University to institutionalise MIT research beyond the work of a single entity. This will require the University to identify and find ways to minimise or remove the barriers to MIT research, and leverage the enablers.

There are a number of methodologies that are available to conduct this kind of systems analysis. In particular, Integral Theory has become recognised as a powerful tool and is increasingly being used in academic research to comprehensively represent and assess complex realities (Esbjörn-Hargens, 2010).

The strength of Integral Theory is its ability to simultaneously represent both objective (empirical, evidence-based) data, such as the structural and institutional factors that affect MIT research, and subjective (interior, experiential) data, such as the values and beliefs of the people in the system. It has increasingly been shown that it is important to focus on both the exterior and interior aspects of a system in order to ensure the success of an initiative (Passmore, 2010). According to Gooley and Lockwood (2001), the creation and advancement of innovative initiatives in traditional university environments must take into account more than just the physical infrastructure of the university – it must also consider the greater, human infrastructure, which functions at the level of values and beliefs. In particular, it has been known for some time that the beliefs of academics affect the uptake and relative success of new practices. This is because beliefs constitute a set of personal theories and guidelines that inform practice (Combs, 1982), fend against threatening aspects of reality (Rokeach, 1960), and could present a challenge to any attempts to introduce change (Gooley and Lockwood, 2001).

Given the proven importance of focussing on both exterior and interior aspects, this research used Integral Theory, and specifically the AQAL (all quadrants, all levels, all lines, all states, all types) framework under Integral Theory, to assess the status quo of MIT research at Wits. In particular, the analysis was conducted with a view to minimising the barriers and leveraging the enablers towards MIT research at Wits. There was no comparable research that could be found that used Integral Theory to conduct similar analyses of the status quo of MIT research within research contexts.

1.3 Aim and Research Questions

Given the scale and complexity of the global challenges that we are confronting, and the imperatives around conducting MIT research in order to address these challenges, it has become widely accepted that universities must become more effective at overcoming the barriers to MIT research. In order to do this, they need a better understanding of the barriers that they face. Integral theory, and in particular the AQAL framework, serves as a useful methodology for identifying such barriers, as well as any enablers that could be better leveraged. In this research, the AQAL framework was also used as a methodology for suggesting ways to overcome barriers, based on the principle that a comprehensive and effective approach requires all four perspectives or quadrants to be aligned (Wilber, 2005).

Transdisciplinarity is understood to be the most desirable form of integrated research (Stock and Burton, 2011). However, it remains the exception (Tress, *et al.*, 2006). Therefore, in the interests of enabling the broadest possible investigation into how and why integrated research does or does not take place at Wits, this research focussed on all three forms: multi-, inter- and transdisciplinarity. The term “integrated research” was used to refer to all three forms collectively.

Aim:

Given the urgency around conducting integrated research, as well as the current failure of universities (including Wits) to appropriately meet this mandate, the aim of this research was to identify the barriers and enablers to integrated research at the University of the Witwatersrand, and to use these, together with the AQAL framework under Integral Theory, to formulate suggestions for achieving a greater degree of integration.

The research questions that emerged from this aim were as follows:

Question 1:

Has integrated research been successfully conducted in some instances at Wits and if so, what were the enabling factors? Conversely, have there been failures and if so, what caused them?

Question 2:

What specific interventions could be implemented in order to create the conditions and perceptions necessary to facilitate interdisciplinary research?

1.4 Integral Theory

Integral Theory is an emerging meta-philosophy (a philosophy that attempts to draw together many existing philosophies) that was developed by the American philosopher Ken Wilber (Esbjörn-Hargens, 2015). Since its first conceptualisation in 1977 it has been refined by many academics and practitioners, and has become increasingly popular as a way to systematically weave together the most important insights from many different disciplines, including the natural and social sciences, into a single holistic worldview. This ability to simultaneously represent a range of different perspectives and reveal the linkages between them makes Integral Theory especially well-suited to understanding and managing the complexity of modern-day life. It honours the complexity of reality in a way that allows practitioners to address problems in a more skilful and nuanced way (Esbjörn-Hargens, 2010).

1.4.1 The AQAL Framework

The AQAL (all quadrants, all levels, all lines, all states, all types) framework is a model that has become iconic of Wilber's work and Integral Theory in general. The quadrants, levels, lines, states and types are five basic elements that characterise Wilber's approach and are used to represent any aspect of reality at any time (Esbjörn-Hargens, 2010). The quadrants, in particular, form the foundation of the AQAL model. They correspond to four irreducible perspectives (subjective, intersubjective, objective and interobjective) that are present in each moment and must all be investigated when attempting to fully understand any aspect of reality. The other four elements that characterize the AQAL framework (all levels, all lines, all states, all types) have not been employed for the purposes of this study.

The quadrants reflect the simple recognition that everything can be viewed from two fundamental perspectives: 1) inside and outside, and 2) singular and plural (Esbjörn-Hargens, 2015; see Figure 1).

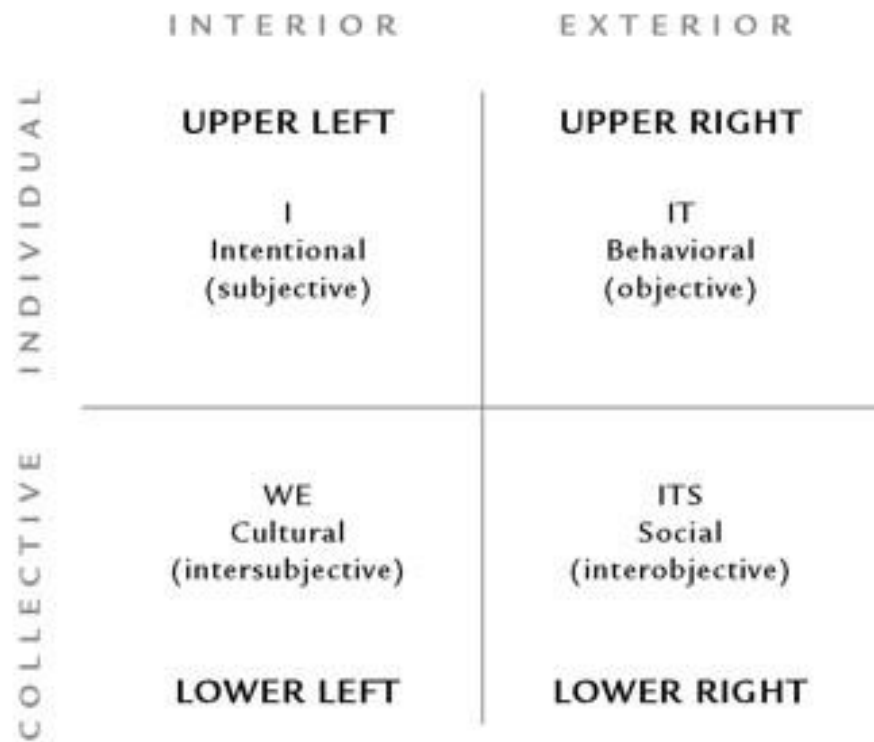


Figure 1: The Four Quadrants of Integral Theory (Esbjörn-Hargens, 2010, p.36)

The subjective perspective (upper left quadrant) refers to the interior, psychological states, emotions and intentions of the individuals within the system, including their values and beliefs. The intersubjective perspective (lower left quadrant) refers to the interiors of the groups within the system, including their collective values and beliefs, which are transmitted through philosophical, ethical and religious viewpoints. The objective perspective (upper right quadrant) refers to the external, observable behaviour of the individuals within the system, which is assessed using empirical physiological and behavioural analyses. The interobjective perspective (lower right quadrant) refers to the hard, structural dynamics of the system such as the environmental, legislative, political, educational and economic factors. These four dimensions are typically referred to using four different pronouns: I, We, It and Its (Esbjörn-Hargens, 2010).

The fundamental principle behind the AQAL framework is that every phenomenon in the manifest world contains all four perspectives, and if one is left out, or in contradiction with any of the other three perspectives, it constitutes “brokenness” that will ultimately result in

systemic failure (Wilber, 2005). For example, a project that addresses the interobjective quadrant by ensuring that the necessary hard systems are in place, but fails to address the subjective and intersubjective quadrants by ensuring that people's individual and collective beliefs and values are in alignment with those systems, is ultimately likely to fail.

In the context of a research environment, and with reference to the barriers and enablers to integrated research, the upper left quadrant can be used to describe the inner consciousness of individuals who conduct integrated research, as well as individuals who are resistant to conducting integrated research. It can reveal their awareness of the possibilities and pitfalls of integrated research, perceptions of agency, personal development, and capacity to initiate collaborative research that might not come naturally. The intersubjective perspective (lower left quadrant) can be used to describe the collective consciousness of researchers. It can reveal the institutional culture, which determines how discussions of integrated research are framed, as well as the likelihood of integrated research being encouraged and supported. The objective perspective (upper right quadrant) allows an insight into the measurable aspects of individual researchers, such as demographics, disciplinarity, technical and interpersonal skills, and leadership, while the interobjective perspective (lower right quadrant) can be used to understand the system as a whole, including political, economic, technical, policy, and environmental factors.

1.4.2 Applications of the AQAL Framework

Integral Theory is steadily gaining acceptance as a valid and useful approach in scholarly work. An increasing number of academics and postgraduate students are applying it in their research (Esbjörn-Hargens, 2010). For example, an integral approach was applied to a complex forest conservation challenge in the Peruvian Amazon, where many previous approaches had failed because they did not develop both “hard” and “soft” capacities (Hochachka, 2009). The same author used Integral Theory to study community and international development in El Salvador (Hochachka, 2005, 2008). An integral approach has also been applied to organisational policies for companies moving into sub-Saharan Africa, leading to a recommendation for a synthesis between indigenous cultures and modern management techniques (One Sky, 2009). Another study used Integral Theory to develop models for leadership and capacity enhancement in communities in 40 countries affected by HIV/Aids (Diouf *et al.*, 2005).

One of the reasons for the effectiveness of Integral Theory is that all research takes place in a context that presents barriers and enablers (i.e., factors that lie outside the direct scope of the project, but which have a significant effect on its outcome). An ability to acknowledge, comprehend and deal with these contextual issues is critical to the successful formulation and implementation of any responses that arise out of the research. In particular, Western society has demonstrated that it is usually good at dealing with technological challenges, but less well equipped to understand and manage the complex interactions between technological, individual, social, and political contextual factors together (Ballard *et al.*, 2010).

For example, the State of the World Forum recognised that technological interventions alone were not resulting in the collective action necessary to combat climate change, and employed the AQAL framework to develop a 10-year plan to reduce carbon reliance. Under the upper left quadrant, they explored the inner world of individuals who might act in response to climate change, looking at climate awareness, denialism, perceptions of agency, personal development, and capacity to conceptualise and hold a higher purpose over long periods of time. Under the lower left quadrant, they assessed collective subjective factors, including how discussions of climate change are framed in societies, communities or organisations, and the capacity of that group to generate and support action. They used the upper right quadrant to assess the measurable aspects of individuality, such as demographics, knowledge of climate change issues, and technical and interpersonal skills. Under the lower right quadrant, they looked at the PESTLE (political, economic, social, technical, legal, and environmental) factors that determine the likelihood of reducing carbon reliance (Bradbury, 1998).

Bradbury (1998) used the State of the World Forum analysis as an overall orientation in a research project that looked at how low carbon innovation can be accelerated. The project included interviews with managers from industry and local government who had been involved in low carbon initiatives to gather evidence for learning histories. The results suggested that a fast and effective response was most likely to occur when the quadrants were strongly aligned. In other words, change happens when an individual's sense of themselves as being ready and well-equipped to take action (upper left) and having relevant skills and knowledge (upper right) coincides with a cultural inclination towards change (lower left) and an opportunity in the outside world (lower right). Bradbury (1998) concluded that the AQAL framework was a very useful tool for thinking through the context in which low carbon (and climate adaptation) initiatives are undertaken, and that, as we learn to employ the model more skilfully, our capacity to implement successful initiatives will improve.

CHAPTER TWO: METHODOLOGY

The data were collected through a series of interviews with two groups of people:

- 1) research managers at Wits who were chosen because they play a role in determining and stewarding research projects, and
- 2) researchers at Wits who are currently or have previously been engaged in integrated research.

The latter group was identified through interviews with the former. The interviews were mostly oral and based on open-ended questions. The engagements were preceded with a couple of minutes of general conversation, including pleasantries related to shared contexts or mutual associates. This initial conversation served to put the interviewee at ease and established a rapport between interviewer and interviewee. Thereafter, the interviewee spent a couple of minutes explaining the study, as well as the reasons for requesting an interview with the particular interviewee. This gave the interviewee an opportunity to ask any questions or clarify any uncertainties, and it also served to establish a mutual understanding that the interview was both appropriate and relevant to the study. Upon the conclusion of the interview, the data (statements regarding the perceived barriers and enablers to integrated research) that were collected were categorised and analysed using the AQAL framework under Integral Theory.

It should be noted that some of the statements that were recorded were perceptions arising from individual beliefs, and would need to be verified before they could be taken as fact. However, this does not diminish the helpful or hindering effects that these perceptions may have on integrated research, since it is the perceptions themselves that inform aspects of individual and collective behaviour, such as resistance to change (Bovey and Hede, 2001) and efficacy of cross-disciplinary communication (Murray, 2015), and therefore impact on the overall success or failure of a given system.

2.1 Data Collection

The collection of data commenced after receiving clearance from the Human Research Ethics Committee (Non-Medical; H15/08/12) and notifying the University Registrar. The first set of interviews that was conducted was with the following seven Wits research managers:

- Director of the Wits Research Office;
- Director of the GCSRI;
- Dean of the Faculty of Commerce, Law and Management;
- Dean of the Faculty of Engineering and the Built Environment;
- Dean of the Faculty of Health Sciences;
- Dean of the Faculty of Humanities;
- Dean of the Faculty of Science.

The Director of the Wits Research Office was selected for his role in managing research output at the University, the Director of the GCSRI was selected for his role in leading the GCSRI, which carries an explicit mandate around integrated research, and the deans were chosen for their responsibilities around managing the academic projects of the individual faculties.

The interviews were oral and based on open-ended questions (see Appendix A) that were intended to start broader conversations. The answers were audio-recorded with the permission of the interviewee and later transcribed. The interviewees were asked to provide their view of each of the following four aspects of Wits which, according to the principles of the AQAL framework (Esbjörn-Hargens, 2010), govern the feasibility of integrated research at the institution:

- Values and beliefs of individual researchers at Wits in general (subjective perspective);
- Collective values and beliefs (intersubjective perspectives);
- Measurable aspects of individual researchers at Wits in general (objective perspectives);
- Institutional and external structures (interobjective perspectives).

They were also asked to identify researchers at Wits who had engaged in integrated research and who might serve as interview candidates for the second part of the data collection.

Based on the results of the interviews, and taking into account the need to interview researchers from a range of faculties, institutes and centres, a shortlist of 40 researchers was created. The first 20 researchers on the shortlist were contacted via email to ascertain their willingness to be interviewed, as well as the correctness of the assumptions around their research. In instances where an individual indicated that he or she was unavailable, or felt that he or she did not have anything to contribute to the research, the next individual on the shortlist was contacted.

The second part of the data collection involved interviewing 20 researchers from a cross-section of the University's five faculties on each of the four aspects of Wits that, according to the AQAL framework, govern the feasibility of integrated research at the institution (see above). In particular, the intention was to engage the experiences of the researchers in conducting or attempting to conduct integrated research, collaborate with their peers, and receive instruction and support from research managers and other University leaders.

Seventeen of the interviews were oral and, due to the geographic location of the interviewees, two of the interviews were conducted telephonically and one was conducted via email. All of the interviews were based on open-ended questions (see Appendix B) that were intended to start broader conversations. The answers were audio-recorded with the permission of the interviewee (except in the case of the interview that was conducted via email) and later transcribed.

2.2 Construction of the AQAL Map

Firstly, statements that recurred often, indicating a strong agreement across interviewees, were noted. Secondly, the data were analysed by constructing an AQAL map. Statements from the interview transcripts were categorised into four separate tables (or quadrants), according to whether they described the current subjective, intersubjective, objective or interobjective perspectives of integrated research at Wits. Within the quadrants, the statements were grouped according to interviewee. The statements were then shortened, repeat statements were removed, and some statements that were found to have been incorrectly categorised were moved to a more relevant quadrant. Within the quadrants, the

statements were grouped according to sub-headings. The statements were further shortened, some statements that were still found to be incorrectly categorised were moved to a more relevant quadrant, and within the quadrants, more accurate sub-headings were allocated.

The resulting AQAL map was used to identify the positive aspects (enablers to interdisciplinarity) and the negative aspects (barriers to interdisciplinarity) at Wits. Aspects that were seen to support and enhance each other were regarded as aligning, and items that were seen to contradict each other were regarded as misaligning.

CHAPTER THREE: RESULTS

Appendix C contains the comprehensive set of data that were collected from the interviews that were conducted with the seven research managers and 20 researchers. There were a number of noteworthy observations that can be made from looking at these data. In particular, there were several statements that recurred, indicating a strong level of agreement between interviewees. Some of the statements that appeared most frequently related to the following:

- desire to make a difference: 13 interviewees (48%) provided statements indicating that the desire to make a difference beyond simply publishing in academic journals was a commonality between integrated researchers;
- ego: 11 interviewees (41%) believed that ego, arrogance and the reluctance to relinquish control has an inhibiting effect on integrated research;
- structural and cultural siloes: 10 interviewees (37%) said that construction of the University according to traditional disciplinary siloes is unsupportive of integrated research;
- vulnerability: nine interviewees (33%) perceived integrated research to be an inherently vulnerable space, involving a high degree of reputational and other risks, and perceived this space to be occupied by researchers who are innately secure and adventurous individuals;
- curiosity about the bigger picture: six interviewees (22%) perceive curiosity about the bigger picture and the ability to think systemically in this regard to be important to integrated research.

There were a number of other statements that also addressed similar issues, but appeared less often. Some of these relate to the following:

- ratings: five interviewees (19%) indicated that the manner in which academic ratings are awarded by the National Research Foundation (NRF) and the pursuit of ratings are a barrier to integrated research;
- trust: three interviewees (11%) said that trust between researchers was an important aspect of integrated research;
- language barrier: three interviewees (11%) referenced the language barrier between researchers from different disciplines as a barrier to integrated research;

- hierarchy: three interviewees (11%) said that a flat hierarchy is important to enabling integrated research. However, these interviewees differed in their perceptions of the extent to which Wits is hierarchical, with one interviewee saying that the University is very hierarchical and two interviewees saying that the University exhibits a lack of hierarchy.
- gender: three interviewees (11%) referred to the perception that women are more likely to engage in integrated research.

Other noteworthy observations included that 15 researchers (75% of researchers) referenced the inhibiting effects of poor leadership and policy-making, but only one research manager referenced this, saying that “management systems reinforce silos because we manage process rather than the science”. In addition to the fact that all but one of the research managers were silent on this issue, one of the research managers suggested that “formal structures cannot legislate the integrated research process”.

Seven interviewees (26%) perceived funding for integrated research to be difficult to obtain, but three interviewees (11%) perceived funding to be easy to obtain and plentiful. Similarly, two interviewees (7%) perceived there to be a lack of journals in which to publish integrated research, whereas an equal number of researchers perceived there to be several journals in which to publish, with one saying that there are “thousands” of journals.

Finally, four interviewees (15%) stated that integrated researchers were likely to be younger and were broadly supportive of this trend. Two interviewees warned of the drawbacks of integrated research for younger researchers, with the first saying that younger researchers “will not climb fast by doing integrated research” and that they should “identify with a discipline for legitimacy”, and the second saying that younger researchers “cannot afford to show their finger to the hierarchy because they will not get promoted”.

3.1 AQAL Map

The results in Appendix C (the comprehensive set of data that were collected from the interviews) were collapsed into Appendix D, which groups the results according to topic. The final AQAL map appears in Tables 1-4 below.

Table 1: Upper Left (UL) Quadrant

Consciousness of Integrated Researchers

1. Curious & willing to learn
2. Socially responsible; look for societal impact
3. Epistemological openness
4. Value other disciplines
5. Believe traditional methods not working; have realised the limits of their disciplines
6. Enjoy integrated research
7. Solution oriented
8. See bigger picture & systemic connections
9. Energetic & adventurous
10. Resist languishing in comfort zones
11. Exhilarated by discovering new & bold connections
12. Want to remain current
13. Find personal satisfaction in teamwork
14. Believe universities exist to improve their contexts & should be more externally focussed
15. Assert own value systems
16. Self-aware
17. Committed
18. Able to “let stuff go” & not get caught up in resentment
19. Generous; comfortable with sharing resources & credit
20. Not incentivised by money
21. Driven by passion not prestige
22. Internalise their own successes
23. Confident in unfamiliar spaces
24. Willing to be vulnerable & get shot down by people from other disciplines
25. Able to look at problems from different perspectives
26. Trusting
27. Not ashamed to admit that they do not understand
28. Bold enough to get up & talk

Views on Consciousness of Those Who Resist Integrated Research

29. Other disciplines have no value
30. Assume idiocy on the other side
31. Change resistant
32. Believe social scientists do not solve problems
33. Concerned about being a generalist
34. Resistant to being disturbed
35. Closed mind-set
36. Unconvinced of intellectual rationale behind integrated research
37. Believe integrated research is a fad
38. Believe knowledge can only be produced in particular sites
39. Lack vision; cannot buy into big picture
40. Cannot engage with new ideas
41. Driven by self-interest
42. Want to earn “brownie points”
43. Insecure
44. See threats not opportunities
45. Fear the unknown & want to retain the status quo
46. Territorial
47. Like being in control
48. Proud & reluctant to seem stupid
49. Egotistical
50. Do not trust anybody else to get things done
51. Distrust outsiders
52. Self-worth dependent on being able to do something that others cannot
53. Fear the loss of power of not being special
54. Too arrogant to learn
55. Believe that their disciplines are more valuable
56. Lack of trust around talking to others about their research
57. Sceptical of people they do not know
58. Fear heads of schools

Table 2: Lower Left (LL) Quadrant

Institutional Culture

1. Lack of imagination required to transcend disciplinary boundaries
2. People need to see a clear purpose
3. People are incentive driven; unrewarded work is unusual
4. No thought into why institutes & centres exist
5. Wits is special, more worthy of respect
6. Institutes should pay for the privilege of being at Wits
7. Research must be driven by the academy, not external priorities
8. Pressure to meet targets is destroying the greater good mentality
9. Research councils jealously guard IP & do not commercialise
10. Adherence to rules
11. Competition for funding
12. Intellectual belittling
13. Policy is decided by bean counters who do not get it & do not care
14. Intellectual freedom
15. Tension: public good vs profit motive
16. Unhappiness with rating system
17. People are just waiting for retirement
18. Integrated research is non-experts interfering
19. Publish or perish – huge pressure

Culture of Disciplines

20. Epistemological differences
21. Schools think that they are superior
22. Faculties not open to acquiring knowledge from each other
23. Humanities scared of sciences because they do not feel their forms of evidence count
24. Sciences scared of being proven wrong
25. Lack of respect between disciplines
26. Faculties irrationally territorial
27. Hard scientists have more legitimacy

28. Belief that everyone knows social science
29. Belief that it is wrong for faculties to talk to each other
30. Acceptance of structural constraints

Culture Regarding Integrated Research

31. University claims to support integrated research but has no idea how
32. Mostly not understood nor valued
33. Threat to disciplinarity & pedagogy
34. Resistance to anomalies; preference for clean structures & reporting lines
35. Uncertainty about what is successful integrated research
36. Institutional buy-in on surface only
37. Not real science; play & “wishy washy garbage”
38. NRF says publishing broadly is “academic suicide”

Collaboration

39. Difficult to culturally integrate researchers from different backgrounds
40. Explosive to bring elitist, high maintenance people into same space
41. Research groups protect their turf from other groups
42. Disciplinary arrogance
43. Reluctance to share resources
44. Building collaborations takes time & effort
45. Hierarchy which only reinforces itself rather than building respect
46. Pressure to meet targets makes people less collaborative
47. Subtle skills required for collaboration are not well understood
48. Competitiveness makes it difficult to reach out
49. NRF calls for collaboration are ignored because of a lack of relationships & trust

Table 3: Upper Right (UR) Quadrant

Incentives/Disincentives

1. Few rewards for solving real problems
2. Difficult to get rated
3. Difficult to get hired
4. Requires discomfort of commenting on research outside one's field
5. Easier to work with known team
6. Difficulty of working with people who are demanding & high maintenance
7. Boosted by going abroad
8. South Africans can afford to "lose" half a year without publishing
9. Comes at a personal cost
10. Scientists are difficult to manage

Demographics

11. Integrated researchers tend to be younger, because they are:
12. - More open to new ideas & risks
13. - More solution-oriented
14. - More tech savvy
15. Young researchers need jobs
16. Most integrated researchers are women
17. Women do not get funding
18. High level, impactful integrated researchers are rooted in one discipline
19. Trained to stay within a discipline
20. Diverse skill sets & approach problems in non-traditional ways

Collaboration

21. Need to be clear about what success would look like
22. Need to find people with same values
23. Credibility depends on publications
24. Need to market one's mission
25. Need to approach people in person
26. Language barrier
27. Interpersonal skills are important
28. Researchers have no idea what their colleagues are working on
29. Natural teachers
30. Scientists conditioned to work alone
31. Uncommon for both to benefit
32. One has to find alignments & clusters

33. Everyone is immersed in own projects
34. Large grants create competitiveness; less at stake leads to more dialogue
35. Some researchers make themselves difficult to reach
36. People focus on distributing the spoils before the collaboration is even formed
37. Credentials are important otherwise perceived as junior needing senior

Resources

38. Time is scarce
39. Money is scarce
40. Being employed in a centre is grant-based & precarious
41. Heads of schools discourage integrated research because the school gets less money
42. Admin people are unhelpful
43. Required to service own departments first because they pay salaries
44. Generating own resources gives ownership over how they get deployed
45. Lack of initiative & willingness to help
46. Academics are overloaded

Leadership

47. Requires respected, public face
48. Requires champions to keep it alive
49. Leaders tend not to be iconic scholars
50. Difficult for novices to drive integrated research
51. Research managers should facilitate by removing impediments
52. Leaders should not be too busy with other things
53. Fundraising detracts from intellectual input of leaders
54. Must hold the space intellectually
55. New leaders hostile or uninterested if they do not own projects
56. Territorial leaders can stymie projects
57. Institutional support depends on interests of current dean
58. Leaders have onerous administrative & fundraising responsibilities

Table 4: Lower Right (LR) Quadrant

National & Institutional Environment

1. Companies affiliated with universities deal with challenges better
2. Johannesburg is a living laboratory
3. Minister to start giving points for policy oriented research
4. Companies do not see value of research to operations
5. Wits has many young people
6. Wits has a flat hierarchy
7. Business is in search of solutions
8. South Africa is lagging
9. Wits is punitive towards failure
10. NRF does not realise that wicked challenges cannot be solved with a silo approach
11. Traditional disciplinary structure
12. Management systems reinforce silos – manage process rather than science

Methodology

13. Institutes & centres are important – host workshops, enable collaboration
14. Technology enables collaboration
15. Requires regular discussions, transparency & a flat hierarchy
16. No recipe for integrated research
17. Collect data & reach solution faster because more people working on problem
18. Takes longer (outside comfort zone, timelines unpredictable)
19. Exploratory & higher failure rate
20. Top down arouses opposition
21. External work requires permission
22. Requires political support, faculty ownership; vulnerable to resignations
23. Formal structures cannot legislate – need room for imperfect processes
24. Intellectual freedom
25. Problem originates from context, taken up by leaders, mandated to researchers
26. Teams report to multiple people
27. Required to belong to one faculty
28. No proper lifecycle – no closure
29. Need joint, measurable objectives

30. Management is supportive
31. Requires high level buy-in but grassroots implementation
32. Admin systems are a big barrier
33. Have to develop the institutional governance & engage in the politics
34. Have to force people to sit in a room & brainstorm a problem together
35. Relationships form in non-threatening environments with low stakes
36. Lack of hierarchy helps collaboration
37. Poor advertising of ongoing research
38. Poor advertising of grants
39. Integrated research involves external relationships built up over years
40. IP belongs to Wits; commercial drive creates competitiveness & unwillingness to partner; if you jointly develop IP who owns it?
41. Projects tend to comprise handful of senior & large number of young, very motivated researchers

Promotions/Ratings/Funding/Journals

42. Metrics for publish or perish route only
43. SA system likes the showman – bad at rewarding good collaborators
44. Reward structures are archaic
45. Peer review does not work – reviewers do not understand research approach nor agree it is research
46. Rating, staffing & promotions, & funding done by peer review
47. Ratings awarded within disciplines
48. Difficult to move money
49. Start-up funding is a problem
50. Funding easy if demonstrable outcome
51. Lean funding climate with onerous accountability requirements
52. Funders like integrated research – trend is to take on grand challenges
53. NRF is primary funder
54. Lots of journals in which to publish
55. Publishing gives legitimacy, enabling Wits to serve as an interlocutor
56. No journals in which to publish
57. Impact factor of journals is low

3.2 Alignments Between Quadrants

The analysis below was done by looking for statements in one quadrant that aligned with statements in one or more other quadrants. The statements are thus not in conflict with each other, and support or strengthen each other. If enhanced, they could further contribute to mutual success. They were grouped into five thematic areas of alignment.

a) Integrated researchers are driven by passion, not prestige or money:

The perception that integrated researchers are driven by passion and not prestige (UL21) suggests that they are not discouraged by archaic reward structures (LR44), reward metrics for the “publish or perish” route only (LR42), and ratings, staffing, promotions and funding that are decided by peer review (LR46), which may not work for integrated research because the perception is that reviewers do not understand the integrated research approach and do not agree that it is valid research (LR45). The perception that they are not incentivised by money (UL20), and that they are generous and comfortable with sharing resources (UL19), suggests that they are not discouraged by the perception that start-up funding may be a problem (LR49) and that it is difficult to move money across institutional boundaries (LR48). Their relative immunity to some of the challenges of integrated research is further enabled by their assertion of their own value systems (UL15), their internalisation of their own successes (rather than waiting for external validation) (UL22), their enjoyment of integrated research (UL6), their exhilaration at discovering new and bold connections (UL11), and the personal satisfaction that they derive from teamwork (UL13). In addition, an institutional culture of unhappiness with the rating system (LL16) could be seen as supporting some researchers in their decision to disregard the University’s requirement that they apply for a rating.

b) There are incentives for externally responsive research:

Business is in search of solutions (LR7), and companies that affiliate themselves with universities deal with challenges better (LR1). Companies are likely to see quick benefits from working with integrated researchers because they can collect data and reach a solution faster (there are more people working on the problem) (LR17). In addition, the Minister of Higher Education and Training is said to be about to start giving points for policy oriented

research (LR3). This provides incentives for integrated researchers, who believe that universities exist to improve their contexts and should be more eternally focussed (UL14), are socially responsible and looking for societal impact (UL2), are solution-oriented (UL7), and see the bigger picture and systemic connections (UL8). Integrated researchers are also incentivised to work on real world problems because of their inherent resistance to disciplinary comfort zones (UL10), and because they want to remain current (UL12) and are exhilarated by discovering new and bold connections (UL11). They are aided in this kind of work by their confidence in unfamiliar spaces (UL23) and diverse skill sets (UL25), as well as their ability to look at problems from different perspectives (UL25) and to approach problems in non-traditional ways (UR20). The location of Wits in Johannesburg means that integrated researchers have access to a living laboratory (LR2) with every imaginable challenge.

c) There is an availability of younger researchers:

Integrated researchers tend to be younger (UR11), because younger researchers are more open to new ideas and risks (UR12), more solution-oriented (UR13), and more tech savvy (UR14) (technology enables collaboration (LR14)). Integrated research projects tend to comprise a handful of senior researchers and a large number of young, very motivated researchers (LR41). The observation that Wits has many younger people (LR5) is therefore supportive of integrated research.

d) There is leadership support and grassroots implementation:

Successful integrated research requires high level buy-in but grassroots implementation (LR31) (top down implementation arouses opposition (LR20)). In other words, research problems originate from their context, and are taken up by leaders and mandated to researchers (LR25). Research managers are also required to remove impediments (UR51). At Wits, this is enabled by the perception that research managers are supportive of integrated research (LR30). Grassroots implementation is enabled by the epistemological openness of integrated researchers (UL3), the value that these researchers place on other disciplines (UL4), their natural teaching abilities (UR29), their generosity, and comfort with sharing resources and credit (UL19), their trusting nature (UL26), their willingness to be vulnerable

and receive criticism from researchers from other disciplines (UL24), their ability to admit when they do not understand (UL27), and their commitment (UL14). Grassroots implementation is also enabled by institutes and centres, because institutes and centres host workshops that lead to personal interactions and collaborations (LR13). Personal interactions are important because integrated researchers who are looking for collaborators have the most success if they approach people in person (UR25) and market their mission (UR24). At Wits, in particular, these interactions and collaborations are further encouraged by the University's strong tradition of intellectual freedom (LR24).

e) There is time in which to explore:

Integrated research is exploratory and has a high failure rate (LR19). It also takes longer than traditional research because the researchers are outside of their comfort zones (LR18) there is no recipe for integrated research (LR16), so timelines are unpredictable (LR18), and building collaborations takes time and effort (LL44). The perception that South Africans can afford to “lose” half a year without publishing (UR8), as opposed to their American and European counterparts, in particular, is therefore supportive of integrated research.

3.3 Misalignments Between Quadrants

The analysis below was done by looking for statements in one quadrant that are misaligned with statements in one or more other quadrants. This means that the statements are in conflict with each other. They are likely to result in tension within the system, and ultimately comprise the success of the system. They have been grouped into 20 thematic areas of misalignment. It should be noted that these statements are perceptions only, based on verbatim responses from interviewees, and have not been verified.

a) There is a lack of recognition and reward for integrated research:

Researchers at Wits are driven by self-interest (UL41), incentives (LL3) and the desire to earn favour with superiors (UL42), and unrewarded work is unusual (LL3). This stymies integrated research at Wits because South Africa is lagging (LR8) and therefore reward

structures are archaic (LR44). In particular, there are no reward metrics for anything other than the “publish or perish” route (LR42); there are few rewards for solving real world problems (UR1); the South African system is poor at recognising good collaborators (LR42); there is a perception that there are no journals in which to publish (LR55) and the impact factor of the journals that do exist is low (LR56); and ratings, staffing, promotions and funding are decided by peer review (LR46), which does not work for integrated research because reviewers do not understand the integrated research approach and do not agree that it is valid research (LR45). This means that it is difficult for integrated researchers to get hired (UR3) and rated (UR2), since ratings are awarded within disciplines (LR46). This is borne out by the observation that the National Research Foundation says that publishing broadly is “academic suicide” (LL38). Furthermore, integrated research comes at a personal cost (UR9), in a context where time (UR38) and money (UR39) are constrained, and where researchers have to service their own departments first because those departments pay their salaries (UR43). At Wits, the observation that reward structures are archaic (LR44) is incompatible with the perception that management is supportive of integrated research (LR30).

b) There is resistance to change:

Researchers at Wits resist change (UL31), fear the unknown and want to retain the status quo (UL45), see threats not opportunities (UL44), adhere to rules (LL10), and are, in some cases, simply waiting for retirement (LL17). This is in conflict with the requirement that integrated researchers resist languishing in comfort zones (UL10), have a desire to remain current (UL12), be curious and willing to learn (UL1), be confident in unknown spaces (UL23), be energetic and adventurous (UL9), and be exhilarated by discovering new and bold connections (UL11). The fear of the unknown is exacerbated by the perception that there is no recipe for integrated research (LR16), and uncertainty about what constitutes successful integrated research (LL35). It is seen as a threat to disciplinarity and pedagogy (LL33).

c) Collaboration is difficult:

Successful integrated research requires regular discussions, transparency and a flat hierarchy (LR15), and joint, measurable objectives (LR29). One has to find alignments and clusters (UR32). It requires forcing people to sit in a room and brainstorm a problem together (LR34).

This kind of collaboration is stymied by the observations that scientists are conditioned to work alone (UR30), researchers are resistant to being disturbed (UL43), everyone is immersed in their own projects (UR33), and academics are overloaded (UR46). In addition, some make themselves difficult to reach (UR35), there is poor advertising of ongoing research (LR37), and researchers have no idea what their colleagues are working on (UR28). Furthermore, there is disciplinary arrogance (LL42) and a belief that other disciplines have no value (UL29), so faculties are not open to acquiring knowledge from each other (LL22) and there is a belief that it is wrong for faculties to talk to each other (LL29). This contributes to a situation where building collaborations takes time and effort (LL44), and it is easier to work with one's own team where there is a shared culture (UR5). The situation is exacerbated given that it is uncommon for both parties to benefit (in instances where one researcher's work is "leaning over into" another researcher's work) (UR31), and South African systems like the showman and are bad at rewarding good collaborators (LR42). Finally, scientists are difficult to manage (UR10). Some are demanding and high maintenance (UR6), and assume idiocy on the other side (UL30), and it can be explosive to bring these elitist, high maintenance people into the same space (LL40). These character traits conflict with the requirement that integrated researchers have good interpersonal skills (UR27), must be able to "let stuff go" (UL18), and should not get caught up in resentment (UL18).

d) There is a language barrier between disciplines:

In order for integrated research to take place successfully, there should be regular discussions, transparency and a flat hierarchy (LR15), as well as joint, measurable objectives (LR29). Finding alignments and clusters between researchers is important to achieving this kind of research environment (UR32), and may require forcing people to sit in a room and brainstorm a problem together (LR34). One has to approach people in person (UR24) and market one's mission (UR23). This kind of communication could be stymied by language barriers between researchers from different disciplines (UR26). Interpersonal skills are important (UR27), but the subtle skills that are required for collaboration are not well understood (LL47), and it is easier to work with one's own team where there is a shared language (UR5).

e) Competitiveness stifles collaboration:

The scarcity of money (UR39), competition for funding (LL11), and the difficulty of moving money across institutional boundaries (LR47) leads to a reluctance to share resources (LL43), scepticism (UL57) and distrust (UL51) of outsiders, lack of trust around talking about one's research (UL56), research groups protecting their turf from other groups (LL41) and a focus on distributing the spoils before the collaboration is even formed (UR36). This conflicts with the requirement that integrated researchers should be trusting (UL26), should be generous, and comfortable sharing resources and credit (UL19), and should find personal satisfaction in teamwork (UL13). Large grants exacerbate competitiveness (UR34), making it difficult to reach out (LL48). Relationships actually form better in non-threatening environments with low stakes (LR35), which enable more dialogue (UR34). Thus, paradoxically, competition for resources leads to a lack of trust, which in turn leads to funding calls for collaborative research being ignored, because of a lack of relationships (LL49). Pressure to meet institutional targets also makes people less collaborative (LL46).

f) There is an adherence to academic silos:

Integrated researchers believe that traditional research methods are not working; they have realised the limits of their disciplines (UL5) and they value input from other disciplines (UL4). This epistemological openness (UL3) clashes with the attitudes of other researchers who believe that knowledge can only be produced in particular sites (UL38), and that their disciplines are more valuable than other disciplines (UL55), which have no value (UL29). They assume idiocy on the other side (UL30). This is also reflected on an institutional level with epistemological differences (LL20), a lack of respect between disciplines (LL25), disciplinary arrogance (LL42) and a belief that integrated research is non-experts interfering (LL18) and threatening disciplinarity and pedagogy (LL33). Schools think that they are superior (LL21), and there is a belief that it is wrong for faculties to talk to each other (LL29). Natural scientists have more legitimacy (LL27), and there is a belief that everyone knows social science (LL28) and that social scientists do not solve problems (UL32). Therefore, social scientists are afraid to engage hard scientists because they do not feel that their forms of evidence will count (LL23). Hard scientists, on the other hand, are afraid of being proven wrong (LL24). Wits, as a whole, demonstrates an acceptance of structural constraints (LL30) and a lack of the imagination that is required to transcend disciplinary

boundaries (LL1). Management systems reinforce silos because they focus on process rather than science (LR12). There is the perception that even the National Research Foundation does not realise that wicked challenges cannot be solved with a silo-based approach (LR10).

g) Integrated research lacks legitimacy:

The requirement that there be high level buy-in (LR31) is undermined by the observation that integrated research is mostly not understood or valued (LL32), integrated research is not considered to be real science, but rather play and “wishy washy garbage” (LL37), there is no recipe for integrated research (LR16), and there is uncertainty about what constitutes successful integrated research (LL35). The commitment of integrated researchers (UL17) is undermined by other researchers being unconvinced of the intellectual rationale behind integrated research (UL36). They believe that integrated research is a fad (UL37), and are concerned about becoming a generalist (UL33).

h) There is insecurity and egotism:

Integrated researchers are self-aware (UL16), confident in unknown spaces (UL23), not ashamed to admit that they do not understand (UL27), willing to be vulnerable by commenting on research outside one’s field (UR4) and receiving robust criticism from people from other disciplines (UL24), able to “let stuff go” and not get caught up in resentment (UL18). However, some researchers are insecure (UL43), territorial (UL46), egotistical (UL49), like being in control (UL47) and proud and reluctant to seem stupid (UL48). Their self-worth is dependent on being able to do something that others cannot (UL52), and they fear the loss of power of not being special (UL53). They engage in intellectual belittling (LL12), which makes colleagues even less willing to be vulnerable. Social scientists are afraid to engage hard scientists because they do not feel that their forms of evidence will count (LL23), and hard scientists are afraid of possibly being proven wrong (LL24).

i) Researchers are afraid of asking permission to do external work:

Integrated research is often conducted as a result of external relationships that are built up over years (LR39). However, external work requires permission (LR21) from heads of schools, and some researchers fear their head of school (UL58).

j) There is a failure to commercialise research:

Business is in search of solutions (LR7); integrated researchers are solution oriented (UL7); integrated researchers believe that universities exist to improve their contexts and should be more externally focussed (UL14), and companies that affiliate themselves with universities deal with challenges better (LR1). However, companies do not see the value of research to their operations (LR2). This misalignment, and the resulting failure of companies to capitalise on the University's research offerings, are further exacerbated by the lack of rewards for solving real world problems (UR1), and the belief that research should be driven by the academy, and not by external priorities (LL7). This belief may arise from a lack of vision (UL39), a failure to buy into the big picture (UL39), an inability to engage with new ideas (UL40), and an adherence to rules (LL10). The misalignment is also exacerbated by the belief that Wits is special and more worthy of respect (LL5), which makes it difficult for the public and private sectors to approach the University. Once research has been conducted, it is difficult to commercialise it because there are questions around intellectual property (IP) ownership (LR40). This creates competitiveness and an unwillingness to partner (LR40). Research councils jealously guard IP and do not commercialise (LL9).

k) Wits is punitive towards failure:

Integrated research is exploratory and has a high failure rate (LR19). It also takes longer because researchers are outside their comfort zones (LR18), timelines are unpredictable (LR18), and building collaborations takes time and effort (LL44). This does not align with the perception that Wits is punitive towards failure (LR9). Researchers who are driven by self-interest (UL41) and want to earn "brownie points" (UL42) will be dissuaded by the penalties.

l) There is a lack of support for institutes and centres:

Institutes and centres play an important role with regard to hosting workshops and enabling collaboration (LR13). This does not align with the observation that there has been no thought by Wits into why institutes and centres exist (LL4). Furthermore, there is a belief that Wits is special and more worthy of respect (LL5), and that institutes should pay for the privilege of being at the University (LL6), which results in them being established at other institutions. The importance of centres is undermined by the perception that being employed by a centre is grant-based and precarious (UR40).

m) There is a lack of leadership and other pre-conditions for grassroots implementation:

Successful integrated research requires high level buy-in and grassroots implementation (LR31), with research managers facilitating the process by removing impediments (UR51). However, despite the University's claim to support integrated research, it has no idea how (LL31), and the institutional buy-in is on the surface only (LL36). Integrated research is mostly not understood or valued (LL32). This is dangerous for integrated research because policy ends up being decided by bean counters who do not get it and do not care (LL13). Heads of schools discourage integrated research because the school gets less money as rewards are shared (UR41). Furthermore, there is an institutional resistance to anomalies, and a preference for clean structures and reporting lines (LL34). This does not align with the belief that integrated research cannot be legislated by formal structures (LR23), and needs room for imperfect processes (LR23), with team members often reporting to multiple people (LR26). If integrated research requires high level buy-in, political support and faculty ownership, then it will be vulnerable to leaders leaving (LR22). Institutional support depends on the interests of the current leader (UR57), and new leaders can be hostile or uninterested if they do not own projects (UR55). Territorial leaders can also impede projects (UR56). At the grassroots level, implementation could be frustrated by academics being overloaded (UR46), a lack of initiative and willingness to help (UR45), administrative systems which are a big barrier (LR32), and administrators who are unhelpful (UR42).

n) Integrated research is imperfect:

Researchers need to see a clear purpose (LL2). This does not align with the observation that, at Wits, there is a tension between the public good and a profit motive (LL15). In addition, for integrated research to be successful, the team needs to be clear about what success would look like (UR21), and to have joint, measurable objectives (LR29). This does not align with the perception that there is no recipe for integrated research (LR16), no proper lifecycles (LR28), and no closure (LR28). In fact, integrated research needs room for imperfect processes (LR23). This makes it more difficult to attract funding, since there are not necessarily any demonstrable outcomes (LR49).

o) Senior researchers are not interested:

Integrated research projects tend to comprise a handful of senior researchers and a large number of young, very motivated researchers (LR41). However, some senior researchers are simply waiting for retirement (LL17), and are resistant to being disturbed (UL43). This is detrimental to integrated research given that it requires champions to keep it alive (UR48), that these champions must hold the space intellectually (UR54), and that, therefore, it is difficult for novices to drive integrated research (UR50).

p) There is strong pressure to meet targets:

Integrated researchers are socially responsible and look for societal impact (UL2). However, pressure to meet targets is destroying this greater good mentality (LL8). This pressure is exacerbated by the scarcity of time (UR38) and money (UR39), and the observation that academics are already overloaded (UR46).

q) It is difficult to attract and retain younger researchers:

Integrated researchers tend to be younger (UR11), with projects comprising a handful of senior researchers and a large number of young, very motivated researchers (LR41). Because leaders must hold the space intellectually (UR54), it makes it difficult for novices to drive integrated research (UR50). However, younger researchers need jobs (UR15), and it is

difficult for integrated researchers to get hired (UR3). Staffing is done by peer review (LR45), and peer review does not work for integrated researchers, because reviewers do not understand the integrated research approach or agree that it is research (LR44). In addition, the perception that South Africa is lagging (LR8) may encourage younger researchers to go elsewhere.

r) There is gender bias against women:

Integrated researchers tend to be women (UR16), and women do not get funding (UR17).

s) Publishing is important but difficult:

Integrated research projects must be led by a respected, public face (UR47). Credentials are important, otherwise integrated researchers who approach colleagues are perceived as junior researchers needing support from a senior researcher (UR37). This does not align with the perception that in academia, credibility depends on publications (UR23), and in integrated research, there are no journals in which to publish (LR55). (The data on numbers of journals that publish integrated research were contradictory. Some interviewees said that there were no journals in which to publish (LR55), and others said that there were lots of journals in which to publish (LR53)). Furthermore, leaders have onerous administrative and fundraising responsibilities (UR58), leaving them little time to publish. The result is that leaders tend not to be iconic scholars (UR49). Publishing also gives legitimacy to Wits, enabling it to serve as an interlocutor (LR54).

t) There is a lack of funding:

Funders like integrated research because the trend is to take on grand challenges (LR51). However, some researchers still experience scarcity of funding (UR39), and start-up funding, in particular, is a problem (LR48). There is a lean funding environment with onerous accountability requirements (LR50), and the grants that do become available are poorly advertised (LR38). In addition, funding is allocated by peer review (LR45), and the peer review mechanism does not work for integrated research, because reviewers do not

understand the integrated research approach nor agree that it is research (LR44). Most importantly, the NRF, which is the primary funder (LR52), does not realise that wicked challenges cannot be solved with a silo-based approach (LR10), and holds the view that publishing broadly is “academic suicide” (LL38). Funding is easier to obtain if the research has a demonstrable outcome (LR49), but integrated research is exploratory and has a high failure rate (LR19).

CHAPTER FOUR: DISCUSSION

Given the widespread realisation that bridging disciplinary boundaries is critical to tackling the urgent, complex global challenges of today, and in a context where universities are largely failing to deliver appropriately on this mandate, this research aimed to investigate the barriers and enablers to integrated research at Wits University. After interviewing researchers and research managers regarding their perceptions around the reasons for integrated research successes and failures, this research used the AQAL framework under Integral Theory to analyse the alignments and misalignments between these perceptions. In the discussion below, some suggestions are formulated for creating an institutional environment that encourages and supports integrated research. According to the AQAL methodology, this should be done by identifying interventions that will remove or minimise the misalignments in the system and achieve stronger alignment between the quadrants, since an integrally informed path must take all four perspectives or quadrants into account, and thus arrive at a more comprehensive and effective approach (Wilber, 2005).

4.1 The Need for Vulnerability and the Transcendence of Ego

The data revealed consensus among many interviewees regarding a number of the key barriers and enablers to integrated research. In particular, there was a perception that integrated research was an inherently vulnerable space, involving a high degree of reputational and other risks, and that this space was typically occupied by researchers who were innately secure and adventurous individuals. The perception that integrated research involves personal risk is supported by Amey and Brown (2004). They note that individual and institutional reputations are usually built on the recognisable portfolios of work that result from closely observing the time-honoured traditions of disciplinary productivity. Integrated researchers must take on the risk of trying to build their portfolios without relying on the recognisability that is afforded by such disciplinary productivity.

In addition to being willing to make themselves vulnerable, integrated researchers were perceived by interviewees to have transcended ego, arrogance and the reluctance to relinquish control. This observation is supported by Heberlein (1988), who identified decades ago that

interdisciplinary research was tough on the ego. This is not an inconsequential matter, since much research is motivated by the self-gratification of the scientist (Amey and Brown, 2004). In an intensive study of a 10-member university research team that was involved in an 18-month university-community partnership in which they were contracted to provide technical help and training to an inner city council, Amey and Brown (2004) noted that all 10 members (who represented five different units on campus) believed that they were experts who interpreted the world more correctly than the others. In examining the ways in which the members dealt with the formation of an interdisciplinary team and the associated leadership issues, Amey and Brown (2004) observed that few members were willing to have their expert roles challenged. Instead, they viewed the group experience as an opportunity to demonstrate their expertise, rather than to learn.

In attempting to address issues around vulnerability and ego, personal development courses and career counselling could assist researchers to become more self-aware. According to Swan (2010), personal development courses provide advice and techniques focussed on self-improvement in mental, social, psychological and emotional tasks, and they help individuals to become more effective at work and home. Personal development has a lot in common with clinical therapy, but it is more hybrid in the knowledge and techniques that it draws from, and it is broader in terms of the contexts in which it can be applied. It is useful in dealing with, among others, a lack of confidence and interpersonal conflict at work. When recommending personal development or career counselling, the fact that individuals have varying levels of receptivity towards such interventions will need to be taken into account. These recommendations may need to be preceded by the development of some reflexivity and awareness of alternative modes of thinking and paradigms.

4.2 Leveraging Existing Incentives

A number of interviewees also held that the desire to solve real world problems and to make a difference beyond simply publishing in academic journals was a commonality between integrated researchers. This observation is supported by Brewer (1999) who defines interdisciplinarity as the appropriate combination of knowledge from different disciplines in order to shed light on an actual problem. A growing number of researchers are realising that old problems require new solutions (Amey and Brown, 2004). They want to make a

difference, and this not only draws researchers to integrated endeavours, but also stops them from leaving when things become difficult.

Moore (2015b) examines a South African case study of a formal research partnership between a City-region and two universities, which grew out of the newly established City-region's understanding that it would need credible sources of information if it was to manage the diverse and widely dispersed population. The partnership resulted in a research centre that was staffed by the two universities and governed by representatives from all three founding entities. Moore (2015b) attributes the ability of the project participants to successfully span the boundaries of their different organisations and disciplines to a strong shared desire to uplift communities. The staff came from a wide variety of disciplines, and they were governed by three very different institutional entities, but according to Moore (2015b), their shared social purpose encouraged them to work together. It also provided the incentive for project participants to stay, even when they inevitably encountered problems. Amey and Brown (2004) found that the team members in their study coped with potential conflict by using the question, "What would the community want?" to discuss issues from a discipline-neutral stance.

The observation that integrated researchers are driven by relevance and passion, rather than financial remuneration or prestige, is one of the strongest alignments that was identified in the Wits context. It could be leveraged by improving awareness of opportunities for integrated research and the ways in which integrated research delivers ground-breaking solutions to real world problems. There has already been a rapid increase in understanding of the importance of science communication as a discipline (Gilbert and Stocklmayer, 2013). In addition, Wits could stimulate more opportunities for externally responsive research by creating awareness in the public and private sectors of the possibilities that exist, and the ways in which integrated research meets public and private sector needs (Taebi *et al.*, 2014). Finally, one of the interviewees mentioned a possible point system that would use government subsidies to incentivise policy oriented research. The Minister of Higher Education and Training could be lobbied to speed up the implementation of such a system.

4.3 Addressing the Lack of Incentives

The data suggested that while some researchers are motivated by non-material incentives, there are others who are dissuaded from integrated research by the perceived difficulty in achieving material incentives, such as ratings. The manner in which academic ratings are awarded by the NRF and the pursuit of these ratings were mentioned by 19% of interviewees as a barrier to integrated research. According to Amey and Brown (2004), most academic structures and reward systems foster and promote individual contributions within narrow disciplines. Fairweather (2002) observed that even when researchers do stray outside of university structures and reward systems, external review committees often do not know how to evaluate them. These committees then fall back on assessing more heavily those aspects with which they have more familiarity, such as single-authored publications. According to Amey and Brown (2004), this is also true of national ratings systems.

In South Africa, the NRF does seem to take into account the need for a rating assessment process that can accommodate integrated research. According to the NRF website, the NRF assesses applications through one of 25 Specialist Committees. These Committees are listed on the website and are broadly representative of the range of academic disciplines offered at universities, described by the NRF as “key research areas”. They include Anthropology, Development Studies, Geography, Sociology and Social Work; Biochemistry, Molecular and Cell Biology; Chemistry, Economics, Management, Administration and Accounting; Engineering; Health Sciences; Law; Literary Studies; Language and Linguistics; Mathematical Sciences; Physics; and Political Studies and Philosophy. However, the NRF acknowledges the potential for overlap between these fields, and the possibility that applicants who work in a “multi- and/or interdisciplinary way” may have difficulty in selecting any single Specialist Committee to apply to. Therefore, the NRF allows applicants to request consultation between Specialist Committees (NRF, 2014).

This decision might also be influenced by the need for the national Department of Science and Technology (DST), through the NRF, to fund research that addresses the DST’s Global Grand Challenges. The Global Grand Challenges are a programme of five key research priorities which are identified in the DST’s, *Innovation Towards a Knowledge-based Economy: Ten-year Innovation Plan for South Africa (2008-2018)*. The purpose of the plan is “to help drive South Africa’s transformation towards a knowledge-based economy, in which the production and dissemination of knowledge leads to economic benefits and enriches all

fields of human endeavor” (DST, 2008: p.iv). Each of the challenges is intended to stimulate multidisciplinary thinking and to encourage interdisciplinary collaboration (Council for Scientific and Industrial Research, 2009).

However, despite this concession by the NRF, researchers and research managers at Wits hold the view that ratings assessment processes are biased against integrated researchers. This may be due to one of two reasons. Firstly, it may not be sufficient to simply enable consultation between two or more Specialist Committees. The likely failure of assessing interdisciplinary research by slightly adapting the evaluation procedures for disciplinary research is implied by Laudel and Origgi (2006) who describe such an approach as “muddling through” (p.2). As previously stated, when confronted with integrated research, review committees tend to fall back on assessing more heavily those aspects with which they have more familiarity, such as single-authored publications (Fairweather, 2002). Combining inputs from two or more Specialist Committees, each of which may attempt to assess a rating application based on its own familiar, disciplinary metrics, may not result in a proper assessment of integrated research. In addition, studies have shown that it can be difficult to integrate the different scientific perspectives of reviewers. Therefore, procedure matters if we are to ensure that interdisciplinary research is not the loser in the assessment process (Laudel and Origgi, 2006). One way to address this problem might be for the NRF to create separate, specially constituted Specialist Committees comprising experts in integrated research, instead of simply enabling consultation between existing Specialist Committees. According to Amey and Brown (2004), finding such a set of interdisciplinary peers remains one of the most crucial problems to be resolved.

Secondly, it may be that the perception that ratings assessments are biased against integrated research is simply not true. This explanation is supported by an extensive study of all of the academic physics groups in the Netherlands which investigated whether interdisciplinary research is valued less in both qualitative (peer-review based) and quantitative (bibliometric) assessments. The study found no general evidence for either a peer-review or a bibliometric bias against interdisciplinary research (Rinia et al., 2001).

In addition to ratings, internal recognition and reward are regarded as important incentives. At Wits, the lack of recognition and reward for integrated research could be addressed by introducing a performance management system that encourages not just teaching and research, as per traditional academic criteria, but also collaborative and externally responsive

(integrated) research. Performance management metrics could include quantitative measures such as the number of co-authored publications, as well as qualitative measures such as the degree of multi-, inter- or transdisciplinarity in a researcher's work. Academics could be required to report on their performance under this category in probation forms and annual performance assessments. Staffing and promotions committees could also include these criteria in their evaluations. This has been implemented at the Arizona State University (ASU) where co-teaching and integrated research are requirements for tenure (ASU, 2014). In addition to the increased remuneration offered by performance management systems, other incentives could be used, such as providing release-time, resources, and additional administrative and professional staff (Aldrich, 2014). It is particularly important for younger researchers to see their more established peers being rewarded for integrated research, rather than penalised or delayed in their career progression (Amey and Brown, 2004).

4.4 Overcoming the Lack of Funding

A number of the alignments and misalignments that were identified in the data analysis deal with the financial incentives – or lack thereof – for integrated research. There was a lack of consensus between interviewees on whether there was enough funding available for integrated research at Wits. This difference in perceptions may be due to the different amounts of funding that are available for disciplines. In particular, the social sciences receive less funding in many countries (Davidson, 2016). This is exacerbated by the perception that, as indicated by one of the interviewees, the current funding environment is particularly lean and requires many onerous reporting mechanisms. This may be having a greater effect on the social sciences. In addition, the social sciences tend to see disproportionate, politically motivated funding cuts (Simon and Schiemer, 2015). It must be noted that the underfunding of the social sciences is problematic for the development of integrated research, since investment in social science research is important for maintaining existing interdisciplinary and applied collaborations (Woolley *et al.*, 2014). However, the literature supports the view that there is a widespread lack of funding for integrated research in general. Brewer (1999) lists funding as one of the top institutional impediments to integrated research. Amey and Brown (2004) cite budgetary inflexibility on a faculty/school/departmental level as a potential problem. In addition, most integrated research projects take longer and this present a challenge to budget cycles.

The perceived lack of funding could also be addressed by identifying and focussing efforts on funders that are receptive to integrated research, realise that integrated research is exploratory and does not always lead to solutions, and allow the space in which to fail. For example, the Open Society Foundations (OSF) focus on funding research that produces innovative and unconventional approaches to fundamental societal challenges, and that enriches public understanding of those challenges. OSF's specific focus on bringing about lasting social change is particularly compatible with integrated research (OSF, 2016). Indeed, according to Aldrich (2014), the ultimate goal of philanthropy is to address the question: "How can we make society better?" rather than: "What fundamental truth can we uncover?" This is borne out by the example of ASU, where research questions are identified in collaboration with society in a deliberate attempt to target fundamental societal challenges, and the university has nearly tripled its research funding over the past 10 years, making it one of the fastest-growing large research entities in the United States (ASU Knowledge Development Enterprise, 2016). In fact, Simon and Schiemer (2015) suggest that the number of funders that prioritise integrated research and solutions for complex "real world problems" are increasing, due to the use of what is referred to as the "impact agenda", which is an instrument to demonstrate immediate policy relevance of funders and the research that they fund.

Funding could also be increased by removing the barriers that inhibit the commercialisation of research, such as restrictive intellectual property policies. It is important to note that in attempting to stimulate the commercialisation of research, universities have seen higher success rates when allowing significant academic freedoms to interact with industry, including involvement in new firms. By contrast, universities that follow a top-down approach in which academics are discouraged from actively participating in the commercialisation of their ideas are less likely to succeed (Goldfarb and Henrekson, 2003). At Wits University, the marketing and commercialisation of the University's intellectual capital is a function of Wits Commercial Enterprise (Pty) Ltd, a private company that is wholly owned by the University, and is focused on short course management, research support, intellectual property management and technology transfer (Wits Commercial Enterprise, 2016). In 2015, the annual turnover of Wits Commercial Enterprise was R34 858 000 (University of the Witwatersrand, 2015b). By contrast, the annual turnover of the Wits Health Consortium (Pty) Limited, also a wholly owned Company of the University which has a similar function to Wits Commercial Enterprise but focusses solely on the health

sciences (Wits Health Consortium, 2016), was R666 317 000 (University of the Witwatersrand, 2015b). The fact that the Wits Health Consortium produces an income that is almost 20 times greater than that of Wits Commercial Enterprise could indicate that there is a lot more room for growth by Wits Commercial Enterprise, and it raises questions about why that growth has not yet been achieved.

Finally, since the data show that women are more likely to conduct integrated research, there should be an emphasis on creating funding opportunities for women, such as dedicated research chairs and fellowships.

4.5 Addressing Difficulties in Collaborating

The data revealed a number of issues that make it difficult for researchers to collaborate at Wits, including a lack of trust, and the language barrier between disciplines. The analysis that both of these issues are resulting in misalignments at Wits is supported by Brewer (1999) who lists the following as two of the most common obstacles to integrated research: a) personal challenges related to gaining the trust and respect of others working in different disciplines, and b) the difference in languages between disciplines and between disciplines and the world at large.

The link between trust and collaboration in integrated research is described by Amey and Brown (2004), who found that there are a greater number of interpersonal and identity conflicts in integrated research, and that trust and respect are usually the first casualties of these conflicts. Perhaps more importantly, the degree to which trust exists at the outset of a collaboration can affect the success of the collaboration, as indicated by Fulmer and Gelfand (2012) who found that trust has implications in multiple levels across organisations, including teamwork. Fulmer and Gelfand (2012) synthesised numerous definitions of trust to arrive at two key dimensions: positive expectations about an individual's intentions and reliability, and willingness to accept vulnerability, which generally involves suspending uncertainty and taking the risk to depend on an individual. In the context of integrated research, it has already been discussed in 4.1 that researchers who are more willing to make themselves vulnerable are more likely to conduct integrated research. With regard to expectations about intentions and reliability, since expectations are influenced by the extent to which individuals share

values, principles and domain-specific competence (Fulmer and Gelfand, 2012), such expectations are likely to be less positive between researchers from different disciplines.

Fulmer and Gelfand (2012) found that trust has implications for not just teamwork, but also leadership success. This is relevant to integrated research, given that there was strong consensus among researchers that effective leadership and policy-making are important to the success of integrated research (see 4.7). Whereas interpersonal trust may be particularly affected by shared perspectives and disciplinary backgrounds, trust in leaders might rely more on similarities in goals (Fulmer and Gelfand, 2012). It is therefore important for university leaders to share the vision to move towards integrated research.

Having identified the importance of trust and communication to collaborative research, it can be said that members of integrated research teams must work on finding intellectually neutral spaces from which to listen to other perspectives, to see how these perspectives complement their own thinking, and to be able to resolve some of the gaps in their own thinking (Amey and Brown, 2004). In this regard, an important intervention could be an improvement in interpersonal and listening skills, which could be achieved through professional coaching and mediation. Improved interpersonal skills could also have a positive effect on the language barrier between researchers from different disciplines, since individuals will become more sensitised to the experiences of their colleagues and how confusing and alienating jargon can be. According to Taylor *et al.* (2015), a multi-disciplinary team of collaborators who were creating the curriculum for a new academic programme benefitted from having gone through an initial series of externally facilitated workshops and other interventions, which left them with a common language and a desire for the programme to be successful regardless of any personal benefit.

Developmental workshops are another possible tool. According to Taylor *et al.* (2015), developmental workshops that involve taking a closer look at internal individual and collective change processes, developing indicators for the meaning of effective change, and gaining experiential insight into the skills and tools required are “intensely personal, introspective and extremely cathartic” (p.430). They enable some team members to develop close personal bonds with each other, while others might find the process difficult and withdraw. However, ultimately, such workshops enable a team to develop a shared understanding of what it would require to meld their disparate personalities, skills and experiences into a unified collective (Taylor *et al.*, 2015).

4.6 Shifting the Institutional Culture

One of the reasons why integrated research is both so powerful and so necessary, is that it generates new research avenues. However, it does this in part by challenging established beliefs, which can cause resistance (Barry *et al.*, 2008). One of the longstanding norms that is challenged by integrated research is the structuring of universities according to traditional disciplinary siloes. According to the data, these siloes are a significant barrier to integrated research. Aldrich (2014) writes that the need to draw departmental boundaries at universities has inevitably caused institutional incentives to favour the “intellectual centre of gravity” of the departments over integrated research (p.186). Brewer (1999) concludes that traditional institutional arrangements are the chief barrier to integrated research.

Overcoming the adherence to academic silos at Wits could require a shift in institutional culture, since according to the data, there is pervasive disciplinary arrogance and this is likely to entrench disciplinary thinking. In this regard, the interventions that were introduced at the ASU could be instructive. ASU, under the strategic leadership of its President, Michel Crow, has proven its willingness to redraw traditional university structures and encourage movement across disciplinary boundaries (McGregor and Volckmann, 2011). Despite their disciplinary flexibility, ASU was ranked in the top 100 universities in the world by the 2015 edition of the prestigious Academic Ranking of World Universities, better known as the Shanghai Ranking, which measures criteria such as the number of alumni and staff winning Nobel Prizes and Fields Medals, the number of highly cited researchers selected by Thomson Reuters, and the number of articles published in *Nature* and *Science* (ShanghaiRanking Consultancy, 2015). In following ASU’s example, Wits could consider adopting the eight design principles that were developed by Crow (see p.8-9) for universities seeking the sustainability, social immersion and global engagement (ASU, 2015) that are cited as prerequisites for conducting integrated research (Crow, 2009). Regardless of how the adherence to academic silos is addressed, an important principle to bear in mind is that disciplines should not be attacked directly. Rather, integrated research entities should be established in the crevices between disciplines, as non-threatening alternatives to the dominant paradigm (Brewer, 1999).

The data indicated that a further shift in institutional culture is required around attitudes towards failure. According to the data, South African researchers are not under as much pressure to publish as their northern hemisphere colleagues and therefore, they have more

time in which to fail. This should make them more likely to engage in integrated research, since integrated research is exploratory by nature. This is described by one respondent who said: “South Africans have less peer pressure; we can afford to lose half a year without publishing – this enables us to try new things.”

However, the data also indicated that Wits is punitive towards failure, which could be stifling creativity and ultimately discouraging integrated research. One respondent said: “I failed a PhD because I took an integrated approach.” Another stated: “The University is quite punitive if your student fails.” Taken together, these statements reveal that not only are there perceived negative repercussions for undertaking integrated research, there are also perceived negative repercussions for encouraging one’s postgraduate students to undertake integrated research. In addition, the data show that research managers are under pressure to meet targets and that they transfer this pressure to researchers. As one respondent put it: “The vice-chancellor is putting pressure on the deans and they are putting pressure on schools.” Another respondent linked this phenomenon to a reluctance to conduct integrated research, saying: “Pressure to meet targets destroys a greater good mentality.” In addressing this issue, Wits could follow the example of the Stockholm Resilience Centre (SRC). The SRC aims to give creativity and innovation room to thrive. As mentioned earlier, the SRC holds that allowing temporary integrated research constellations or teams to self-organise around research problems is more important than pushing productivity, and leadership is less about control and more about creating an enabling environment that supports exploration (SRC, 2014). Despite following the SRC’s untraditional approach, Stockholm University was ranked in the top five environmental science and engineering universities in the world by the 2016 edition of the Academic Ranking of World Universities (SRC, 2016).

The perception that integrated research is imperfect could be exacerbating its lack of legitimacy. In this regard, exposure to international research environments where integrated research is more established could assist in normalising the imperfect processes that are associated with integrated research. Woolley *et al.* (2014) found that work experience in foreign universities boosted the number of collaborative research relationships that academics were involved in. They also found that holding an international citizenship increased the extent to which academics were involved in interdisciplinary collaborations. Therefore, Wits researchers should be encouraged to spend time abroad and research managers could be more deliberate about facilitating international staff exchange opportunities.

The legitimacy of integrated research could also be improved by increasing the number of integrated research articles that are published in accredited journals. Here, it is relevant to raise the issue of whether there are a sufficient number of journals that publish integrated research. The data indicated a difference in perception in this regard. One of the interviewees who held that there was a lack of journals said that editorial boards were comprised of disciplinarians who did not value integrated research. This may well be true. It is a perception that is supported by Aldrich (2014) who writes that journal reviewing is an inherently conservative process and that reviewers tend to discard work that does not conform to their disciplines. However, it may also be true that there are many journals, but that these journals tend to be newly established, with low impact factors, and that researchers therefore disregard them. The NRF (2014) explicitly encourages researchers applying for ratings to publish in high impact journals/outlets. According to Aldrich (2014), it is not necessarily true that new journals with no proven track records are inferior. However, it is more difficult to judge whether they are inferior.

In addition, there is quantitative evidence that the use of journal rankings in evaluations can disadvantage integrated research. Rafols *et al.* (2012) compared the degree of interdisciplinarity and the research performance of a number of Innovation Studies units versus Business and Management Schools in the UK. They showed that the Innovation Studies units were consistently more interdisciplinary than the Business and Management Schools. Because the top journals span a less diverse set of disciplines than lower-ranked journals, this results in Innovation Studies units scoring lower on journal ranking-based assessments. In citation-based assessments, the high scores were of the Business and Management Schools were not repeated. Rafols *et al.* (2012) concluded that journal ranking-based assessments are biased against interdisciplinarity.

4.7 Demographics and the Role of Leadership

The data depicted a number of commonalities in the typical demographics of integrated researchers. In particular, interviewees perceived that young researchers and women were more likely to engage in integrated research. While no literature was found to support these perceptions, Brewer (1999) indicates that rapidly developing technologies, as well as the rise of the virtual communities that they represent, are enhancing the opportunity for collaboration. It is not unreasonable to determine that younger researchers are more likely to

engage with such technologies. Some interviewees indicated that younger researchers should be discouraged from partaking in integrated research. This is because there are professional impediments related to integrated research, such as hiring, promotion, status, and recognition (Brewer, 1999), and these impediments are likely to have a greater impact on younger researchers, since they are more dependent on career recognition and cannot afford to take risks (Amey and Brown, 2004).

There was strong consensus among researchers that effective leadership and policy-making are important to the success of integrated research. However, the same consensus was not evident among research managers, with one individual explicitly discounting the importance of what was termed, “legislation”. The literature supports the former view, with many authors arguing the importance of project leadership, which sets vision, goals, roles and tasks, and nurtures the team until an interdisciplinary relationship emerges, as well as institutional leadership, which facilitates integrated research on a systemic level (Amey and Brown, 2004). In general, leadership is seen to play a critical role and issues with leadership are held to be particularly destructive (McGregor and Volckmann, 2011). The fact that Wits research managers failed to put forward these points may be due to an unwillingness to accept personal accountability.

The data indicate that there is existing leadership support and grassroots implementation at Wits. This alignment could be leveraged by encouraging leaders, such as the vice-chancellor, the deputy vice-chancellors and the deans to be more vocal in their support for integrated research. Given the success of research entities such as the Newcastle Institute for Energy and Resources and the Stockholm Resilience Centre at other universities, it could be argued that at least some of this support should be levied towards the efforts of individual research entities that are showing innovation in integrated research. According to Aldrich (2014), another of the most obvious but important ways for administrators to encourage integrated research is by featuring it in the university’s strategic plans.

The University of South Dakota has tied integrated efforts to monetary reward by placing 15% of its salary pool into a category known as “institutional priorities”, and awarding this money to, among others, academics who teach interdisciplinary courses (Aldrich, 2014). At Wits, such a scheme may be premature. However, executives are currently managed through key performance indicators (KPIs) which are informed by the University’s institutional scorecard (University of the Witwatersrand, 2015b). These executives could be held

accountable for the extent to which they encourage and support integrated research through the creation of KPIs for integrated research. There is an associated risk that, for those who are not interested in integrated research, such KPIs may be dis-incentivising and result in these executives leaving the institution. To counteract this risk, the KPIs should not be enforced in a top-down manner, but rather decided jointly in discussion with each executive. One of the ways in which executives could score well on the above mentioned KPIs would be to develop institutes and centres, which are known to foster integrated research (Aldrich, 2014). Deans could also score well by encouraging heads of schools to be more receptive to requests for permission to do external work, thereby addressing the fear of requesting permission to do external work.

Finally, issues with grassroots implementation could be mitigated by tasking an individual with significant institutional knowledge and power to facilitate introductions between researchers and mandate those researchers to collaborate. The appointment of project managers (particularly in institutes and centres) could provide administrative support and reduce the reliance on faculty administrators who are not invested in the project. In addition, existing initiatives that enable grassroots interactions and collaborations could be funded by a central University pot, enabling them to take place more frequently.

4.8 Future Investigations

Future investigations could tap the full potential of the AQAL framework by applying not just the quadrants, but all aspects of the framework (all levels, all lines, all states, all types) to the data that were generated by this research. This should include an analysis of the values, worldviews and scientific paradigms of the respondents, which might provide the opportunity to present some important enablers and barriers linked to the development of mind-sets, social consciousness, self-awareness, etc. Future studies could also repeat the investigation that is contained within this research, but using alternative methodologies, as one way of assessing whether the quadrants had been a helpful framework. The research could also be furthered by using the Wits case study to arrive at larger lessons that might be applicable to other institutions and contexts. Another possibility would be to compare the results of this study to other comparative studies, in order to arrive at a more engaged approach to facilitating integrated research at Wits.

Future investigations that could flow out of this research could also be those that study the validity of the claims in the data. In particular, it would be worth investigating whether there is in fact a lack of funding and journals in which to publish, since this would enable researchers and research managers to move past any incorrect perceptions in this regard. Such studies might include interviews with the Vice-Chancellor and the three Deputy Vice-Chancellors at Wits. If appropriate, these studies might then result in the compilation and distribution of lists of funders and journals that are receptive to integrated research. This would enable researchers to avoid disappointing outcomes and subsequent discouragement, and instead concentrate their efforts on approaching funders or journals that are likely to be receptive to integrated research. It might also be worth conducting further investigations around the perception that women are more likely to engage in integrated research, and the potential to foster these inclinations through targeted interventions.

CONCLUSION

The modern world is a very different place from the world of 50 years ago. The problems that are confronting society today are increasingly large and multifaceted, and as a result, there is also growing recognition that these challenges cannot be solved using yesterday's research methods. Modern human systems have increased significantly in size, complexity, and fluidity. At the same time, these systems have extensive interfaces and dependencies with biophysical systems. These factors are contributing to a modern era in which numerous environmental and socioeconomic problems, as well as crises around migration, inequality, conflict and disease, have unprecedented ramifications. They are both more severe and have a far greater global reach. This is making them increasingly difficult to address using traditional research approaches, and is leading to more exploration of untraditional research approaches (Moore, 2015a).

This research has been motivated by the following obstacle that is expressed by cynical observers: "The world has problems, but universities have departments" (Brewer, 1999: p.328). The research has been led by the assumption that there is a better way to respond to global challenges, and it has been premised on the understanding that one of the interventions that is necessary in this regard is for universities and other research entities to increase their integrated research. In fact, it has become accepted that institutions need to develop significant capacities in conducting multi-, inter- and transdisciplinary research. This has proven to be a challenging mandate, given that universities have been operating in quite strict and closely guarded disciplinary silos more than a century. Now, universities and other research entities are being confronted with the need to rapidly reorganise their institutional systems and cultures to accommodate the free flow of intellectual enquiry across disciplinary and structural boundaries.

Using Integral Theory as an analytical framework, this research has examined the barriers and enablers to integrated research at the University of the Witwatersrand in Johannesburg. This is only one university within the South African higher education system, and it can in no way be assumed to be representative of the sector as a whole. Furthermore, the interviewees who were selected constitute only a small sample out of the many researchers and research managers at the University.

Nevertheless, the interviews generated a rich set of data which revealed extensive perceptions around the possibilities and challenges of integrated research. The data were analysed using, in particular, the AQAL framework under Integral Theory. The investigation led to a number of suggestions for interventions that might mitigate or remove the barriers to integrated research, and better leverage the enablers. These interventions are designed to operate on a number of different levels, including the systemic, interpersonal and individual. They include suggestions as diverse as policy changes, increased administrative support for integrated research, performance management, and individual coaching. These interventions are in many cases unproven, and would require further research or testing to determine their efficacy. However, it is hoped that this research will have, in some small way, contributed to the path that is being charted towards a more externally responsive and contextually relevant institution.

REFERENCES

- Aldrich, J.H. (2014) *Interdisciplinarity: Its Role in a Discipline-Based Academy*. New York, Oxford University Press.
- Amey, M.J. and Brown, D.F. (2004) *Breaking Out of the Box: Interdisciplinary Collaboration and Faculty Work*. Connecticut, Information Age Publishing.
- Anderson, M. and De Silva, S. (2009) *Beliefs, Values and Attitudes*. Sedbergh, Me-and-Us.
- ASU Knowledge Development Enterprise (2016) *About us*. [Online] Available from: <https://research.asu.edu/about-us> [Accessed 5 March 2016].
- Arizona State University (2015) *About Michael M. Crow*. [Online] Available from: <http://president.asu.edu/about/michaelcrow> [Accessed 16 February 2015].
- Arizona State University (2014) *Academic Affairs Manual*. [Online] Available from: <https://www.asu.edu/aad/manuals/acd/acd506-05.html> [Accessed 5 March 2016].
- Ballard, D., Reason, P. and Coleman, G. (2010) Using the AQAL Framework to Accelerate Responses to Climate Change. *Journal of Integral Theory and Practice*, 5 (1).
- Barry, A., Born, G. and Wieszkalnys, G. (2008) Logics of interdisciplinarity. *Economy and Society*, 37 (1), 20-49.
- Biodesign Institute (2015) *About the Biodesign Institute*. [Online] Available from: <http://www.biodesign.asu.edu/about> [Accessed 16 February 2015].
- Beugré, C.D. and Offodile, O.F. (2001) Managing for organizational effectiveness in sub-Saharan Africa: a culture-fit model. *The International Journal Of Human Resource Management*, 12 (4), 535-550.
- Bovey, W.H. and Hede, A. (2001) Resistance to organizational change: the role of cognitive and affective processes. *Leadership & Organization Development Journal*, 22 (8), 372-382.
- Bradbury, H. (1998). *Learning with the Natural Step: cooperative ecological inquiry through cases, theory and practice for sustainable development*. Unpublished doctoral thesis. Boston, Boston College.
- Brown, V.A., Harris, J.A. and Russell, J.Y. (2010) *Tackling Wicked Problems through the Transdisciplinary Imagination*. London, Earthscan.
- Brewer, G.D. (1999) The Challenges of Interdisciplinarity. *Policy Sciences*, 32, 327-337.
- Buller, H. (2009) The lively process of interdisciplinarity. *Area*, 41 (4), 395-403.
- Combs, A.W. (1982) *A personal approach to teaching: Beliefs that make a difference*. Boston, Allyn & Bacon.

Council for Scientific and Industrial Research (2009) *DST's forward-looking strategy to address global change*. [Online] Available from: http://www.csir.co.za/enews/2009_climate/06.html [Accessed 8 August 2016].

Crow, M. (2009) *The research university as comprehensive knowledge enterprise: The reconceptualization of Arizona State University as a prototype for a new American university*. [Online] Seventh Glion Collquium. Montreux, Switzerland, 23 June. Available from: <http://universitydesign.asu.edu/udc-resources/asu-president-michael-crow/the-research-university-as-comprehensive-knowledge-enterprise-the-reconceptualization-of-arizona-state-university-as-a-prototype-for-a-new-amercian-university> [Accessed on 5 July 2015].

Davidson, D. (2016) Gaps in agricultural climate adaptation research. *Nature Climate Change*, 6, 433-435.

Department of Science and Technology (2008) *Innovation Towards a Knowledge-based Economy: Ten-year Innovation Plan for South Africa (2008-2018)*. [Online] Available from: http://www.esastap.org.za/download/sa_ten_year_innovation_plan.pdf [Accessed 8 November 2016].

Diouf, D., Chaava, T., and Tiomkin, D. (2005) *Community capacity enhancement handbook: Leadership For Results Programme*. New York, UNDP HIV/AIDS Group Bureau for Development Policy.

Dixon, F. (2004) *Proceedings of the First International Conference on Operationalization of Gross National Happiness*. [Online] Available from: <http://archiv.ub.uni-heidelberg.de/savifadok/370/> [Accessed 8 March 2015].

Esbjörn-Hargens, S. (2010) *Integral Theory in Action: Applied, Theoretical, and Constructive Perspectives on the AQAL Model*. [Online] New York, State University of New York Press. https://books.google.co.za/books?hl=en&lr=&id=hZxsLq_7ZJ0C&oi=fnd&pg=PA33&dq=Esbj%C3%B6rn-Hargens+book&ots=KcZxcZPLIQ&sig=BBqQxE5NMhXiEnKM7TdRd9VqRsU#v=onepage&q=Esbj%C3%B6rn-Hargens%20book&f=false [Accessed 27 April 2015].

Esbjörn-Hargens, S. (2015) An Overview of Integral Theory. *Integral Life*. [Online] Available from: <https://www.integrallife.com/integral-post/overview-integral-theory> [Accessed 16 February 2015].

Evans, J. and Randalls, S. (2008) Geography and paratactical interdisciplinarity: Views from the ESRC-NERC PhD studentship programme. *Geoforum*, 39 (2), 581-592.

Fairweather, J.S. (2002) The mythologies of faculty productivity: Implications for institutional policy and decision-making. *The Journal of Higher Education*, 73 (1), 43-68.

Fulmer, C.A. and Gelfand, M.J. (2012) At What Level (and in Whom) We Trust Trust Across Multiple Organizational Levels. *Journal of Management*, 38 (4), 1167-1230.

GCSRI (2015) *Global Change and Sustainability Research Institute*. [Online] Available from: <http://www.wits.ac.za/gcsri> [Accessed 5 July 2015].

- Gilbert, J.K., and Stocklmayer, S.M. (2013) *Communication and Engagement with Science and Technology: Issues and Dilemmas: A Reader in Science Communication*. Abingdon, Routledge.
- Giri, A.K. (2002) The calling of a creative transdisciplinarity. *Futures*, 34 (1), 103-115.
- Goldfarb, B. and Henrekson, M. (2003) Bottom-up versus top-down policies towards the commercialization of university intellectual property. *Research Policy*, 32, (4) 639-658.
- Gooley, A. and Lockwood, F. (2001) *Innovation in open and distance learning: Successful development of online and web-based learning*. London and New York, Routledge.
- Habib, A. (2013) *Wits: Leading a University at the Very Source of Civilization*. [Online] Available from: http://www.wits.ac.za/files/prmpv_927094001377353801.pdf [Accessed 5 July 2015].
- Hadorn, G.H., Bradley, D., Pohl, C., Rist, S. and Wiesmann, U. (2006) Implications of transdisciplinarity for sustainability research. *Ecological Economics*, 60, 119-128.
- Hamilton, M. (2006) Integral metemap creates common language for urban change. *Journal of Organizational Change Management*, 19 (3), 276-306.
- Hammer, M. and Söderqvist, T. (2001) Enhancing transdisciplinary dialogue in curricula development. *Ecological Economics*, 38 (1), 1-5.
- Heberlein, T.A. (1988) Improving interdisciplinary research: Integrating the social and natural sciences. *Society & Natural Resources: An International Journal*, 1 (1), 5-16.
- Hinrichs, C.C. (2008) Interdisciplinarity and boundary work: challenges and opportunities for agrifood studies. *Agriculture and Human Values*, 25 (2), 209-213.
- Hochachka, G. (2005). *Developing sustainability, Developing the self. An integral approach to community and international development*. Victoria, University of Victoria.
- Hochachka, G. (2008) Case studies in integral approaches in international development: An integral research project. *Journal of Integral Theory and Practice*, 3(2), 58-108.
- Hochachka, G. (2009) *Integral Approach to Capacity Building for Amazon rainforest Conservation*. [Online] Available from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.687.5129&rep=rep1&type=pdf> [Accessed 7 November 2016].
- Hopton, M.E., Cabezas, H., Campbell, D., Eason, T., Garmestani, A.S., Heberling, M. T., Karunanithi, A.T., Templeton, J.T., White, D. and Zanolini, M. (2010) Development of a multidisciplinary approach to assess regional sustainability. *International Journal of Sustainable Development and World Ecology*, 17 (1), 48-56.
- IPCC (2014) *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. [Online] Available from: <https://www.ipcc.ch/report/ar5/wg2/> [Accessed 7 November 2016].

- Irvine, K.N., Devine-Wright, P., Payne, S.R., Fuller, R.A., Painter, B. and Gaston, K.J. (2009) Green space, soundscape and urban sustainability: an interdisciplinary, empirical study. *Local Environment: The International Journal of Justice and Sustainability*, 14 (2), 155-172.
- Jackson, M.C. (2006) Creative holism: A critical systems approach to complex problem situations. *Systems Research and Behavioral Science*, 23, 647-657.
- Jerneck, A., Olsson, L., Ness, B., Anderberg, S., Baier, M., Clark, E., Hickler, T., Hornborg, A., Kronsell, A. and Lövbrand, E. (2011) Structuring sustainability science. *Sustainability Science*, 6, 69-82.
- Kajikawa, Y. (2008) Research core and framework of sustainability science. *Sustainability Science*, 3 (2), 215-239.
- Kueffer, C., Hadorn, G.H., Bammer, G., van Kerkhoff, L. and Pohl, C. (2007) Towards a publication culture in transdisciplinary research. *Gaia Ecological Perspectives for Science and Society*, 16 (1), 22-26.
- Laudel, G. and Origgi, G. (2006) Introduction to a special issue on the assessment of interdisciplinary research. *Research Evaluation*, 15 (1), 2-4.
- Lélé, S. and Norgaard, R.B. (2005) Practicing Interdisciplinarity. *BioScience*, 55 (11) 967-975.
- Massey, C., Alpass, F., Flett, R., Lewis, K., Morriss, S. and Sligo, F. (2006) Crossing fields: The case of a multi-disciplinary research team. *Qualitative Research*, 6 (2), 131-149.
- Max-Neef, M.A. (2005) Foundations of transdisciplinarity. *Ecological Economics*, 53, 5-16.
- McGregor, S.L.T and Volckmann, R. (2011) *Transversity: Transdisciplinary Approaches in Higher Education*. London, Integral Publishers.
- Moore, R. (2015a) Universities need to adapt to become part of shaping a better future. *The Conversation*. [Online] Available from: <https://theconversation.com/universities-need-to-adapt-to-become-part-of-shaping-a-better-future-45254> [Accessed 18 December 2015].
- Moore, R. (2015b) Connective Cognition: Transdisciplinarity in a Precarious World. *Quaderna*, [Unpublished].
- Murray, T. (2015) *A post-metaphysical approach to second tier skill and belief*. [Online] Available from: http://www.perspegrity.org/papers/Murray_SecondTierSkillBelief_Oct14-2015.pdf [Accessed 24 August 2016].
- National Research Foundation (NRF) (2014) *NRF Rating*. [Online] Available from: <http://www.nrf.ac.za/rating> [Accessed 10 June 2016].
- Naveh, Z. (2005) Epilogue: Toward a transdisciplinary science of ecological and cultural landscape restoration. *Restoration Ecology*, 13 (1), 228-234.

Newcastle Institute for Energy and Resources (NIER) (2015) *About us*. [Online] Available from: <http://www.newcastle.edu.au/research-and-innovation/centre/nier/about-us> [Accessed 22 March 2015].

OECD (2014) *Fostering Research Excellence in Higher Education*. [Online] Available from: <http://www.oecd.org/edu/imhe/Fostering-Research-Excellence-in-Higher-Education.pdf> [Accessed 13 February 2016].

Open Society Foundations (2016) *Grants, Scholarships, and Fellowships*. [Online] Available from: <https://www.opensocietyfoundations.org/grants> [Accessed 5 March 2016].

Oswald Spring, U., Brauch, H.G., Edwards, G. and Timmons Roberts, J. (2013) The Impact of Climate Change on Human Security in Latin America and the Caribbean. In: Michael Redclift and Marco Grasso (eds.) *Climate change and Human Security Handbook*. [Online] Cheltenham, Edward Elgar, pp. 227–253. Available from: <http://www.elgaronline.com/view/9780857939104.00019.xml> [Accessed 5 July 2015].

Passmore, J. (2010) *Leadership Coaching: Working with Leaders to Develop Elite Performance*. London, Kogan Page Publishers.

Pedler, M. and Trehan, K. (2008) Action learning, organisational research and the ‘wicked’ problems. *Action Learning: Research and Practice*, 5 (3), 203-205.

Petts, J., Owens, S. and Bulkeley, H. (2008) Crossing boundaries: Interdisciplinarity in the context of urban environments. *Geoforum*, 39, 593-601.

Piketty, T. (2014) *Capital in the Twenty-First Century*. Cambridge, Harvard University Press.

Rafols, I., Leydesdorff, L., O’Hare, A., Nightingale, P. and Stirling, A. (2012) How journal rankings can suppress interdisciplinary research: A comparison between Innovation Studies and Business & Management. *Research Policy*, 41 (7), 1262-1282.

Rinia, E.J., Van Leeuwen, T.N., Van Buren, H.G. and Van Raan, A.F.J. (2001) Influence of interdisciplinarity on peer-review and bibliometric evaluations in physics research. *Research Policy*, 30 (3), 357-361.

Rittel, H.W.J and Webber, M.W. (1973) Dilemmas in a general theory of planning. *Policy Sciences*, 4 (2) 155-169.

Robinson, J. (2008) Being undisciplined: Transgressions and intersections in academia and beyond. *Futures*, 40 (1), 70-86.

Rokeach, M. (1960) *The Open and Closed Mind. Investigations into the nature of belief systems and personality systems*. New York, Basic Books.

ShanghaiRanking Consultancy (2015) *Academic Ranking of World Universities 2015*. [Online] Available from: <http://www.shanghairanking.com/ARWU2015.html> [Accessed 8 August 2016].

Simon, D. and Schiemer, F. (2015) Crossing boundaries: complex systems, transdisciplinarity and applied impact agendas. *Current Opinion in Environmental Sustainability*, 12, 6-11.

Somerville, M.A. and Rapport, D.J. (2000) *Transdisciplinarity: Recreating Integrated Knowledge*. Oxford, EOLSS Publishers Co. Ltd.

Stock, P. and Burton, R.J.F. (2011) Defining Terms for Integrated (Multi-Inter-Trans-Disciplinary) Sustainability Research. *Sustainability*, 3, 1090-1113.

Stockholm Resilience Centre (SRC) (2014) *Action plan 2014-2018*. [Online] Available from: http://www.stockholmresilience.org/download/18.2f7e0423148c33cc98f13fe/1412172993364/Action_plan_2014-2018_Updated.pdf [Accessed 22 March 2014].

Stockholm Resilience Centre (SRC) (2014) *Stockholm University fifth in the world in Environmental Science*. [Online] Available from: <http://www.stockholmresilience.org/research/research-news/2016-06-17-stockholm-university-fifth-in-the-world-in-environmental-science.html> [Accessed 8 August 2016].

Swan, E. (2010) *Worked Up Selves: Personal Development Workers, Self-Work and Therapeutic Cultures*. Basingstoke, Palgrave Macmillan.

Taebi, B., Correljé, A., Cuppen, E., Dignum, M. and Pesch, U. (2014) Responsible innovation as an endorsement of public values: the need for interdisciplinary research. *Journal of Responsible Innovation*, 1 (1), 118-124.

Taylor, D., Schwaibold, U. and Watson, I. (2015) A Transdisciplinary Journey: Course Creation at a South African University. *European Scientific Journal*, 1, 427-439.

Termeer, C.J.A.M., Dewulf, A., Breeman, G. and Stiller, S.J. (2013) Governance Capabilities for Dealing Wisely With Wicked Problems. *Administration & Society*, [Online] Available from: <http://aas.sagepub.com/content/early/2013/01/02/0095399712469195.abstract> [Accessed 8 August 2016].

Thompson Klein, J. (2010) *Creating Interdisciplinary Campus Cultures: A Model for Strength and Sustainability*. Hoboken, Wiley.

Tress, B., Tress, G., Décamp, H. and d’Hauteserre, A.M. (2001) Bridging human and natural sciences in landscape research. *Landscape and Urban Planning*, 57 (3-4), 137-141.

Tress, G., Tress, B. and Fry, G. (2006) Publishing integrative landscape research: Analysis of editorial policies of peer-reviewed journals. *Environmental Science and Policy*, 9 (5), 466-475.

University of the Witwatersrand (2015a) *Mission and Vision*. [Online] Available from: <http://www.wits.ac.za/aboutwits/3160/introducingwits.html> [Accessed 5 July 2015].

University of the Witwatersrand (2015b) *Annual Report 2015*. [Online] Available from: <https://www.wits.ac.za/about-wits/governance/strategic-leadership/annual-reports/> [Accessed 24 June 2016].

Vandermuelen, V. and van Huylenbroeck, G. (2008) Designing transdisciplinary research to support policy formulation for sustainable agricultural development. *Ecological Economics*, 67, 352-361.

Van Breda, J. (2007) Towards a transdisciplinary hermeneutics. *The Global Spiral e-Journal*, 8 (3).

Walter, A.I., Helgenberger, S., Wiek, A. and Scholz, R.W. (2007) Measuring societal effects of transdisciplinary research projects: Design and application of an evaluation method. *Evaluation and Program Planning*, 30, 325-338.

West, S., Haider, J., Sinare, H. and Karpouzoglou, T. (2014) *Beyond Divides: Prospects for synergy between resilience and pathways approaches to sustainability*. Brighton, STEPS Centre.

Wilber, K. (2005) Introduction to Integral Theory and Practice: IOS Basic and the AQAL Map. *Journal of Integral Theory and Practice*, 1 (1).

Wilshire, B. (1990) *The Moral Collapse of the University Professionalism, Purity, and Alienation*. New York, SUNY Press.

Wits Commercial Enterprise (2016) *About Wits Enterprise*. [Online] Available from: <http://wits-enterprise.co.za/about> [Accessed 8 August 2015].

Wits Health Consortium (2016) *Welcome to Wits Health Consortium*. [Online] Available from: <https://www.witshealth.co.za/Pages/default.aspx> [Accessed 8 August 2016].

Woolley, R., Sánchez-Barrioluengo, M., Turpin, T. and Marceau, J. (2014) Research collaboration in the social sciences: What factors are associated with disciplinary and interdisciplinary collaboration? *Science and Public Policy*, 42 (4), 567-582.

Zaman and Goschin (2010) Multidisciplinarity, Interdisciplinarity and Transdisciplinarity: Theoretical Approaches and Implications for the Strategy of Post-Crisis Sustainable Development. *Theoretical and Applied Economics*, 12 (553), 5-20.

APPENDIX A

Questions for Research Managers

1. Which Wits researchers have previously, or are currently, engaged in some form of integrated research?
2. Which Wits researchers have never engaged in any form of integrated research, despite working in fields that offer opportunities to do so?
3. What is the greatest enabler to integrated research at Wits?
4. What is the biggest impediment to integrated research at Wits?
5. How much funding is available is available for integrated research, how many journals publish integrated research, and do researchers engaging in integrated research have peer groups with which to identify?
6. Which disciplines are most open to integrated research and which are most closed to it? In your opinion, why is this so?
7. Which personal attributes make a researcher most likely to engage in integrated research and succeed at it? Conversely, which attributes inhibit a researcher from engaging in integrated research or succeeding at it?
8. How do Wits academics in general feel about integrated research?

APPENDIX B

Questions for Academics

1. Given the definition of integrated research that has been provided, would you say that you have conducted integrated research at Wits? If yes, please describe the research and if no, please describe your reasons for not conducting integrated research.
2. Do you think that integrated research is valuable? Please explain your answer.
3. How do Wits academics in general feel about integrated research?
4. What is the greatest enabler to integrated research at Wits? Does the University itself encourage and support integrated research?
5. What is the biggest impediment to integrated research at Wits?
6. How much funding is available for integrated research, how many journals publish integrated research, and are there peer groups with which to identify?
7. Do external research organisations encourage and support integrated research? Please explain your answer.
8. Which disciplines are most open to integrated research and which are most closed to it? Please explain your answer.
9. Which individual attributes make a researcher most likely to engage in integrated research and be successful at it? Conversely, which attributes inhibit a researcher from engaging in integrated research?
10. What is the most enjoyable thing about conducting integrated research and what is the most uncomfortable thing about conducting integrated research. Please answer based either on your personal experience or your observations.
11. What is the attitude of your postgraduate students to integrated research?
12. Is there a future for integrated research at Wits? Please explain your answer.

APPENDIX C

AQAL Framework: Draft 1

Upper Left Quadrant: Research Managers (RM)

RM1	• Being an academic is vulnerable; it is all about putting your thoughts out into the public space; you are risking your reputation all the time • You have even more vulnerable in integrated research because you are commenting on research that is outside of your field • Integrated researchers are driven by finding rich research areas that offer a lot of potential and interesting outcomes • It is difficult to understand the value of the others until you see it for yourself • Those who do integrated research like doing it
RM2	• Large funding opportunities create competitiveness and one-upmanship because researchers want to get their share of the money; if there is not a lot of funding at stake, researchers are more open to dialogue • Integrated researchers have a desire to make a greater impact than simply publishing papers • Integrated researchers are social responsible • Academic credentials are important otherwise you are perceived as a junior guy who needs something from a senior guy • Academics aspire to do research not teaching
RM3	• Trust is important to being comfortable collaborating • Huge scepticism: I do not quite get what you do, I do not understand • As an engineer you are taught that you solve problems; why should you talk to a social scientist? • Resistance to change • It is necessary to recognise that there are other people who offer profoundly important insights • It is important to have a willingness to learn • Integrated researchers are inherently secure • Insecure people are not interested in integrated research • Integrated researchers have no problem with their position of authority; they have no problem with working in teams, empowering others and sharing the glory; they realise that they achieve greatness through that; it is not about them • Those who push back are very egotistical and insecure; they are micro-managers who do not trust anybody; their attitude is: if I do not do it, it is not going to happen; they are not easy to get along with, very demanding and high maintenance • Integrated researchers are people who ask what the world needs and then work at understanding how to service this need • It is easier to get engineers to talk to other researchers from very different disciplines than other types of engineers • Creative people are more insecure because when you deal with form (an opinion) rather than function (an optimisation process) you become vulnerable to criticism

	You have to create an enabling environment for integrated research in a way that makes people think it was their idea; subtly and surreptitiously
RM4	- People see threats rather than opportunities and start protecting their turf - Researchers are so comfortable where they are that they would rather fight to hold onto it than see a new opportunity - People have a fear of the unknown and a wish to retain the status quo - Ego: I am a big chief in a small pond here, why should I become a small chief in a very big pond? - Disinterested scientists are hard to find; often people are driven by many agendas - Integrated research projects need someone who is single-minded, determined and absolutely committed - People have to be convinced that working in large groups is in their best interests in the long term, that it will be possible to make a more convincing case to potential donors, that it will be easier to get industry interested - Integrated researchers are driven by a desire to make a difference
RM5	- The incentive for integrated research is working with really highly regarded scientists in an international team - Integrated research requires an epistemological openness – you do not see knowledge produced in a linear way but in different sites of practice, without relativism (the view that everything is ok) - An adherence to the belief that knowledge can only be produced in particular sites is a barrier - Territorialism - Comfort of working with known entities - Crossing disciplinary boundaries involves taking risks - It is easier to work with your own team because you share a scientific language and you move rapidly to your solution
RM6	We should be working together
RM7	- Because integrated research is goal oriented, it is not far outside of the comfort zones of health scientists - Some individuals will do something because they can do it, the vast majority will do something because they believe that there is benefit to them - Integrated researchers see the bigger picture - Individuals who do not collaborate easily are those who do not see the bigger picture - Individuals who do not collaborate easily are those who like being in control

Upper Left Quadrant: Academics (A)

A1	- Integrated researchers value the context that other disciplines bring - Integrated researchers look for ways in which their fields connect to other fields - Integrated research is led by people who see systemic connections
A2	- People are driven by rewards – whether prestige or money - You need to be clear about what success would look like, and you need to be able to communicate why other people should join your mission - People respond well if you go to them

	• It is important to explain to researchers how they will benefit from integrated research • It is worrying to become a generalist • Integrated researchers are interested in whether research is useful and advances society • Integrated researchers are solution oriented • Integrated researchers are interested in how to the way forward for a better world • Everybody wants to see that their work will make a difference • Researchers like to hear that there will be a positive outcome • Researchers are persuaded by the argument that if they worked alone they would not get such an impact • There is a view is that universities should be much more externally focussed
A3	• There is tension between students coming from different disciplines • Students who are conservative gravitate towards science, whereas students who are more progressive gravitate towards social science
A4	• Researchers fail at integrated research when they are convinced that their discipline is more valuable than another • Vulnerability is core – you must be willing to be shot down by people from other disciplines • Integrated researchers are steeped in their disciplines but have also realised the limits of their disciplines • Academics look down on government officials when they ask questions • Universities should not simply be responding to the economy – they exist to improve their contexts • It is a question of orientation – what you think your purpose is • People are very comfortable in their disciplines and they have to endure discomfort to work across disciplines
A5	• There is a reluctance to recognise the potential for a discipline other than your own to be of value • It assumes idiocy on the other side • There is a sense of self-worth associated with being able to do something that other people cannot • There is a loss of power when you realise that you are not as special as you thought you were • Psychologically, receiving emails regarding opportunities for collaboration is not as effective as seeing them on a public screen
A6	• New leaders can be a mixture of hostile and not interested if they do not own projects • New leaders can refuse to expend any political capital on projects that they do not own • Territorial leaders can stymie projects by refusing to approve them • Changes in political situations can affect the survival of projects • We do really need large integrated research groups – we cannot carry on doing things the way we have been doing them
A7	• Only adventurous people like integrated research • Curiosity is key and the desire never to languish in a comfort zone • Institutional support depends a lot on the interests of the current dean

	• Institutional support depends on the individual academic's energy and the commitment to creating something • It is exhilarating being able to draw new and bold connections between things • It is difficult to venture into areas which you know very little about and occasionally make a fool of yourself
A8	• Generosity is important to collaboration • A lack of territoriality and a willingness to uplift other people is important to collaboration • A desire to show to others what can be done and incorporate them rather than create boundaries is important to collaboration • Integrated researchers want to teach in a way that is responsive
A9	• Some people are curious when approached, others do not want to be disturbed • The other four faculties do not exist to some people • Organisational boundaries are not as inhibitive as closed mind-sets • Integrated researchers must be comfortable with sharing the credit, the financial resources and other resources • Academics believe that they are overloaded with teaching and have no inclination to get involved in other work • Integrated researchers are people who want to remain current and actively seek out opportunities to collaborate
A10	• Integrated research is fraught with the challenges of recognition, funding, jealousies and attitudes • Integrated researchers must assert their own value systems • Integrated researchers have a natural energy and curiosity • Integrated researchers have a deep sense of social activism • Integrated researchers have to develop enough of a sense of self to withstand battering
A11	• Integrated researchers tend to be young because they have to be more competitive and orient themselves more towards international research to make a name for themselves • Integrated researchers tend to be young because they are more open to new ideas • If you are young you take more risks than if you are at the end of your career
A12	• Researchers who are not committed push back by not replying to emails, being difficult to reach, saying they are busy, and saying that it is going to be difficult to have the next meeting • Some people cannot buy into the bigger picture, have a lack of vision, and are very set in their ways • Older researchers do not see the point of getting into a new field when they are going to retire soon • Working together with someone you like is a personal high because you can talk to them on many levels • It is more enjoyable and personally satisfying to work in a team • Humans do not like change
A13	• Arrogance prevents learning • Humility makes people with bigger egos accept you
A14	• I will not talk to some people because I have been battered by their egos • Personal value systems affect what people ascribe value to

	• I have been bashed a number of times by disciplinary arrogance – I know nothing because I am from a different discipline and they know everything • People are so well trained in one discipline that when new ideas come, they cannot engage with them • Integrated researchers think about the bigger picture • Integrated research requires confidence because it is a scary space – you know nothing • Integrated research requires openness • Integrated research requires humility, you have to respect that discipline because you are playing in their space • Integrated researchers are driven by finding out something new • Integrated researchers are not driven by money • Integrated researchers see interconnectedness • Integrated researchers are driven to understand other areas of research so that they can affect societal change • Integrated researchers have to internalise their own successes because there is little external acknowledgement • Integrated researchers have to be able to let stuff go and not get caught up in resentment • Integrated researchers are self-aware
A15	• Integrated researchers are driven by doing work in an area that they love rather than an area that is attractive to highly rated journals • Integrated researchers are driven by social relevance
A16	• Collaboration requires looking at a problem from another person's perspective • If you want to be at the cutting edge, you have to do integrated research
A17	• Engineers enjoy developing solutions that make life easier and having a window into another world allows them to create something new in that area • It is easier to conduct integrated research if you have no shame and no problem saying to someone that you have no idea what they are saying • People might give up easily because they are embarrassed to admit that they do not understand what someone is saying • People are quite proud and they hate to appear stupid • I generally care less than a lot of other people I have met
A18	• Scientists should be humble enough to describe integrated research as hard science • If you are trying to solve big problems, you have to realise that you are not the only one with solutions • Scientists are arrogant and insecure; they are supposed to be the gurus and they cannot leave their egos at the door • Social scientists are reluctant to frame a problem because they know that it is so complicated
A19	• If you want to be a rated researcher then you have to demonstrate focus; researchers worry that if they collaborate, the reviewers will see it negatively
A20	• Students are largely stuck in a disciplinary head space because they come through a disciplinary undergrad • I not that concerned about the disciplinary distinction; what is wrong with disciplines, why do we want to be multidisciplinary? • People should work on integrated research but I need to be convinced of the

	intellectual rationale • I fear that integrated research will become one of those catch phrases
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Lower Left Quadrant: Research Managers (RM)

RM1	- Integrated researchers are poorly perceived - Integrated research is not valued as much
RM2	- There is a perception that integrated research requires large teams - Trust your scientists, get the right people with the inclination to work across boundaries and they will do it
RM3	- A paradigm shift is necessary - There is a lack of trust around talking to others about your research - It is difficult to culturally integrate researchers from different backgrounds - Some schools perceive themselves to be superior to other schools within the same faculty and refuse to talk to them - The institutional culture is around staying in a narrow space; it does not recognise anything else - Engineers deal in facts; they have an obligation to be profoundly honest about what is happening; social scientists can take a thing and look at it from 100 different angles - Humanities has a broader perspective on the human condition - It is potentially explosive to take elitist, high maintenance people and force them into the same space
RM4	Research groups protect their turf from other similar groups
RM5	- There are epistemological or even ontological differences between disciplines - Humanities are dismissive of quantitative modes; Science is dismissive of narrative modes
RM6	- Wits is not imaginative enough to escape disciplinary boundaries - People feel that integrated research is non-experts interfering - Integrated research needs to be perceived as bringing the best minds in a discipline to cohere around a larger area - There is disciplinary arrogance
RM7	- Health Sciences has to have a concrete outcome - People need to see a clear purpose - People are incentive driven; esoteric, unrewarded work is unusual

Lower Left Quadrant: Academics (A)

A1	- Departments are often pitted against each other - Integrated research is seen as a threat to your ability to stay within your discipline - Difficult to get people to share resources to create an integrated research project - The Health Sciences idea of a clinician is so rigid that researchers get into trouble for talking to other types of researchers - Health Sciences does not see value in integrated research - Integrated researchers are committed people with a zealous project and strong commitment; that leads them into the heart of their discipline but their bigger interest is bigger impact - Integrated researchers are not driven by financial interest - Internationally, people are already convinced that you have to have
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	collaboration • It is difficult to convince people that their way of doing things will not be threatened • It is a fundamental challenge to their pedagogy • Faculties will not open up to the idea of acquiring knowledge from each other, despite the fact that they can only benefit from attention to other disciplines • Humanities is scared of Science – they balk because they do not feel that their forms of evidence count • Science and Health Sciences are also scared of being proved wrong
A2	• There is initial resistance around time • The resistance decreases following face to face engagements • Building collaborations takes time and effort; you have to go and talk face to face to researchers • There is a lot of hierarchy in the university which only serves to underscore hierarchy rather than build any kind of respect • The university has not thought about why it is establishing centres and institutes • There has been no real thinking about what it means to introduce a new entity rather than getting existing entities to work together • You have to find people who have the same objectives and outlook, otherwise you are just swimming upriver
A3	• Because of the way science is funded it is perceived as cleaner and more coherent • There is an extraordinary belief that all scientists know social science • Some physical scientists are incredibly nasty about what we are doing • Scientists are threatened by science philosophy and work to shut it down
A4	• We are under no illusions that we are up against university, funding, NRF and government structures • These structures are set up by disciplines to reward and guard disciplines • Wits thinks it is special and more worthy of respect • Wits thinks no one understands them and that they are to be pitied because all the money goes elsewhere • Wits operates under an anachronistic paradigm that because disciplinary work was rewarded during apartheid, it should be rewarded now • Integrated research is driven by people not the university • Wits claims to support integrated research but has no idea how • Wits adopts an attitude towards institutes of you will pay for the privilege of being here • There is a resistance to being driven by the city's research priorities and a belief that research must be driven by the academy • Being responsive to the city should be equally regarded and utterly legitimate
A5	• There is a mob mentality • Researchers have been taught that it is wrong for faculties to talk to each other • Researchers believe that they have the right knowledge and can do no wrong • Ethics boards believe only clinically trained people can work in any capacity in hospitals • Different disciplines have different opinions of what research is, what kind of question is adequate and worthwhile • Solving a problem is not a research question in engineering

	• Science has a purist research approach that values universal truths • Social scientists think scientists are reductionist and lose the complexity of the human experience • There is a lack of respect between disciplines • Disciplines think other disciplines have no value and cannot contribute
A6	• Strong buy-in at all levels of the hierarchy (vice-chancellor, deans, heads of schools) makes integrated research easier • There is a lack of territoriality if the lead researcher is in an acting position and not perceived to be empire building • Integrated research requires political support and faculty ownership • Faculties become territorial for irrational reasons • Schools being put under pressure to increase their honours numbers has had a negative effect on integrated research because people have become less cooperative and more concerned with FTEs • Pressure to meet targets destroys a greater good mentality • The vice-chancellor is putting pressure on the deans and they are putting pressure on schools • Integrated research initiatives are bound in the people not the structure; when people move on then things change • There is resistance to integrated research because it is an anomaly; people prefer clean structures, clear reporting lines, no wrinkles • Anomalies take up more time than their size is worth • There has to be an understanding that if you want integrated research then you have to accommodate anomalies • Attempts to formalise integrated research projects into centres are hindered when faculties become territorial
A7	• We have to keep up with the way that knowledge is evolving in the world
A8	• The personality of the research leader is critical • Integrated research must be about solidarity not individuality • Ideological rifts are difficult to heal • Integrated research often comes through private work which requires permission; this is can be a barrier, especially if you are afraid of the head of school • The interdisciplinary value of private work is not always recognised • The subtle skills required for collaboration are not well understand
A9	• IP negotiations – be pragmatic, some research councils sit on mountains and mountains of IP which they guard jealously and they don't commercialise • Pragmatism – don't say that's the rule and that's the only way to do it • If you come across an opportunity, review it critically and objectively, is it not maybe time to change some of the rules, stay relevant
A10	• There are islands that embrace integrated research • Competitiveness makes it almost impossible to reach out • People do not understand what we do • When you suggest that you have something to offer, you are not taken seriously • Gatekeeping and competition for funding • There are some enlightened people who recognise the value of what we do • Academic and intellectual belittling • Policy is decided by bean counters who do not get it and do not really care

A11	• Young researchers need to be attracted away from the pursuit of ratings; this requires senior people helping junior people • In the US, specialisation is considered very bad, you have to build international leadership in two fields • People who come up with new approaches usually have diverse skill sets and approach problems in non-traditional ways • It is important to maintain curiosity by regularly changing the topic
A12	• There is intellectual freedom at Wits • In engineering, integrated research is driven by the desire for research to be applied • People have to be pushed into it and then they are out of their comfort zone • Scientists are notoriously difficult to manage; they do not come to the party or they have a hidden agenda • People are driven by self-interest
A13	• Value systems do not align • NRF calls for collaboration are ignored because there are no relationships nor trust between researchers
A14	• There are clashes in philosophies, e.g. social responsibility versus a profit motive • There is tension between public good and the profit motive • Profit is being prioritised • Parts of Wits that prioritise profit have lost the plot because the University does not exist to make a profit • The power base sits in the School of Clinical Medicine; they can do the exact same course and it carries more gravitas • The School of Clinical Medicine is oriented towards helping patients rather than creating profit • It is unfair to expect schools to change their philosophies • People focus on distributing the spoils before the collaboration is even formed • Integrated research requires trust • Every discipline thinks that they are the best • Engineers and scientists are particularly narrow minded
A15	• Soft skills do not carry as much gravitas as scientific evidence • Hard science alone does not lead to public uptake • Wits says it supports the institutes but still wants people to teach in departments • Wits is driven by individualism – promotions reward individual efforts (single authored publications, supervising, teaching, admin contributions)
A16	• Current and past leadership have tried to foster integrated research • Most initiatives have aroused opposition because of a top down approach • Researchers are too willing to accept the constraints of school/faculty structures • Some academics enjoy favours for scientific work and others are more responsible for teaching • Integrated research requires developing the institutional governance and engaging in the politics • The 21st century institutes are a red herring now • The 21st century institutes were perceived to be taking leading scientists out of schools and faculties which would then be hollowed out • Institutional change takes many years

	• Leaders did not appreciate how top down and destructive the 21st century institutes were perceived to be • Bringing heads of schools together is a good way to launch a programme but then you need to institutionalise and mainstream
A17	• It is difficult to engage people from the outside if they do not know you • No one wants to engage you
A18	• The key challenge internationally is the framing of science; hard scientists have a positivist approach while social scientists are more interested in how knowledge is framed initially, who sets the agenda, how knowledge is defined, what counts as valid knowledge • Hard scientists think that they are the only ones who have solutions • Hard scientists do not understand other approaches • Hard scientists treat social scientists badly • There is institutional commitment on the surface only • Hard scientists have to come on board because they are the ones with legitimacy • There is a perception that valid research has to have numbers and graphs • Integrated research is not valued as science; it is seen as play and wishy washy garbage • Everyone want to earn brownie points
A19	• N/A
A20	• There is a tendency to see disciplinarity as too small or myopic • The burden of applied research should not be placed on academic institutions • It is not the role of universities to be conducting integrated research to the same extent as external research entities

Upper Right Quadrant: Research Managers (RM)

RM1	• There is a language barrier and language is a reflection of a way of thinking • Research questions have a lifespan and then you need to find something else • Interpersonal skills are important in integrated research because of the need to communicate
RM2	• Younger scientists are more inclined to think practically about solutions not another paper • Younger scientists are more inclined to wonder about what other disciplines are doing • The high level, impactful integrated researchers are solidly rooted in one discipline; they maintain a core discipline competency • Younger scientists are ready to go into integrated research a lot sooner • There is concern around younger scientists moving into integrated research without being rooted in a core discipline, like the impactful international scientists • Credibility depends on your publication record • You have to bump into someone else with an inclination to cross boundaries • The inclination to cross boundaries usually comes from a realisation that you have been at it for years and are not solving the problem • We need certain people interacting in a way that they have not interacted before, which typically does not happen around funding opportunities, but around

	interest and a desire to have an impact
RM3	• Researchers within the same school do not know what their colleagues are doing • Experts do not meet each other, there is no need to go out • No integrated researcher is an iconic scholar • Push back comes from very strong researchers, typically single authors in narrow fields • Engineers do not have good interpersonal skills • Integrated researchers have to have very well developed interpersonal skills • Integrated researchers are natural teachers; they have to go down to a common denominator and make sure everyone understands each other • Some people can be quite nasty to each other
RM4	• Integrated researchers have to be articulate, convincing and respected • It is important to be a well-known, public face • It is important to have a good research track record to give stature • It is very difficult for a novice to drive an integrated research project • It is at the point of implementation that people put up barriers; they come up with a million excuses why they cannot do it • The role of a research manager is to facilitate integrated research by removing impediments
RM5	• Any scientist who claims no link to the humanities is actually not on the cutting edge of science; equally any humanities person who claims that science is something else for someone else is not on the cutting edge of humanities • The benefit of collaborating with well-known researchers is that your publications get disseminated and cited faster (even if you are the tenth author); your trajectory is steeper • Integrated research helps you to come to a solution faster • The downside of is that it is completely exploratory and a long exploration might not result in a solution; it is easier option is to stay within bounded territory and reach a solution, even though it may not be responsive to the bulk of society • Integrated research requires effort • Integrated research requires crossing many boundaries – scientific, language – which few can do and many find uncomfortable • The more well established you are in your discipline, the less chance of you crossing boundaries • Younger academics relate completely differently to technology, and technology facilitates boundary-crossing, so younger researchers have a better chance of conducting integrated research • Younger integrated researchers need structural support and financial incentives • It is important to have older, leading researchers working in young integrated research teams
RM6	• Academics are essentially people who carve out a little niche for themselves • The incentives drive you towards finite thinking; the more narrow the application of your ideas, the better you are going to be rated as an academic
RM7	• You can open up silos through dialogue • Relating across disciplines is often not the problem – selling the concept and putting together the systems is where the problems often arise; we constrain

	ourselves with silly things like time and money
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Upper Right Quadrant: Academics (A)

A1	• As an integrated researcher, it is difficult to be considered excellent • Initiating integrated research projects costs the people involved • Integrated researchers read outside their fields • Integrated research is overwhelmingly led and pushed by women which means they take a longer time to get ahead in their careers • Integrated research projects are inevitably comprised of people who have to sacrifice their own careers • Many women are being awarded research chairs in integrated research areas • If you are illiterate in integrated research, you are far less helpful to society • Collaborators express it as a huge cost to themselves
A2	• The first four of seven pages of my probation form are about how I teach • You need to be clear about what success would look like, and you need to be able to communicate why other people should join your mission
A3	• N/A
A4	• Researchers must be rewarded for solving real world problems • Integrated research only begins when you force people to sit in a room and brainstorm a problem together, but even then they retreat into their disciplines to write; the problem is that they write it in a way that no one else can understand it • Integrated researchers are up against everything that they have been trained to do, which says stay within a discipline • There is no incentive to conduct integrated research aside from your audience out there • Conducting integrated research in in conflict with doing well academically; you are not going to be patted on the back by the NRF • You have to go into a team with a willingness to learn from others • It is dangerous to say that being multidisciplinary is better; if you are not in control of a discipline, you do not have anything to offer • It is difficult to get rated on a body of work that talks to no particular discipline • Co-supervision means half the interest because there is half the reward • Integrated research is about trying to rise above a discipline because you are trying to deal with a complex problem • The deputy vice-chancellors have got to start talking integrated research • There are lots of people – all women – who are ahead of their curve
A5	• It is necessary to build relationships • We do similar work but we just do not talk • heads of schools discourage integrated research because of funding reasons; if you bring in another author, your school gets less money • People do not know each other • Doctors lean on research well
A6	• It is difficult to recruit someone external for a position in an integrated research area that is not structurally embedded
A7	• Academics are hired under disciplinary structures – where will someone trained

	across disciplinary boundaries be hired?
A8	• Integrated research requires a leader who is not too busy with other things, otherwise the project gets initiated and then there is no input for months • Integrated research project leaders usually have onerous administrative and fundraising responsibilities • When integrated research leaders have to fundraise for their own jobs, the time spent and the stress detracts from their intellectual input • Wits does not provide a track for integrated researchers, you do not have that choice • Being employed in a centre is often very precarious because it is grant-based; if you want security, you are based in a school • There is no recognition for integrated research projects or basis for them to become known • Integrated research projects need to be led by people who can hold the space intellectually
A9	• It is important to find common ground and common interest • It is important to find the right individuals; organisations can inhibit and prevent, but it is individuals who make it happen
A10	• It is important for researchers to read outside their discipline • You have to be a citizen of the world, otherwise you cannot impose the correct focus on your work • Women do not get funding • People who say unpopular things do not get funding • To get tender at Wits you need to have international people who recommend you
A11	• No one is happy with the rating system • The rating system is not transparent across disciplines • The best people are sitting somewhere silently behind, making themselves useful to a collaboration • Good at impressing people • Perceive a senior professor who is not key making himself useful on a flat hierarchy • When you do that immediately your rating drops • When a person is excited they are very interested in working in this way • Physicists and chemists find it easy to collaborate because we have similar backgrounds • Collaboration enables researchers to push each other • Collaboration enables researchers to become more understanding of the value of each other's disciplines • Most of the students are very firm in two if not three or four of the silos • It is easier for South Africans to work across disciplines – Europeans sit in silos • South Africans have less peer pressure; we can afford to lose half a year without publishing – this enables us to try new things • Funding is not a problem in SA; you just have to write proposals and go overseas to present at conferences and make yourself known
A12	• An integrated approach can help you career • Scientists are conditioned through education to work by themselves; teaching has to change to encourage collaboration, but the teachers are scientists

	themselves and they have been conditioned • Industry provides an understanding of integrated research • Communication is important – being able to transport an idea and involve several layers of understanding • Integrated researchers tend to be younger • You have to bring the skills to the table that enable you to talk to someone in the first place • Problem solving skills and exposure to other disciplines are important • Problem solving requires asking for help which naturally leads to integrated research • It is important to listen rather than act • Once I have identified someone I would like to collaborate with, there are no barriers; we are free to do anything we want at Wits • It takes much longer to conduct integrated research; you are outside your comfort zone, timelines are more difficult to judge, and the results are slower
A13	• I failed a PhD because I took an integrated approach • I am very careful in my supervision and choice of examiners • Until 10 years ago, you would go deeper and deeper into your discipline; in the last three to four years, new algorithms have replaced the need for fancy equations, but now you have to embrace complexity by looking at many different data sets, so you start pulling in lots of different people; you have to be careful because your maths is not so fancy anymore and examiners say you have not done enough work • I need the time in which to do integrated research • The less research active must take a higher teaching load • We all have different words for the same things • If we do not understand each other we cannot work together • You cannot force people to conduct integrated research; it is better to enable the willing than to force people • Researchers should raise funding, not management
A14	• If you are humble, people with bigger egos tend to accept you • Huge problems with initiative and willingness to help • Need someone who understands all the rules and wants to help to make it happen • I think people deliberately obstruct and say this is not my job so that they get paid to do it after hours • Admin people are generally incredibly unhelpful; there is self-interest in being inefficient; they say I will help you but it is not my job so can you pay me extra? • Integrated academics have to give up the assumption that “I am going to teach the course” and liaise with colleagues on course content
A15	• There are no barriers to talking, but the problem is finding the right people by finding out what problems they are trying to solve • You need human connectors – people who connect one person with another • Connectors need to really care about the project, be highly sociable, understand enough to connect people • The rating system recognised researchers who are single-minded and focussed in a particular field

	• Most of the people who are A-rated scientists function well in large groups • Academics have to service their own departments first because they pay their salaries; this reduces the amount of time that they have available for integrated research • My career has been enhanced not inhibited • No one has all the science skills and the people skills to address all the problems around global change • We need people who are willing to help other people create new ideas • We have had lots of discussions but our main barrier has been the time to see through those discussions
A16	• Integrated research is boosted by study, fellowship and work related opportunities abroad • Generating your own resources gives you ownership over how they get deployed • In the current global context where the norm is change rather than stasis, it is retarding, at a personal and institutional level, to not create enabling environments for collaborations • It is not difficult to get funding because the tide is to take on the grand challenges • Institutional leaders may have many outstanding strengths, and integrated research may not be one of them • Use individual efforts to establish the institutional basis • The champion of the 21st century institutes was a highly creative and energetic individual who was willing to take on the push-back from faculties • Those who manage integrated research will be those who are able to operate outside the existing structures, form the collaborations and simply take the institution with them • It requires scientific deal making to continue to ensure that you are well positioned, with the University behind you, and generating the partnerships and income you need
A17	• The biggest challenge is to get in touch with the right person • There is a lack of communication between schools and departments • You need people to guide you in the integrated part of the research, the work that I did for my PhD only happened because I had a close personal friendship with someone in a different faculty • If you make an enquiry from the outside, no one wants to engage you • It is rare for people to work together towards a common research goal; usually, it is my research that leans over into someone else's area, there is nothing for them to gain • If everyone stands to gain from it then people are much more keen • Integrated research has to be bottom up because you cannot force someone to work on something that they are not interested in • You need to market yourself • If researchers knew what other researchers at the University were working on, it would probably lead to a sparking of ideas • Our knowledge of each other's fields is so limited
A18	• Integrated researchers do not get rated • I have been trained as a physical scientist but I have read and read to see where

	we can fill the gaps • No one knows the difference between multi-, inter- and transdisciplinarity • Many people want to do this work but know that they will not get rewarded, it is just hard grind • If you are a young scientist, you will not climb fast by doing integrated research • Young scientists should identify with a discipline for legitimacy • You have to find alignments and clusters, and build a pack like the others do • Building integrated research projects takes a lot of patience • You have to be bold enough to get up and talk • Students understand integrated research easily • Colleagues say we really, really need integrated research but they cannot go there • Young people need jobs • People who look at my CV do not know what I do • Many people on campus are just waiting for retirement • Finding spaces and opportunities is a slow process
A19	• Academics are overloaded • Collaborations at Wits can be tricky because everyone is involved in their own projects • It is highly desirable to be multidisciplinary because the most lateral thinking that I have ever managed has resulted from something unexpected in another field that has challenged what I think about my field • It was only by moving laterally into another subject that I was able to get the tools that enabled me to progress • You must not be a scientific grasshopper • If you only have one paper on a particular topic, you will not become known; you need to get a body of research together • Some researchers maintain their narrow focus but get their PhD students to work on problems in different areas
A20	• Having a different tradition to my colleague enables us to invigorate each other's debates, gives us different angles, different ways of coming at the question; if we were both generalists, we would not have that kind of debate • When I write and publish I do it in a disciplinary way, and then I move out again • For most academics, places like CUBES do not even figure on the radar • Students have access to the broader discussion but their supervision is within a particular discipline

Lower Right Quadrant: Research Managers (RM)

RM1	• Integrated research is where the richness is • The science/policy gap is being highlighted by global challenges • The peer review mechanism does not work for integrated research • It is difficult to get integrated research published because journals are discipline specific • Funding is done by peer review • Staffing and promotions are done by peer review
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	• The NRF rating system is done by peer review
RM2	• There is uncertainty about what constitutes a successful integrated research process • The institutional reward system does not favour integrated research • The success of integrated research teams is based on relationships and you need an opportunity to build these in a non-threatening way where the stakes are low • Formal structures cannot legislate integrated research – you need to be able to fuddle forward with imperfect processes • You need to have intellectual freedom to make the links; but the research agenda should not be loose and undefined, you need to identify the problem and provide a framework • The lack of hierarchy at Wits makes people talk to each other • You need some core ideas and research competencies within an efficient environment that is a safe space for you to come and do your thing • Integrated research projects have to be designed from the beginning as collaborative and cross-cutting • It is important to identify a funder that is amenable to cross-cuts, realises that cross-cuts do not necessarily lead to solutions, and allows the space to fail • Administrative barrier: it is very difficult to move money across boundaries • Large companies with close affiliations with higher education institutions are better positioned to deal with unknown challenges • Talk-shops cost R20 000 and have potentially no reportable deliverables • Research stewardship can facilitate communication between researchers but sometimes it is better to just put them in a room • The real problems are never solved by somebody with a microscope on the boundary of knowledge
RM3	• How do you create a common vocabulary? • Integrated research has to involve technologies because it is always about solving a problem • The NRF says that if you publish broadly, you are committing academic suicide • The value to be gained from academic endeavour is in bringing together people's narrow channels of knowledge to serve a real purpose
RM4	• Start-up funding is always a problem • There is no incentive to have postdocs between more than one school • If there is a demonstrable outcome, it is much easier to get funding • There are thousands of journals in which to publish integrated research
RM5	• It is the interface between science and the humanities that helps us to solve human problems • The problem is structural more than lack of will – the traditional disciplinary organisational structure • Two groups working together have to share the same money, but you get funding in relation to your institutional location, and the NRF allocates more funding to science than the humanities • Integrated research should not be supported for the sake of it – it has to serve a particular purpose • Interdisciplinarity comes from disciplinarity in the first place • By emphasising the disciplines as the basis for interdisciplinarity, you are reemphasising the canon and then the canon can never change, but you run the

	risk of relativism – anything is ok at any time • Disciplinary research appeases funders because there is a quick return on investment, but it is usually a short term solution that serves a particular group of people • The funding climate is very lean compared to 20 years ago and the current funding regimes discourage integrated research by requiring too much accountability • Integrated research problems have to be conceptualised together rather than by calling in a specialist afterwards • Integrated research enables you to come to the problem from a variety of perspectives • The speed at which you collect data and disseminate information is much faster because there are more people to do the work
RM6	• Universities advocate integrated research • Everyone means something different by integrated research • Discipline training is a very good thing, but when you are working on bigger problems, people should be brought together under an overarching institutional arrangement that can exploit all the advantages of the disciplines • Postmodernism has pushed things so far that people would argue that discipline does not matter, but you want to train students very hard in a particular area and then bring those deeply rooted skills together to tackle a set of problems that cannot be tackled individually • Crisis can be used as incentive – it forces people to work together • Johannesburg provides amazing opportunities as a living laboratory because we have many global problems on our doorstep
RM7	• Management systems reinforce silos because we manage process rather than the science • Unless it is driven by management as a very clear goal, it is generally not done • The goals of our university are fairly well defined and therefore integrated research is generally going to happen through a top-down approach • A problem originates out of a particular context and is taken up by management and mandated to researchers who are incentivised to fulfil a particular task • Utilise what is freely available and then sell it to individuals who will drive it • Health Sciences is seldom innovative

Lower Right Quadrant: Academics (A)

A1	• You can only get resources for students if they are located within a particular department • International colleagues have to be drawn on to help pass integrated PhDs • Exemplary pieces of work which would get full support elsewhere in the world are turned down in South Africa • Integrated ways of looking at society are initially not welcomed but eventually drawn into disciplines as core courses • The NRF is the most important body for funding knowledge creation areas
A2	• Schools respond to approaches with excuses about resource constraints • The University set-up needs to change in order to respond to real world problems

	• The University is not well placed to respond to external needs – teaching timetable, marking sabbaticals – that is a part of the university that may have to change to respond to 21st century needs • Academia has to be made more practical for the real world • It is not just hard science that is difficult to translate – legalise also has to be unravelled • The whole peer review process and the pressure to publish is huge • People should be focussed in the direction of integrated research and released from the publish or perish paradigm • Wits has to introduce metrics for academics that are not on the publish or perish route • Wanting to be in the top 100 universities by 2022 is in conflict with wanting to transform the academy • There are no metrics for my work in my probation form – most of my reporting goes under “other services that you provide for the university” • We need a better articulation of what centres and institutes are for – they serve a completely different purpose to schools • It is important to publish because it gives the university legitimacy and enables it to serve as an interlocutor; that is the role of the academy – to give the university legitimacy in large, cross-boundary conversations
A3	• Social science often critiques hard science • Everything has become more neoliberal and corporatized, and because science has an established relationship to capital, social science does not have a chance
A4	• Ratings are awarded within disciplines • Institutional structures do not understand that real world problems require a combination of disciplines to produce an output that makes sense • Everything in the academy is organised around you getting very deep in your discipline, being recognised for your discipline, publishing in your discipline and being rated in your discipline • The more you test a solution from multiple angles, the better • Often it is how you formulate your research problem that really matters • The academy tells you to publish but there are no journals that take integrated research, unless it is tacked on as a poor cousin • Journal editorial boards are made up of disciplinarians who do not value integrated research • A politician should be able to ask any question and the academy should be nimble enough to respond by assembling a team • The Minister of Higher Education and Training is about to start giving universities points for policy oriented research • Research that the NRF currently disregards will soon be considered fantastic • If you change the structure of incentives, and equally incentivise integrated, research academics will follow • Change the structure so that there is space for both a disciplinarian and an integrated researcher • There need to be journals that are deliberately set up to publish integrated research and existing journals need to start accepting integrated research • The 21st century institutes were supposed to be multidisciplinary by design but they lost that in trying to tell people what to do

	• The world has changed • Universities have had 1 000 years of being in silos • Every institute in the world is sitting in Pretoria because they are willing to play the game and Wits is not • The world itself is not disciplinary but integrated
A5	• Faculties do not talk to each other • Universities are incredibly silo-based • No dialogue between silos • There are 6 000 people so change is difficult • Engineering should be collaborative because you cannot build anything without four or five different types of engineers • Jargon is a major barrier at the outset but it can be overcome • People need a forum where they can hear about each other's research • Wits needs to advertise ongoing research better • Wits needs to advertise grants better • It is important to find reviewers who understand the research approach and agree that it is research • South African organisations do not understand the value of quality academic research to their operations • Research is useless without a way to translate it into commercial interest
A6	• Members of integrated research teams report to multiple people • Integrated research projects straddle faculties but are required to belong to only one • Students have to be registered in one faculty but are supervised across faculties • Researchers have a firm foundation in a discipline before they move into integrated research • There needs to be way of putting shared visions across faculties into the rulebook • Most of our funding has been external
A7	• Globally, knowledge no longer sits in silos • There are lots of opportunities for funding, journals and peer groups
A8	• Integrated research projects do not follow a proper lifecycle – there is no closure • Integrated research involves the creation of a community • Monthly meetings should be loose in organisation with everyone reporting so that you get a sense of synergy • There is a lot of integrated research happening at Wits but it involves external relationships that have to be built up over the years • Integrated research should not be restricted to reaching across disciplines but also across institutional boundaries • Partnerships with key players on the ground are important
A9	• Integrated research is enabled by business in search of solutions wanting to broaden its research portfolio and scope • Integrated research is enabled by having researchers with unique knowledge who can make unique contributions • National imperatives (such as the NDP) give new impetus to certain research areas • Centres create research foci and find projects for students • The IPR PFRD Act says that any IP that gets generated belongs to the

	University and that the University has an obligation to exploit it; when there is commercial drive, there is competition and an unwillingness to enter into partnerships; if you jointly develop IP who owns it? • It is very difficult to keep integrated research alive – you need champions • Integrated research projects need a joint, measurable objective
A10	• The NRF does not know how to rate integrated researchers through so they get shunted from one committee to another and their ratings drop • Funding applications for integrated research are energy consuming and have a very low success rate • International colleagues confirm the value of integrated research and local people have to reluctantly agree • SA is lagging • No peer review panels to adjudicate funding proposals for integrated research
A11	• Integrated research projects tend to comprise a handful of senior people and a large number of young, very motivated researchers • Wits has a lot of young, very motivated people • We are always trying to enable the ambitious projects of younger researchers • It is important to have regular discussions, transparency and a flat hierarchy • We really try to explain to each other what is going on, we do not say that you cannot understand this because you are a chemist, because there is a common problem solving interest • Collaboration forces a common language • Everyone is interacting on equal terms and bringing an equal contribution • Mostly we only fight over the budget • The downside of collaboration is that the group is dependent on the weakest link • The institutional environment has been very supportive – they reduced my teaching load when I assumed the chair • SA system likes the showman and is very bad at picking out people who are good at collaborating • Wits has the experience of a flat hierarchy
A12	• Research questions are better addressed with help from people from different backgrounds • Integrated research is not done at Wits on a major scale • Management should give more support to integrated research • Entities that conduct integrated research have project managers who can provide administrative support and create the glue • Funders like integrated research • International funding is very difficult to get
A13	• There is always risk in an integrated research space • The University is quite punitive if your student fails; if we are going into the integrated research space, then we have to be less punitive towards failure • Management should be clearing the hurdles • Management should not be deciding the structure because the structure has to be owned by the researchers • Management is supportive and engages with requests
A14	• Integrated research requires agreement from management but there is more chance of it happening if academics talk to each other rather than working through committees and deaneries

	• You need high level agreement and then proposals from academics • There are pockets of people doing amazing things • People get caught up around who gets the FTEs and the finance so you need a model that is viable • Administration systems are a big barrier, I spend hours going from office to office trying to get someone registered, trying to find out where the money is sitting • Wits does not have many people who have worked across disciplines • People are very narrow in their focus, the trick is to provide the platform to bring narrow thinkers together
A15	• There are journals that are already integrated • Hard science question of what needs to change and soft science question of how to change • The impact factor of journals that publish integrated research is low
A16	• Things are evolving; words like agile, nimble • There is no recipe for integrated research • There are areas where small groups might make breakthroughs by sticking to disciplines • But in a context like SA, in dramatic transition, you have to bring integrated thinking to problems and institutions can be either constraining or enabling • No SA institution has got it completely right • Applied professions engage you in problems and stimulate integrated thinking • The way the institution is able to configure and focus itself can be a constraint • Leading universities elsewhere have made amazing investments to build their integrated research • Wits does not have the institutional flexibility that is required to create the internal collaborations that are needed to be strong in international partnerships • The UK invests heavily into large scale integrated research projects that are inter-institutional, bringing together the most capable to create scale and heft • Modern technology allows integration in a way that was not possible before • Schools and universities battle to work out what formulation will work for them • You have to have people who come with shared problems from utterly unrelated angles • The complexity of the institution means that efforts to establish integrative projects are not familiar to many people
A17	• There are tribes within a university that have their own languages that make their disciplines inaccessible to people from different disciplines • The University needs a person with some power who is tasked with enabling integrated research – they need to be able to phone someone and say you need to make time to see this person • When people from different disciplines talk to each other, ideas get generated • The people who know what everyone else does are usually senior people who do not need that information anymore, rather than the junior researchers who are looking for a research project • The University needs a forum where people can get to know what the others are doing
A18	• The structures that reward science are archaic • The NRF does not realise that wicked challenges cannot be solved with one

	siloed approach and the NRF is the main funder so many scientists are not brave enough to do integrated research • The system is against integrated research and yet in the very next breath everyone gets up and repeats the rhetoric around how the world is so complex that we need integrated research • We need to do research on pedagogy and how knowledge is framed to understand why integrated research is not happening • Academics at Wits are not opposed to integrated research but the system is not geared to reward us • Publish or perish • Commodified education • Younger academics cannot afford to show their finger to the hierarchy because they will not get promoted • A turning point is coming where the world will have to think hard about this • The system does not allow for creativity • The University is about research, teaching and then this other stuff that they cannot get their head around; the last part on everyone's CV is all bull • How knowledge is formed should be a compulsory subject for all undergraduate students
A19	• Communication can be an issue
A20	• There has to be a pragmatic dividing of work between supervisors in an integrated research project • The University has really started asking what integrated research means • The SA academy is not huge so we have conversations with other researchers all the time • The humanities lend themselves more to integrated research because of the broader social questions that they ask • Institutes and centres are important spaces because they are constantly hosting workshops and enabling a collaborative space

APPENDIX D

AQAL Framework: Draft 2

Upper Left Quadrant

1. Drivers for Integrated Research:

- The inclination to cross boundaries usually comes from a realisation that you have been at it for years and are not solving the problem
- We need certain people interacting in a way that they have not interacted before, which typically does not happen around funding opportunities, but around interest and a desire to have an impact
- Integrated researchers are driven by finding rich research areas that offer a lot of potential and interesting outcomes
- Those who do integrated research like doing it
- Integrated researchers have a desire to make a greater impact than simply publishing papers
- Integrated researchers are social responsible
- It is important to have a willingness to learn
- Integrated researchers are people who ask what the world needs and then work at understanding how to service this need
- Integrated researchers are driven by a desire to make a difference
- The incentive for integrated research is working with really highly regarded scientists in an international team
- Integrated research requires an epistemological openness – you do not see knowledge produced in a linear way but in different sites of practice, without relativism (the view that everything is ok)
- Integrated researchers value the context that other disciplines bring
- Integrated researchers look for ways in which their fields connect to other fields
- Integrated research is led by people who see systemic connections
- Integrated researchers are interested in whether research is useful and advances society
- Integrated researchers are solution oriented
- Integrated researchers are interested in how to the way forward for a better world
- Everybody wants to see that their work will make a difference
- Researchers like to hear that there will be a positive outcome
- Researchers are persuaded by the argument that if they worked alone they would not get such an impact
- It is a question of orientation – what you think your purpose is
- Only adventurous people like integrated research
- Curiosity is key and the desire never to languish in a comfort zone

- Institutional support depends on the individual academic's energy and the commitment to creating something
- It is exhilarating being able to draw new and bold connections between things
- Integrated researchers are people who want to remain current and actively seek out opportunities to collaborate
- Integrated researchers have a natural energy and curiosity
- Integrated researchers have a deep sense of social activism
- It is more enjoyable and personally satisfying to work in a team
- Integrated researchers think about the bigger picture
- Disinterested scientists are hard to find; often people are driven by many agendas
- Integrated research projects need someone who is single-minded, determined and absolutely committed
- People have to be convinced that working in large groups is in their best interests in the long term, that it will be possible to make a more convincing case to potential donors, that it will be easier to get industry interested
- Integrated researchers see the bigger picture
- You need to be clear about what success would look like, and you need to be able to communicate why other people should join your mission
- People respond well if you go to them
- Researchers believe that universities should be much more externally focussed
- Universities should not simply be responding to the economy – they exist to improve their contexts
- Integrated researchers must assert their own value systems
- Integrated researchers tend to be young because they are more open to new ideas
- Working together with someone you like is a personal high because you can talk to them on many levels
- Integrated research requires openness
- Integrated researchers are driven by finding out something new
- Integrated researchers see interconnectedness
- Integrated researchers are driven to understand other areas of research so that they can affect societal change
- Integrated researchers are self-aware
- Integrated researchers are driven by social relevance
- Engineers enjoy developing solutions that make life easier and having a window into another world allows them to create something new in that area
- Integrated researchers are committed people with a zealous project and strong commitment; that leads them into the heart of their discipline but their bigger interest is bigger impact

2. Push-back Against Integrated Research:

- It is at the point of implementation that people put up barriers; they come up with a million excuses why they cannot do it
- It is difficult to understand the value of the others until you see it for yourself
- Resistance to change
- As an engineer you are taught that you solve problems; why should you talk to a social scientist?
- Researchers do not recognise that there are other people who offer profoundly important insights
- It is worrying to become a generalist
- There is tension between students coming from different disciplines
- A desire to show to others what can be done and incorporate them rather than create boundaries is important to collaboration
- Generosity is important to collaboration
- New leaders can be a mixture of hostile and not interested if they do not own projects
- New leaders can refuse to expend any political capital on projects that they do not own
- Psychologically, receiving emails regarding opportunities for collaboration is not as effective as seeing them on a public screen
- Territorial leaders can stymie projects by refusing to approve them
- Changes in political situations can affect the survival of projects
- Institutional support depends a lot on the interests of the current dean
- Some people are curious when approached, others do not want to be disturbed
- The other four faculties do not exist to some people
- Organisational boundaries are not as inhibitive as closed mind-sets
- Academics believe that they are overloaded with teaching and have no inclination to get involved in other work
- Integrated research is fraught with the challenges of recognition, funding, jealousies and attitudes
- Researchers who are not committed push back by not replying to emails, being difficult to reach, saying they are busy, and saying that it is going to be difficult to have the next meeting
- Integrated researchers have to be able to let stuff go and not get caught up in resentment
- I am not that concerned about the disciplinary distinction; what is wrong with disciplines, why do we want to be multidisciplinary?
- People should work on integrated research but I need to be convinced of the intellectual rationale
- I fear that integrated research will become one of those catch phrases

3. Resistance to Change:

- An adherence to the belief that knowledge can only be produced in particular sites is a barrier
- Students are largely stuck in a disciplinary head space because they come through a disciplinary undergrad
- Integrated researchers are steeped in their disciplines but have also realised the limits of their disciplines
- We do really need large integrated research groups – we cannot carry on doing things the way we have been doing them
- If you are young you take more risks than if you are at the end of your career
- Some people cannot buy into the bigger picture, have a lack of vision, and are very set in their ways
- People are so well trained in one discipline that when new ideas come, they cannot engage with them

4. Reward Systems:

- No one is happy with the rating system
- Some individuals will do something because they can do it, the vast majority will do something because they believe that there is benefit to them
- People are driven by rewards – whether prestige or money
- Integrated researchers must be comfortable with sharing the credit, the financial resources and other resources
- Integrated researchers tend to be young because they have to be more competitive and orient themselves more towards international research to make a name for themselves
- Older researchers do not see the point of getting into a new field when they are going to retire soon
- Integrated researchers are not driven by money
- Integrated researchers are driven by doing work in an area that they love rather than an area that is attractive to highly rated journals
- If you want to be at the cutting edge, you have to do integrated research
- Individuals who do not collaborate easily are those who do not see the bigger picture
- It is important to explain to researchers how they will benefit from integrated research
- If you want to be a rated researcher then you have to demonstrate focus; researchers worry that if they collaborate, the reviewers will see it negatively
- Integrated researchers have to internalise their own successes because there is little external acknowledgement
- Integrated researchers are not driven by financial interest
- People are driven by self-interest
- People focus on distributing the spoils before the collaboration is even formed
- Everyone wants to earn brownie points

5. Vulnerability:

- Being an academic is vulnerable; it is all about putting your thoughts out into the public space; you are risking your reputation all the time
- You have even more vulnerable in integrated research because you are commenting on research that is outside of your field
- Integrated researchers are inherently secure
- Insecure people are not interested in integrated research
- Creative people are more insecure because when you deal with form (an opinion) rather than function (an optimisation process) you become vulnerable to criticism
- People see threats rather than opportunities and start protecting their turf
- Researchers are so comfortable where they are that they would rather fight to hold onto it than see a new opportunity
- People have a fear of the unknown and a wish to retain the status quo
- Territorialism
- Comfort of working with known entities
- Crossing disciplinary boundaries involves taking risks
- It is easier to work with your own team because you share a scientific language and you move rapidly to your solution
- Because integrated research is goal oriented, it is not far outside of the comfort zones of health scientists
- Individuals who do not collaborate easily are those who like being in control
- Vulnerability is core – you must be willing to be shot down by people from other disciplines
- People are very comfortable in their disciplines and they have to endure discomfort to work across disciplines
- There is a reluctance to recognise the potential for a discipline other than your own to be of value
- It is difficult to venture into areas which you know very little about and occasionally make a fool of yourself
- A lack of territoriality and a willingness to uplift other people is important to collaboration
- Humans do not like change
- Integrated research requires confidence because it is a scary space – you know nothing
- Social scientists are reluctant to frame a problem because they know that it is so complicated
- Integrated researchers have to develop enough of a sense of self to withstand battering

6. Ego:

- Those who push back are very egotistical and insecure; they are micro-managers who do not trust anybody; their attitude is: if I do not do it, it is not going to happen; they are not easy to get along with, very demanding and high maintenance
- Integrated researchers have no problem with their position of authority; they have no problem with working in teams, empowering others and sharing the glory; they realise that they achieve greatness through that; it is not about them
- You have to create an enabling environment for integrated research in a way that makes people think it was their idea; subtly and surreptitiously
- Ego: I am a big chief in a small pond here, why should I become a small chief in a very big pond?
- Academics look down on government officials when they ask questions
- It assumes idiocy on the other side
- There is a sense of self-worth associated with being able to do something that other people cannot
- There is a loss of power when you realise that you are not as special as you thought you were
- Arrogance prevents learning
- Humility makes people with bigger egos accept you
- I will not talk to some people because I have been battered by their egos
- I have been bashed a number of times by disciplinary arrogance – I know nothing because I am from a different discipline and they know everything
- Integrated research requires humility, you have to respect that discipline because you are playing in their space
- It is easier to conduct integrated research if you have no shame and no problem saying to someone that you have no idea what they are saying
- People might give up easily because they are embarrassed to admit that they do not understand what someone is saying
- People are quite proud and they hate to appear stupid
- I generally care less than a lot of other people I have met
- Scientists should be humble enough to describe integrated research as hard science
- If you are trying to solve big problems, you have to realise that you are not the only one with solutions
- Scientists are arrogant and insecure; they are supposed to be the gurus and they cannot leave their egos at the door
- It is easier to get engineers to talk to other researchers from very different disciplines than other types of engineers
- Researchers fail at integrated research when they are convinced that their discipline is more valuable than another
- Collaboration requires looking at a problem from another person's perspective

7. Trust:

- Trust is important to being comfortable collaborating
- Huge scepticism: I do not quite get what you do, I do not understand
- There is a lack of trust around talking to others about your research
- The personality of the research leader is critical
- It is difficult to engage people from the outside if they do not know you
- No one wants to engage you

Lower Left Quadrant

1. Institutional Culture:

- A paradigm shift is necessary
- The institutional culture is around staying in a narrow space; it does not recognise anything else
- Engineers deal in facts; they have an obligation to be profoundly honest about what is happening; social scientists can take a thing and look at it from 100 different angles
- Humanities has a broader perspective on the human condition
- There are epistemological or even ontological differences between disciplines
- Humanities are dismissive of quantitative modes; Science is dismissive of narrative modes
- Wits is not imaginative enough to escape disciplinary boundaries
- People need to see a clear purpose
- People are incentive driven; esoteric, unrewarded work is unusual
- Internationally, people are already convinced that you have to have collaboration
- The university has not thought about why it is establishing centres and institutes
- There has been no real thinking about what it means to introduce a new entity rather than getting existing entities to work together
- Wits thinks it is special and more worthy of respect
- Wits thinks no one understands them and that they are to be pitied because all the money goes elsewhere
- Wits operates under an anachronistic paradigm that because disciplinary work was rewarded during apartheid, it should be rewarded now
- Wits adopts an attitude towards institutes of you will pay for the privilege of being here
- There is a resistance to being driven by the city's research priorities and a belief that research must be driven by the academy
- Being responsive to the city should be equally regarded and utterly legitimate
- There is a mob mentality
- Ethics boards believe only clinically trained people can work in any capacity in hospitals
- Pressure to meet targets destroys a greater good mentality
- The vice-chancellor is putting pressure on the deans and they are putting pressure on schools
- We have to keep up with the way that knowledge is evolving in the world
- Ideological rifts are difficult to heal
- IP negotiations – be pragmatic, some research councils sit on mountains and mountains of IP which they guard jealously and they don't commercialise
- Pragmatism – don't say that's the rule and that's the only way to do it
- If you come across an opportunity, review it critically and objectively, is it not maybe time to change some of the rules, stay relevant
- Gatekeeping and competition for funding

- Academic and intellectual belittling
- Policy is decided by bean counters who do not get it and do not really care
- Every institute in the world is sitting in Pretoria because they are willing to play the game and Wits is not
- There is intellectual freedom at Wits
- Scientists are notoriously difficult to manage; they do not come to the party or they have a hidden agenda
- There are clashes in philosophies, e.g. social responsibility versus a profit motive
- There is tension between public good and the profit motive
- Profit is being prioritised
- Parts of Wits that prioritise profit have lost the plot because the University does not exist to make a profit
- Wits says it supports the institutes but still wants people to teach in departments
- Wits is driven by individualism – promotions reward individual efforts (single authored publications, supervising, teaching, admin contributions)
- Institutional change takes many years
- The burden of applied research should not be placed on academic institutions
- It is not the role of universities to be conducting integrated research to the same extent as external research entities

2. Adherence to Disciplines:

- Some schools perceive themselves to be superior to other schools within the same faculty and refuse to talk to them
- People feel that integrated research is non-experts interfering
- Integrated research needs to be perceived as bringing the best minds in a discipline to cohere around a larger area
- Health Sciences has to have a concrete outcome
- Departments are often pitted against each other
- The Health Sciences idea of a clinician is so rigid that researchers get into trouble for talking to other types of researchers
- Health Sciences does not see value in integrated research
- Faculties will not open up to the idea of acquiring knowledge from each other, despite the fact that they can only benefit from attention to other disciplines
- Humanities is scared of Science – they balk because they do not feel that their forms of evidence count
- Science and Health Sciences are also scared of being proved wrong
- Science has a purist research approach that values universal truths
- Social scientists think scientists are reductionist and lose the complexity of the human experience
- There is a lack of respect between disciplines
- Disciplines think other disciplines have no value and cannot contribute

- Faculties become territorial for irrational reasons
- Attempts to formalise integrated research projects into centres are hindered when faculties become territorial
- In engineering, integrated research is driven by the desire for research to be applied
- The power base sits in the School of Clinical Medicine; they can do the exact same course and it carries more gravitas
- The School of Clinical Medicine is oriented towards helping patients rather than creating profit
- It is unfair to expect schools to change their philosophies
- Every discipline thinks that they are the best
- Engineers and scientists are particularly narrow minded
- Soft skills do not carry as much gravitas as scientific evidence
- The 21st century institutes were perceived to be taking leading scientists out of schools and faculties which would then be hollowed out
- The key challenge internationally is the framing of science; hard scientists have a positivist approach while social scientists are more interested in how knowledge is framed initially, who sets the agenda, how knowledge is defined, what counts as valid knowledge
- Hard scientists think that they are the only ones who have solutions
- Hard scientists do not understand other approaches
- Hard scientists treat social scientists badly
- Hard scientists have to come on board because they are the ones with legitimacy
- Because of the way science is funded it is perceived as cleaner and more coherent
- There is an extraordinary belief that all scientists know social science
- Scientists are threatened by science philosophy and work to shut it down
- These structures are set up by disciplines to reward and guard disciplines
- Researchers have been taught that it is wrong for faculties to talk to each other
- Researchers believe that they have the right knowledge and can do no wrong
- Different disciplines have different opinions of what research is, what kind of question is adequate and worthwhile
- Solving a problem is not a research question in engineering
- Researchers are too willing to accept the constraints of school/faculty structures
- There is a perception that valid research has to have numbers and graphs
- There is a tendency to see disciplinarity as too small or myopic
- Value systems do not align

3. Perceptions of Integrated Research:

- Integrated researchers are poorly perceived
- Integrated research is not valued as much
- There is a perception that integrated research requires large teams
- Integrated research is seen as a threat to your ability to stay within your discipline
- It is difficult to convince people that their way of doing things will not be threatened

- It is a fundamental challenge to their pedagogy
- You have to find people who have the same objectives and outlook, otherwise you are just swimming upriver
- Some physical scientists are incredibly nasty about what we are doing
- Integrated research is driven by people not the university
- Wits claims to support integrated research but has no idea how
- Strong buy-in at all levels of the hierarchy (vice-chancellor, deans, heads of schools) makes integrated research easier
- Integrated research requires political support and faculty ownership
- Integrated research initiatives are bound in the people not the structure; when people move on then things change
- There is resistance to integrated research because it is an anomaly; people prefer clean structures, clear reporting lines, no wrinkles
- Anomalies take up more time than their size is worth
- There has to be an understanding that if you want integrated research then you have to accommodate anomalies
- Integrated research often comes through private work which requires permission; this can be a barrier, especially if you are afraid of the head of school
- The interdisciplinary value of private work is not always recognised
- There are islands that embrace integrated research
- People do not understand what we do
- When you suggest that you have something to offer, you are not taken seriously
- There are some enlightened people who recognise the value of what we do
- There is uncertainty about what constitutes a successful integrated research process
- In the US, specialisation is considered very bad, you have to build international leadership in two fields
- People have to be pushed into it and then they are out of their comfort zone
- Current and past leadership have tried to foster integrated research
- Most initiatives have aroused opposition because of a top down approach
- The 21st century institutes are a red herring now
- Leaders did not appreciate how top down and destructive the 21st century institutes were perceived to be
- There is institutional commitment on the surface only
- Integrated research is not valued as science; it is seen as play and wishy washy garbage
- We are under no illusions that we are up against university, funding, NRF and government structures
- There is a lack of territoriality if the lead researcher is in an acting position and not perceived to be empire building

4. Collaboration:

- It is difficult to culturally integrate researchers from different backgrounds
- It is potentially explosive to take elitist, high maintenance people and force them into the same space
- Research groups protect their turf from other similar groups
- There is disciplinary arrogance
- Difficult to get people to share resources to create an integrated research project
- There is initial resistance around time
- The resistance decreases following face to face engagements
- Building collaborations takes time and effort; you have to go and talk face to face to researchers
- There is a lot of hierarchy in the university which only serves to underscore hierarchy rather than build any kind of respect
- Schools being put under pressure to increase their honours numbers has had a negative effect on integrated research because people have become less cooperative and more concerned with FTEs
- Integrated research must be about solidarity not individuality
- The subtle skills required for collaboration are not well understood
- Competitiveness makes it almost impossible to reach out
- People who come up with new approaches usually have diverse skill sets and approach problems in non-traditional ways
- NRF calls for collaboration are ignored because there are no relationships nor trust between researchers
- Integrated research requires trust

Upper Right Quadrant

1. Incentives:

- Research questions have a lifespan and then you need to find something else
- The incentives drive you towards finite thinking; the narrower the application of your ideas, the better you are going to be rated as an academic
- South Africans have less peer pressure; we can afford to lose half a year without publishing – this enables us to try new things
- An integrated approach can help your career
- Industry provides an understanding of integrated research
- Problem solving requires asking for help which naturally leads to integrated research
- My career has been enhanced not inhibited
- In the current global context where the norm is change rather than stasis, it is retarding, at a personal and institutional level, to not create enabling environments for collaborations
- Integrated research is boosted by study, fellowship and work related opportunities abroad
- Students understand integrated research easily
- Trust your scientists, get the right people with the inclination to work across boundaries and they will do it
- Young researchers need to be attracted away from the pursuit of ratings; this requires senior people helping junior people
- It is important to maintain curiosity by regularly changing the topic

2. Disincentives:

- There not enough rewards for solving real world problems
- Integrated research projects are inevitably comprised of people who have to sacrifice their own careers
- There is no incentive to conduct integrated research aside from your audience out there
- Conducting integrated research in in conflict with doing well academically; you are not going to be patted on the back by the NRF
- It is difficult to get rated on a body of work that talks to no particular discipline
- Academics are hired under disciplinary structures – where will someone trained across disciplinary boundaries be hired?
- Integrated research project leaders usually have onerous administrative and fundraising responsibilities
- Being employed in a centre is often very precarious because it is grant-based; if you want security, you are based in a school
- When you do that immediately your rating drops
- It takes much longer to conduct integrated research; you are outside your comfort zone, timelines are more difficult to judge, and the results are slower
- I failed a PhD because I took an integrated approach
- Integrated researchers do not get rated

- Many people want to do this work but know that they will not get rewarded, it is just hard grind
- Finding spaces and opportunities is a slow process
- Integrated research requires effort
- The first four of seven pages of my probation form are about how I teach
- It is difficult to recruit someone external for a position in an integrated research area that is not structurally embedded
- Wits does not provide a track for integrated researchers, you do not have that choice
- I am very careful in my supervision and choice of examiners
- Building integrated research projects takes a lot of patience
- People who look at my CV do not know what I do
- Many people on campus are just waiting for retirement
- For most academics, places like CUBES do not even figure on the radar

3. Age:

- Younger scientists are more inclined to think practically about solutions not another paper
- Younger scientists are more inclined to wonder about what other disciplines are doing
- Younger scientists are ready to go into integrated research a lot sooner
- Younger academics relate completely differently to technology, and technology facilitates boundary-crossing, so younger researchers have a better chance of conducting integrated research
- Younger integrated researchers need structural support and financial incentives
- It is important to have older, leading researchers working in young integrated research teams
- Integrated researchers tend to be younger
- If you are a young scientist, you will not climb fast by doing integrated research
- Young scientists should identify with a discipline for legitimacy
- Young people need jobs

4. Gender:

- Integrated research is overwhelmingly led and pushed by women which means they take a longer time to get ahead in their careers
- Many women are being awarded research chairs in integrated research areas
- Women do not get funding
- There are lots of people – all women – who are ahead of their curve

5. Disciplinarity:

- The high level, impactful integrated researchers are solidly rooted in one discipline; they maintain a core discipline competency

- Researchers have a firm foundation in a discipline before they move into integrated research
- Integrated research is enabled by having researchers with unique knowledge who can make unique contributions
- There is concern around younger scientists moving into integrated research without being rooted in a core discipline, like the impactful international scientists
- The more well established you are in your discipline, the less chance of you crossing boundaries
- You must not be a scientific grasshopper
- If you only have one paper on a particular topic, you will not become known; you need to get a body of research together
- Some researchers maintain their narrow focus but get their PhD students to work on problems in different areas
- When I write and publish I do it in a disciplinary way, and then I move out again
- Academics are essentially people who carve out a little niche for themselves
- Integrated researchers read outside their fields
- After discussion, people retreat into their disciplines to write; the problem is that they write it in a way that no one else can understand it
- Integrated researchers are up against everything that they have been trained to do, which says stay within a discipline
- It is dangerous to say that being multidisciplinary is better; if you are not in control of a discipline, you do not have anything to offer
- It is important for researchers to read outside their discipline
- You have to be a citizen of the world, otherwise you cannot impose the correct focus on your work
- It is easier for South Africans to work across disciplines – Europeans sit in silos
- You have to bring the skills to the table that enable you to talk to someone in the first place
- Problem solving skills and exposure to other disciplines are important
- Until 10 years ago, you would go deeper and deeper into your discipline; in the last three to four years, new algorithms have replaced the need for fancy equations, but now you have to embrace complexity by looking at many different data sets, so you start pulling in lots of different people; you have to be careful because your maths is not so fancy anymore and examiners say you have not done enough work
- No one has all the science skills and the people skills to address all the problems around global change
- It is highly desirable to be multidisciplinary because the most lateral thinking that I have ever managed has resulted from something unexpected in another field that has challenged what I think about my field
- It was only by moving laterally into another subject that I was able to get the tools that enabled me to progress
- If you are illiterate in integrated research, you are far less helpful to society

- Push back comes from very strong researchers, typically single authors in narrow fields
- Most of the students are very firm in two if not three or four of the silos
- The rating system recognised researchers who are single-minded and focussed in a particular field
- I have been trained as a physical scientist but I have read and read to see where we can fill the gaps
- Students have access to the broader discussion but their supervision is within a particular discipline

6. Collaboration:

- There is a language barrier and language is a reflection of a way of thinking
- Interpersonal skills are important in integrated research because of the need to communicate
- You have to bump into someone else with an inclination to cross boundaries
- Researchers within the same school do not know what their colleagues are doing
- Experts do not meet each other, there is no need to go out
- Engineers do not have good interpersonal skills
- Integrated researchers have to have very well developed interpersonal skills
- Integrated researchers are natural teachers; they have to go down to a common denominator and make sure everyone understands each other
- Some people can be quite nasty to each other
- The benefit of collaborating with well-known researchers is that your publications get disseminated and cited faster (even if you are the tenth author); your trajectory is steeper
- Integrated research requires crossing many boundaries – scientific, language – which few can do and many find uncomfortable
- You can open up silos through dialogue
- Co-supervision means half the interest because there is half the reward
- It is necessary to build relationships
- We do similar work but we just do not talk
- People do not know each other
- It is important to find common ground and common interest
- The best people are sitting somewhere silently behind, making themselves useful to a collaboration
- Physicists and chemists find it easy to collaborate because we have similar backgrounds
- Collaboration enables researchers to push each other
- Collaboration enables researchers to become more understanding of the value of each other's disciplines
- Scientists are conditioned through education to work by themselves; teaching has to change to encourage collaboration, but the teachers are scientists themselves and they have been conditioned

- Communication is important – being able to transport an idea and involve several layers of understanding
- It is important to listen rather than act
- Once I have identified someone I would like to collaborate with, there are no barriers; we are free to do anything we want at Wits
- We all have different words for the same things
- If we do not understand each other we cannot work together
- If you are humble, people with bigger egos tend to accept you
- There are no barriers to talking, but the problem is finding the right people by finding out what problems they are trying to solve
- You need human connectors – people who connect one person with another
- We need people who are willing to help other people create new ideas
- The biggest challenge is to get in touch with the right person
- You need people to guide you in the integrated part of the research, the work that I did for my PhD only happened because I had a close personal friendship with someone in a different faculty
- If you make an enquiry from the outside, no one wants to engage you
- It is rare for people to work together towards a common research goal; usually, it is my research that leans over into someone else's area, there is nothing for them to gain
- If everyone stands to gain from it then people are much more keen
- Our knowledge of each other's fields is so limited
- If researchers knew what other researchers at the University were working on, it would probably lead to a sparking of ideas
- You need to market yourself
- You have to find alignments and clusters, and build a pack like the others do
- Collaborations at Wits can be tricky because everyone is involved in their own projects
- Having a different tradition to my colleague enables us to invigorate each other's debates, gives us different angles, different ways of coming at the question; if we were both generalists, we would not have that kind of debate
- You need to be clear about what success would look like, and you need to be able to communicate why other people should join your mission
- Integrated research only begins when you force people to sit in a room and brainstorm a problem together
- You have to go into a team with a willingness to learn from others
- Connectors need to really care about the project, be highly sociable, understand enough to connect people
- It requires scientific deal making to continue to ensure that you are well positioned, with the University behind you, and generating the partnerships and income you need
- Large funding opportunities create competitiveness and one-upmanship because researchers want to get their share of the money; if there is not a lot of funding at stake, researchers are more open to dialogue

7. Credibility:

- Credibility depends on your publication record
- No integrated researcher is an iconic scholar
- Integrated researchers have to be articulate, convincing and respected
- It is important to be a well-known, public face
- It is important to have a good research track record to give stature
- It is very difficult for a novice to drive an integrated research project
- As an integrated researcher, it is difficult to be considered excellent
- Good at impressing people
- To get tender at Wits you need to have international people who recommend you
- Most of the people who are A-rated scientists function well in large groups
- Academic credentials are important otherwise you are perceived as a junior guy who needs something from a senior guy

8. Resources:

- Relating across disciplines is often not the problem – selling the concept and putting together the systems is where the problems often arise; we constrain ourselves with silly things like time and money
- Initiating integrated research projects costs the people involved
- Collaborators express it as a huge cost to themselves
- heads of schools discourage integrated research because of funding reasons; if you bring in another author, your school gets less money
- People who say unpopular things do not get funding
- Funding is not a problem in SA; you just have to write proposals and go overseas to present at conferences and make yourself known
- I need the time in which to do integrated research
- I think people deliberately obstruct and say this is not my job so that they get paid to do it after hours
- Admin people are generally incredibly unhelpful; there is self-interest in being inefficient; they say I will help you but it is not my job so can you pay me extra?
- Academics have to service their own departments first because they pay their salaries; this reduces the amount of time that they have available for integrated research
- We have had lots of discussions but our main barrier has been the time to see through those discussions
- Generating your own resources gives you ownership over how they get deployed
- Researchers should raise funding, not management
- Need someone who understands all the rules and wants to help to make it happen
- Huge problems with initiative and willingness to help
- Academics are overloaded

9. Leadership:

- The deputy vice-chancellors do not encourage integrated research
- The role of a research manager is to facilitate integrated research by removing impediments
- Integrated research requires a leader who is not too busy with other things, otherwise the project gets initiated and then there is no input for months
- When integrated research leaders have to fundraise for their own jobs, the time spent and the stress detracts from their intellectual input
- Integrated research projects need to be led by people who can hold the space intellectually
- It is important to find the right individuals; organisations can inhibit and prevent, but it is individuals who make it happen
- Institutional leaders may have many outstanding strengths, and integrated research may not be one of them
- Use individual efforts to establish the institutional basis
- You cannot force people to conduct integrated research; it is better to enable the willing than to force people
- The champion of the 21st century institutes was a highly creative and energetic individual who was willing to take on the push-back from faculties
- Integrated research has to be bottom up because you cannot force someone to work on something that they are not interested in
- Those who manage integrated research will be those who are able to operate outside the existing structures, form the collaborations and simply take the institution with them
- You have to be bold enough to get up and talk
- Colleagues say we really, really need integrated research but they cannot go there

Lower Right Quadrant

1. Global and Local Context:

- The world has changed
- The world itself is not disciplinary but integrated
- Globally, knowledge no longer sits in silos
- The science/policy gap is being highlighted by global challenges
- Large companies with close affiliations with higher education institutions are better positioned to deal with unknown challenges
- Johannesburg provides amazing opportunities as a living laboratory because we have many global problems on our doorstep
- The University set-up needs to change in order to respond to real world problems
- The University is not well placed to respond to external needs – teaching timetable, marking sabbaticals – that is a part of the university that may have to change to respond to 21st century needs
- Academia has to be made more practical for the real world
- A politician should be able to ask any question and the academy should be nimble enough to respond by assembling a team
- The Minister of Higher Education and Training is about to start giving universities points for policy oriented research
- There are 6 000 people so change is difficult
- South African organisations do not understand the value of quality academic research to their operations
- Research is useless without a way to translate it into commercial interest
- National imperatives (such as the NDP) give new impetus to certain research areas
- Wits has a lot of young, very motivated people
- Wits has the experience of a flat hierarchy
- Integrated research is not done at Wits on a major scale
- There are pockets of people doing amazing things
- Wits does not have many people who have worked across disciplines
- Things are evolving; words like agile, nimble
- A turning point is coming where the world will have to think hard about this
- Hard science alone does not lead to public uptake

2. Nature of Integrated Research:

- Integrated research is where the richness is
- The real problems are never solved by somebody with a microscope on the boundary of knowledge
- Integrated research has to involve technologies because it is always about solving a problem

- The value to be gained from academic endeavour is in bringing together people's narrow channels of knowledge to serve a real purpose
- It is the interface between science and the humanities that helps us to solve human problems
- Integrated research should not be supported for the sake of it – it has to serve a particular purpose
- Integrated research enables you to come to the problem from a variety of perspectives
- The speed at which you collect data and disseminate information is much faster because there are more people to do the work
- Universities advocate integrated research
- Everyone means something different by integrated research
- Integrated ways of looking at society are initially not welcomed but eventually drawn into disciplines as core courses
- The more you test a solution from multiple angles, the better
- Integrated research is enabled by business in search of solutions wanting to broaden its research portfolio and scope
- International colleagues confirm the value of integrated research and local people have to reluctantly agree
- SA is lagging
- Research questions are better addressed with help from people from different backgrounds
- There is always risk in an integrated research space
- There is no recipe for integrated research
- But in a context like SA, in dramatic transition, you have to bring integrated thinking to problems and institutions can be either constraining or enabling
- No SA institution has got it completely right
- Applied professions engage you in problems and stimulate integrated thinking
- Leading universities elsewhere have made amazing investments to build their integrated research
- Modern technology allows integration in a way that was not possible before
- You have to have people who come with shared problems from utterly unrelated angles
- When people from different disciplines talk to each other, ideas get generated
- The system is against integrated research and yet in the very next breath everyone gets up and repeats the rhetoric around how the world is so complex that we need integrated research
- We need to do research on pedagogy and how knowledge is framed to understand why integrated research is not happening
- The University is about research, teaching and then this other stuff that they cannot get their head around; the last part on everyone's CV is all bull
- The system does not allow for creativity
- How knowledge is formed should be a compulsory subject for all undergraduate students
- The University has really started asking what integrated research means

- The humanities lend themselves more to integrated research because of the broader social questions that they ask
- Integrated research helps you to come to a solution faster
- Any scientist who claims no link to the humanities is actually not on the cutting edge of science; equally any humanities person who claims that science is something else for someone else is not on the cutting edge of humanities
- The downside of is that it is completely exploratory and a long exploration might not result in a solution; it is easier option is to stay within bounded territory and reach a solution, even though it may not be responsive to the bulk of society
- Integrated research is about trying to rise above a discipline because you are trying to deal with a complex problem

3. Methodology:

- Formal structures cannot legislate integrated research – you need to be able to fuddle forward with imperfect processes
- You need to have intellectual freedom to make the links; but the research agenda should not be loose and undefined, you need to identify the problem and provide a framework
- You need some core ideas and research competencies within an efficient environment that is a safe space for you to come and do your thing
- Integrated research projects have to be designed from the beginning as collaborative and cross-cutting
- When you are working on bigger problems, people should be brought together under an overarching institutional arrangement that can exploit all the advantages of the disciplines
- You want to train students very hard in a particular area and then bring those deeply rooted skills together to tackle a set of problems that cannot be tackled individually
- Crisis can be used as incentive – it forces people to work together
- Unless it is driven by management as a very clear goal, it is generally not done
- The goals of our university are fairly well defined and therefore integrated research is generally going to happen through a top-down approach
- A problem originates out of a particular context and is taken up by management and mandated to researchers who are incentivised to fulfil a particular task
- Utilise what is freely available and then sell it to individuals who will drive it
- Often it is how you formulate your research problem that really matters
- Members of integrated research teams report to multiple people
- Integrated research projects straddle faculties but are required to belong to only one
- Students have to be registered in one faculty but are supervised across faculties
- There needs to be way of putting shared visions across faculties into the rulebook
- Integrated research projects do not follow a proper lifecycle – there is no closure
- Monthly meetings should be loose in organisation with everyone reporting so that you get a sense of synergy

- Integrated research should not be restricted to reaching across disciplines but also across institutional boundaries
- It is very difficult to keep integrated research alive – you need champions
- Integrated research projects need a joint, measurable objective
- Integrated research projects tend to comprise a handful of senior people and a large number of young, very motivated researchers
- We are always trying to enable the ambitious projects of younger researchers
- Management should give more support to integrated research
- Entities that conduct integrated research have project managers who can provide administrative support and create the glue
- The University is quite punitive if your student fails; if we are going into the integrated research space, then we have to be less punitive towards failure
- Management should be clearing the hurdles
- Management should not be deciding the structure because the structure has to be owned by the researchers
- Management is supportive and engages with requests
- Integrated research requires agreement from management but there is more chance of it happening if academics talk to each other rather than working through committees and deaneries
- You need high level agreement and then proposals from academics
- Administration systems are a big barrier, I spend hours going from office to office trying to get someone registered, trying to find out where the money is sitting
- People are very narrow in their focus, the trick is to provide the platform to bring narrow thinkers together
- The way the institution is able to configure and focus itself can be a constraint
- The UK invests heavily into large scale integrated research projects that are inter-institutional, bringing together the most capable to create scale and heft
- Schools and universities battle to work out what formulation will work for them
- There is no recognition for integrated research projects or basis for them to become known
- Bringing heads of schools together is a good way to launch a programme but then you need to institutionalise and mainstream
- Integrated research requires developing the institutional governance and engaging in the politics

4. Institutional Structures:

- The problem is structural more than lack of will – the traditional disciplinary organisational structure
- Interdisciplinarity comes from disciplinarity in the first place

- By emphasising the disciplines as the basis for interdisciplinarity, you are reemphasising the canon and then the canon can never change, but you run the risk of relativism – anything is ok at any time
- Postmodernism has pushed things so far that people would argue that discipline does not matter
- Discipline training is a very good thing
- Management systems reinforce silos because we manage process rather than the science
- Social science often critiques hard science
- Health Sciences is seldom innovative
- Everything has become more neoliberal and corporatized, and because science has an established relationship to capital, social science does not have a chance
- Institutional structures do not mirror the fact that real world problems require a combination of disciplines to produce an output that makes sense
- Everything in the academy is organised around you getting very deep in your discipline, being recognised for your discipline, publishing in your discipline and being rated in your discipline
- Change the structure so that there is space for both a disciplinarian and an integrated researcher
- Universities have had 1 000 years of being in silos
- Faculties do not talk to each other
- Universities are incredibly silo-based
- There are areas where small groups might make breakthroughs by sticking to disciplines
- Institutes and centres are important spaces because they are constantly hosting workshops and enabling a collaborative space
- We need a better articulation of what centres and institutes are for – they serve a completely different purpose to schools
- Centres create research foci and find projects for students

5. Collaboration:

- The success of integrated research teams is based on relationships
- Relationships are best built in a non-threatening environment where the stakes are low
- The lack of hierarchy at Wits makes people talk to each other
- Research stewardship can facilitate communication between researchers but sometimes it is better to just put them in a room
- How do you create a common vocabulary?
- Integrated research problems have to be conceptualised together rather than by calling in a specialist afterwards
- Schools respond to approaches with excuses about resource constraints
- It is not just hard science that is difficult to translate – legalise also has to be unravelled
- No dialogue between silos

- Engineering should be collaborative because you cannot build anything without four or five different types of engineers
- Jargon is a major barrier at the outset but it can be overcome
- People need a forum where they can hear about each other's research
- Wits needs to advertise ongoing research better
- Wits needs to advertise grants better
- It is important to find reviewers who understand the research approach and agree that it is research
- Integrated research involves the creation of a community
- There is a lot of integrated research happening at Wits but it involves external relationships that have to be built up over the years
- Partnerships with key players on the ground are important
- The IPR PFRD Act says that any IP that gets generated belongs to the University and that the University has an obligation to exploit it; when there is commercial drive, there is competition and an unwillingness to enter into partnerships; if you jointly develop IP who owns it?
- It is important to have regular discussions, transparency and a flat hierarchy
- We really try to explain to each other what is going on, we do not say that you cannot understand this because you are a chemist, because there is a common problem solving interest
- Collaboration forces a common language
- Everyone is interacting on equal terms and bringing an equal contribution
- The downside of collaboration is that the group is dependent on the weakest link
- Wits does not have the institutional flexibility that is required to create the internal collaborations that are needed to be strong in international partnerships
- The complexity of the institution means that efforts to establish integrative projects are not familiar to many people
- There are tribes within a university that have their own languages that make their disciplines inaccessible to people from different disciplines
- The University needs a person with some power who is tasked with enabling integrated research – they need to be able to phone someone and say you need to make time to see this person
- The people who know what everyone else does are usually senior people who do not need that information anymore, rather than the junior researchers who are looking for a research project
- The University needs a forum where people can get to know what the others are doing
- Communication can be an issue
- There has to be a pragmatic dividing of work between supervisors in an integrated research project
- The SA academy is not huge so we have conversations with other researchers all the time

6. Reward System:

- The institutional reward system does not favour integrated research
- There is no incentive to have postdocs between more than one school
- Wits has to introduce metrics for academics that are not on the publish or perish route
- If you change the structure of incentives, and equally incentivise integrated research, academics will follow
- SA system likes the showman and is very bad at picking out people who are good at collaborating
- The structures that reward science are archaic
- Academics at Wits are not opposed to integrated research but the system is not geared to reward us
- Commodified education
- Younger academics cannot afford to show their finger to the hierarchy because they will not get promoted

7. Review Mechanisms:

- The peer review mechanism does not work for integrated research
- Rating, staffing and promotions, and funding are done by peer review
- International colleagues have to be drawn on to help pass integrated PhDs
- Exemplary pieces of work which would get full support elsewhere in the world are turned down in South Africa
- There are no metrics for my work in my probation form – most of my reporting goes under “other services that you provide for the university”

8. Rating:

- The NRF says that if you publish broadly, you are committing academic suicide
- Ratings are awarded within disciplines
- The NRF does not know how to rate integrated researchers through so they get shunted from one committee to another and their ratings drop

9. Journals and Publishing:

- Journals are discipline specific
- There are thousands of journals in which to publish integrated research
- The pressure to publish is huge
- People should be released from the publish or perish paradigm
- It is important to publish because it gives the university legitimacy and enables it to serve as an interlocutor; that is the role of the academy – to give the university legitimacy in large, cross-boundary conversations

- The academy tells you to publish but there are no journals that take integrated research, unless it is tacked on as a poor cousin
- Journal editorial boards are made up of disciplinarians who do not value integrated research
- There need to be journals that are deliberately set up to publish integrated research and existing journals need to start accepting integrated research
- There are journals that are already integrated
- The impact factor of journals that publish integrated research is low
- Publish or perish

10. Funding:

- It is important to identify a funder that is amenable to cross-cuts, realises that cross-cuts do not necessarily lead to solutions, and allows the space to fail
- Administrative barrier: it is very difficult to move money across boundaries
- Talk-shops cost R20 000 and have potentially no reportable deliverables
- Start-up funding is always a problem
- If there is a demonstrable outcome, it is much easier to get funding
- Two groups working together have to share the same money, but you get funding in relation to your institutional location, and the NRF allocates more funding to science than the humanities
- Disciplinary research appeases funders because there is a quick return on investment, but it is usually a short term solution that serves a particular group of people
- The funding climate is very lean compared to 20 years ago and the current funding regimes discourage integrated research by requiring too much accountability
- You can only get resources for students if they are located within a particular department
- The NRF is the most important body for funding knowledge creation areas
- Most of our funding has been external
- Funding applications for integrated research are energy consuming and have a very low success rate
- No peer review panels to adjudicate funding proposals for integrated research
- Mostly we only fight over the budget
- Funders like integrated research
- International funding is very difficult to get
- People get caught up around who gets the FTEs and the finance so you need a model that is viable
- The NRF does not realise that wicked challenges cannot be solved with one siloed approach and the NRF is the main funder so many scientists are not brave enough to do integrated research
- It is not difficult to get funding because the tide is to take on the grand challenges