Building a New Specialisation of Integration and Implementation Sciences: Would System Dynamics Fit?

Abstract

The theory and methods of integration across disciplines and sectors and of implementation of research into practice need substantial development. I suggest they would benefit from becoming an academic specialization, analogous to statistics. Such a new specialization would draw on systems thinking, participatory methods, complexity science, diverse epistemologies, and inter- and trans-disciplinarity. I argue that understanding system dynamics would be a cornerstone of a new specialisation. The aim of this paper is to stimulate discussion both about such a specialisation and about the role of system dynamics in it.

An Overview of Integration and Implementation Sciences

Researchers, funders and research end-users are increasing appreciating that new research skills must be developed if human societies are to be more effective in tackling the complex problems that confront us. Researchers must collaborate and integrate across traditional boundaries both within and outside the research sphere, as well as become more involved in the implementation of their research in policy, product and action. There is now a critical mass of researchers who have been developing theory and methods to deal with complexity, uncertainty, change and imperfection in order to integrate across disciplines, 'knowledges', cultures, organisations, and between research and its implementation. The development of such theory and methods has been through their application in a diverse range of interdisciplinary problem-focused areas of national and global importance. However these efforts have typically been isolated, with application limited to specific fields, with low levels of intellectual cross-fertilization and learning, and with limited exploitation of the significant synergies between approaches. There is now growing acceptance of these methodologies in mainstream research and as increasing numbers of researchers are attracted to these approaches, there is considerable reinventing of the wheel.

The time is ripe for coalescence and co-ordination – for bringing these approaches together as a new specialisation of Integration and Implementation Sciences.

In essence the specialisation draws together five key theoretical and methodological strands – systems thinking, participatory methods, complexity science, diverse epistemologies, and inter- and trans-disciplinarity – as well as a host of undocumented methods, which have been developed to respond to specific problem-based needs. The vision is to bring together and provide a clear identity for a large and critical 'college' of peers.

Like statistics and epidemiology, the specialisation will advance through application to a diverse range of problems, so that collaboration with research teams that have advanced

content expertise is central. The contribution of Integration and Implementation Sciences will be to increase, and enhance the quality of, use of systems thinking, participatory methods, complexity science, diverse epistemologies, inter- and trans-disciplinarity and other integrative and implementation methodologies. These will complement, rather than replace, traditional disciplinary and specialist perspectives. Such research also involves the development of new partnerships with policy makers, business and civil society. Indeed finding ways to work with research end-users that accommodate respective interests and safeguard academic freedoms is an important challenge. New roles, such as boundary spanners and knowledge brokers, are being developed, and also need clarification and systematisation.

Collaborations between researchers with skills in Integration and Implementation Sciences, researchers with advanced content knowledge and research end-users (including those affected by the research) will enhance the ability to tackle complex social, environmental and technological problems, as well as improving the accessibility of Integration and Implementation Sciences approaches, approaches which are themselves considerably strengthened through the collaborations.

Why a New Specialisation?

Calls for New Approaches

Researchers, research funders, policy makers, business and civil society are grappling with how research can best meet pressing social, environmental and technological challenges.

A 1999 UNESCO report[1] stated:

> *… it must be recognized that the relationship between scientific research, education, technological innovation and practical benefits is much more diverse and complex today than in the past, and frequently involves many players other than researchers. The progress of science cannot be justified purely in terms of search for knowledge. In addition, it must be defended … through its relevance and effectiveness in addressing the needs and expectations of our societies.*

Similarly, in the context of sustainable development, Agenda 21, a key document generated at the 1992 Rio Earth Summit and being implemented world-wide, called for:

> *supporting new scientific research programs, including their socio-economic and human aspects, at the community, national, subregional, regional and global levels, to complement and encourage synergies between traditional and conventional scientific knowledge and practices and strengthening interdisciplinary research related to environmental degradation and rehabilitation* (Article 35.9[a] UNCED 1992[2])

The OECD[3] has also made a similar point about the knowledge-based economy:

> *The science system, essentially public research laboratories and institutes of higher education, carries out key functions in the knowledge-based economy, including knowledge production, transmission and transfer. But the OECD science system is facing the challenge of reconciling its traditional functions of producing new knowledge through basic research and [education] … with its newer role of collaborating with industry in the transfer of knowledge and technology.*

A recent report by Australia's Chief Scientist[4] stated that

> *Integrating the innovation system across all points can increase the chance of generating more products and processes that enhance our lifestyle. The innovation system is dependent on strong links between all players, government, industry and research performers.*

and further:

> *By and large, our competitors and economic partners are adopting different combinations of integrated measures to strengthen their capacity to innovate. Although the pace of progress across these countries fluctuates, they are constant in their drive towards knowledge-based economies.*

Gibbons, Nowotny and colleagues[5] have called for recognition of "Mode 2" knowledge production. Here problems are defined in the context of application rather than a disciplinary framework, the focus is on developing a transdisciplinary approach, the research is carried out by heterogenous non-hierarchical groups that come together transiently and that are based outside universities, the researchers interact with the relevant social actors to ensure a greater degree of social accountability, and quality is judged by a wider range of criteria, using reflexive processes. Mode 2 knowledge production challenges the traditional role of universities.

Other analyses have reflected on the essential elements of universities that must be protected in this era of change. A collection of essays by Australian academics on "Why Universities Matter"[6] focuses particularly on values and ideals of university life and work. In the US context, Bok[7] focuses particularly on pressures on universities to commercialise, examines what universities can learn from business, and cautions against activities that can undermine or distort the foundations of academic work.

Examples of Issues where the Key Deficiency is Lack of Integration and Implementation

All of these initiatives are responses to the growing appreciation that a major deficiency in the ability to tackle key national and global problems lies in the inability to amalgamate knowledge created by different disciplines with the experience of key actors

and interest groups and then to effectively use that knowledge to bring about social improvement.

For example there are 10 risks described in the 2002 World Health Report[8] which account for one-third of premature deaths world-wide. These are risks for which proven cost-effective interventions are available. But human society seems unable to implement integrated solutions in a wide-spread, large-scale and coherent manner.

Despite some successes, in many areas concerned with sustainability, such as global climate change and biodiversity loss, research evidence and consensus among leading researchers about recommended actions has had little impact on government policy, business practice or the actions of local communities in either rich or impoverished countries[9].

Many factors contribute to the inability to implement integrated interventions, including:

- disciplinary, intra- and inter-organisational, and sectoral silos, reinforced by dominant institutional structures, assumptions and reward systems,
- marginalisation and fragmentation of successful research approaches,
- lack of system-wide reflection on and learning from case studies,
- inability to "scale-up" successful small scale interventions, and
- lack of recognition that barriers to integrated implementation are amenable to research. Too often these barriers are greeted with resigned frustration and a view that that they are too hard politically, too sensitive culturally and too intransigent on an individual level.

The examples above show that the calls for improved integration and implementation are widespread and diverse. Nevertheless, while they broadly run along the same themes, the calls do not cohere into a single, easily definable problem or solution. One of the tasks for Integration and Implementation Sciences will be to define the similarities and differences across this range of contexts, and so build a more robust, sophisticated and subtle approach to these issues.

Marginalisation of the Existing Critical Mass of Researchers

As I outline below, there are increasing numbers of researchers developing skills in integration and implementation. But while it can be argued that there is the critical mass of researchers to provide the foundation for a new specialisation, the field is far from cohesive. Instead, the field is characterised by:

- relatively small research groups operating in limited networks, many outside formal academic institutions. Those operating inside Universities tend to be independent centres or an uncomfortable fit within a larger department.

- multiple small professional associations[10], which conduct relatively small-scale conferences and which have few links with each other. Unlike the annual conferences of many of the established disciplines and specialisations, which have

20,000 or so participants, attendance at these conferences is likely to be of the order of 500 people. The point is not that large conferences are necessarily better, but that the "college" represented is substantially larger in the established academic areas.

- no well-established high-impact journals. Although there is a growing number of journals[11], many are newly established and some are only being published sporadically.

- an orientation to consultancy work, which is in high demand from government agencies, business, and other practitioners.

- an enthusiastic undergraduate and postgraduate student body, which faces very limited career opportunities within universities.

- no clearly defined curriculum and no clearly defined relationship with established disciplines and specialisations. There is teaching in both undergraduate and graduate areas, but the development of curriculum is somewhat idiosyncratic, with no agreement on core curriculum elements or on standards or accreditation. There are no standard textbooks. There are also different views about whether students should be required to have a solid education in a discipline before being educated in Integration and Implementation Sciences.

- no unifying name or mission. While some areas that are embraced by Integration and Implementation Sciences seek cohesiveness through associations such as the International Society for the Systems Sciences and Action Learning, Action Research and Process Management, there is little overlap, even though there are many important synergies.

Marginalisation has many consequences for the field. The preponderance of small groups that are not well networked leads to considerable duplication and reinventing of the wheel. Productive cross-fertilisation of ideas is limited, which in turn means that the field does not reach its potential in terms of progress. The practical demand for the approaches encompassed under Integration and Implementation Sciences by policy makers, business, and other practitioners and the associated emphasis on consulting, often leaves little time for reflection, let alone for theory and methodology building.

Multiple groups of small size have costs associated with lack of economies of scale. For example, such groups often have no administrative support, with a disproportionate extra load on research and teaching staff. A disproportionate amount of effort may also have to go into fund raising, especially for self-funded groups either inside or outside the academy. In time the enthusiasm and energy of staff is ground down, limiting opportunities for networking, let alone innovation.

All this can also contribute to low standing within the academy and a perception that the field lacks rigour and attracts only low quality staff and students. This perception is

exacerbated by the lack of high impact journals and the other accoutrements of established disciplines and specialisations.

Even so, there are costs to developing a specialisation. The current diffuse networks have the benefit of inclusivity, and there will certainly be debate and dispute about the boundaries and mission of the new specialisation. But the debates can be structured to help sharpen thinking and to develop a greater sense of collegiality among researchers who are now only dimly aware of each other.

What Does Integration and Implementation Sciences Cover?

Two of the defining characteristics of Integration and Implementation Sciences are firm rooting in practical application and the centrality of collaboration. Individuals can make only limited progress in isolation.

Further, Integration and Implementation Sciences have a broad reach in the theory, methods and problems engaged. The approaches used in Integration and Implementation Sciences aim to provide more effective ways of tackling complexity, uncertainty, change and imperfection. These approaches build on systems thinking, participatory methods, complexity science, diverse epistemologies, inter- and trans- disciplinarity, and a host of undocumented methods, which integrate across disciplines, 'knowledges', cultures, organisations, and between research and its implementation in policy, products and practice.

Complexity, Uncertainty, Change and Imperfection

Complexity has many dimensions, including an extensive array of factors, with both linear and nonlinear connections and interdependencies and a range of relevant political, cultural, disciplinary and sectoral perspectives. In addition, geographical and temporal scales can be huge.

A necessary adjunct to complexity is **uncertainty**. In dealing with any complex problem, there will always be many unknowns, including about 'facts', causal and associative relationships, and effective interventions. Some unknowns result from resource limitations on research; some result from methodological limitations; and some things are simply unknowable.

The unknowns are compounded by constant **change**; change occurring on many fronts including biological evolution (eg the development of new communicable diseases), scientific, technological and economic developments, in international relations and manifold intended and unintended consequences of local, national and international policy and programs.

Perfect knowledge and solutions are impossible. **Imperfection** too has many dimensions. Dealing with complexity involves setting boundaries to the approach taken and where boundaries are set is crucial in determining what is included, excluded and

marginalised. Uncertainty and change also necessarily lead to imperfection. Further, social issues are deeply contextualised so that an excellent solution in one person's eyes is anathema to another.

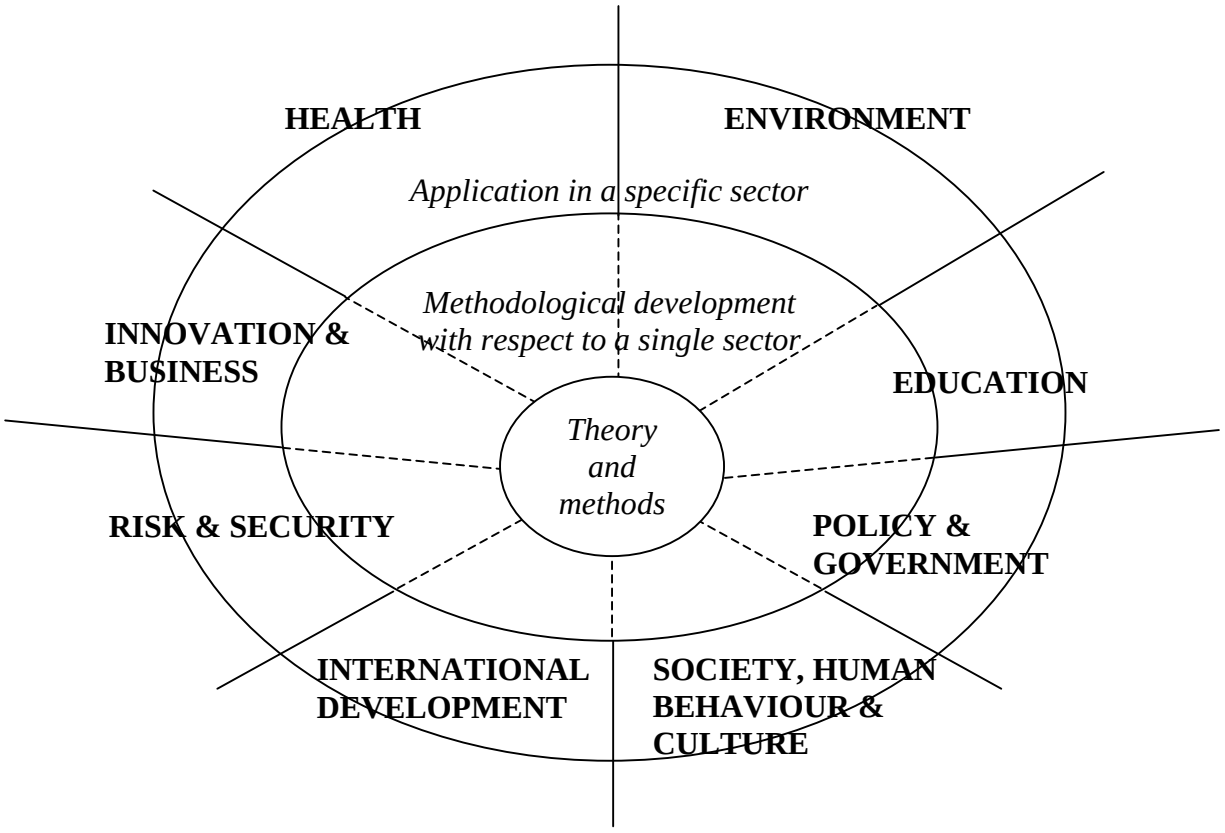
Where Would Integration and Implementation Sciences Sit in Universities?

Like statistics and epidemiology, the theory and methods of Integration and Implementation Sciences are developed through engagement with practical problems. However, unlike these disciplines, there is no home base to which breakthroughs can be reported and where they can be critically assessed. The development of the specialisation of Integration and Implementation Sciences is a way of establishing such a home base.

The lack of a home base also means that those engaged in Integration and Implementation Sciences lack a unifying identity. As a consequence, researchers mainly identify either through their area of application eg as human ecologists, environmental scientists or management specialists or through a key approach or method such as action researcher or systems dynamics specialist.

Identity as a specialist in Integration and Implementation Sciences complements, rather than replaces, these existing identities. The difference that a specialisation will make is that specialists in Integration and Implementation Sciences will be able to identify with a broader cadre of researchers and develop better rounded skill sets. For example, while there is considerable overlap in their modes of operation between researchers using soft systems methods and action researchers, there is little cross-over between these groups in terms of university coursework, professional associations or even research collaboration. Soft systems researchers often have very polished systems methods, but under-developed participatory skills, with the opposite holding for action researchers. Bringing these two groups together under a unifying umbrella will increase the chances that both will bring a more highly developed set of theory and methods to bear on the problems they deal with.

The figure below[12] illustrates the relationship between the home base (the central circle labelled 'Theory and Methods') and the key sectors in which Integration and Implementation Sciences are applied and developed. Some researchers will work predominantly in the home base, focussing on the development of theory and methods in Integration and Implementation Sciences and applying them to a broad range of problems. Some researchers (second circle) will build detailed knowledge of a single sector, such as environment or international development and will use this as the basis for the development of Integration and Implementation Sciences theory and methods. A third group of researchers will be less interested in the development of theory and methods, but will focus much more on their application (outside circle).



A specialisation will also provide a one-stop shop for researchers newly seeking access to integration and implementation skills. As appreciation of the need for these skills grows, more and more researchers are seeking to acquire them. Where new researchers gain a foothold currently tends to be arbitrary, as it is extremely difficult to acquire a comprehensive overview of the Integration and Implementation Sciences field, existing knowledge and key players. Thus researchers new to the area often spend considerable time searching for resources and key contacts and their early work often involves significant reinventing of the wheel.

The same holds for policy makers and other practitioners seeking to link with researchers with Integration and Implementation Sciences skills. There is nowhere for such practitioners to go to receive an overview of what Integration and Implementation Sciences can offer and to match needs with available approaches. If practitioners approach universities or other public good research organisations, the aspect of Integration and Implementation Sciences they link with, and whether they indeed manage to link with any form of Integration and Implementation Sciences, is largely a matter of chance. Outside universities, there are now a large number of commercial, consultant-based packages available, but most are limited in the approaches they offer and there are no mechanisms for quality control.

This last sentence is not intended as a criticism of consultants practising approaches that are part of Integration and Implementation Sciences. Indeed they have largely been responsible for the development of this field. Many have left universities to set up their own businesses because this has given them more freedom to undertake the practice-based research they care about. Further, researchers who survive in universities and other research organisations are often required to be wholly or partially self-funded, often through consultancy work. Commercially-based researchers are not in a position to develop colleges of critical peers, overarching associations, robust and comprehensive theoretical and methodological bases, or curricula for undergraduate and postgraduate education, in other words to develop a specialisation. That is the role of universities. Thus the development of a specialisation will also provide a solid underpinning for commercial consultancy practice, a place where consultants can learn new or update existing skills and where they can feed back lessons from their practice-based experience to invigorate and progress the development of theory and methods[13].

Statistics as a Useful Analogy

So far, I have dealt with the importance of a home base for Integration and Implementation Sciences. Here I will expand on this idea, using analogies between statistics and Integration and Implementation Sciences.

Statistics is embedded in the academy at three levels. First there are home-base departments where theory and methods of statistics are developed and advanced. Second, other significant academic departments incorporate statistical training into their core curriculum and have at least some staff with a strong statistical bent. For example, disciplines like biology, psychology, sociology and geography provide core training in statistics, particularly as relevant to the discipline, and have staff and research programs with a strong quantitative orientation. In addition, multidisciplinary departments such as public health often employ statisticians who are willing to work on public health problems. Third, there is an expectation that a large proportion of staff and students throughout the academy will have a basic level of statistical competence.

Like statistics, some elements of Integration and Implementation Sciences are already embedded in other significant academic areas. For example, many departments and centres dealing with environmental issues incorporate integrated assessment, other systems approaches and participatory approaches in their teaching and research. Public health departments often have a strong orientation to participation and implementation. However the incorporation of Integration and Implementation Sciences is largely idiosyncratic and there is generally little interaction between departments with different content area expertise about core or best methods. Some approaches that are key elements of Integration and Implementation Sciences have become standard in some established academic areas. For example, most law schools now include principled negotiation (alternative dispute resolution) in their teaching, if not research.

As I have already pointed out, unlike statistics, Integration and Implementation Sciences has no home base or shared understanding of what this area encompasses. There is also not the same level of individual competence among researchers in Integration and

Implementation Sciences as there is in statistics. While many staff and students throughout the academy have basic competencies, such as building trust, thinking laterally, and seeing interconnections (and some have very advanced competencies), these tend to be seen as personal attributes rather than academic skills. Furthermore, staff and students tend to be left to their own devices in the development of these competencies.

Certainly, the building blocks for a solid home base for Integration and Implementation Sciences exist and establishing home base departments would have positive spin-offs for established disciplines and specialisations and for individual staff and students.

Statistics provides another useful analogy, namely the comfortable co-existence of diversity in statistics where some statisticians are trained predominantly in statistics and work on a variety of problems, while others have training in statistics and another discipline and work largely on a particular set of problems. It is easily conceivable that some of those trained in Integration and Implementation Sciences would work on a wide range of problems, while others would work in more depth in areas such as environmental sciences and public health.

The relationship between Integration and Implementation Sciences and traditional disciplines might be somewhat different, however, from the relationship of statistics and other traditional disciplines. Those trained in Integration and Implementation Sciences plus a traditional discipline might be expected to focus particularly on bringing that disciplinary perspective to the understanding of a complex problem rather than (or in addition to) advancing the discipline. Certainly, a key task of Integration and Implementation Sciences is to harness and build on disciplinary strengths. The disciplines have developed and continue to develop a wealth of theoretical, methodological and content knowledge. Further, the disciplines themselves recognise the importance of developing effective ways to draw together the strengths of a range of disciplines.

Statistics does not, however, provide a complete analogy. Statistics is obviously a well-developed and defined academic area. There are a range of widely adopted standard techniques and an array of known challenges which stimulate on-going research. Integration and Implementation Sciences is poorly defined, with no widespread agreement about what the field does and does not encompass. As outlined above, some methods, such as principled negotiation, are relatively well defined and accepted, while others are idiosyncratically developed and applied. Even without a clear framework, however, the scope of Integration and Implementation Sciences is likely to be considerably broader than that of statistics. Further, it seems unlikely that one core concept will lie at the heart of Integration and Implementation Sciences, in the same way that probability forms the nucleus for statistics. This is where the real developmental challenges for Integration and Implementation Sciences lie.

Challenges to Developing a Specialisation

There are a number of key challenges in developing a specialisation of Integration and Implementation Sciences, including:

- achieving agreement on whether a specialisation is appropriate, likely to achieve the desired outcomes, and worth the down-sides
- constructing a coherent specialisation from disparate 'bits', many of which now have their own traditions. Some 'bits', like participatory methods and principled negotiation techniques can potentially be fully encompassed within the new specialisation. Others, such as the mathematical development of complexity science, for example, fit more comfortably within an existing discipline and might not sit well in the new specialisation. Redrawing boundaries, and possibly also reallocating resources, are important components of this challenge
- getting this specialisation accepted and implemented, both by those inside and outside the specialisation. Within the specialisation, challenges include that some may not want to refocus their identity and allegiances. Others may have identified a niche in which they are doing well and may either not see the need for, or be too overcommitted to contribute to, a larger enterprise. Those outside the specialisation may oppose it because they fear losing resources or because they see Integration and Implementation Sciences to be about personal skills rather than academic theory, method and application
- developing appropriate intellectual interfaces with traditional disciplines and newer multidisciplinary specialisations (such as environment studies or peace studies)
- overcoming unevenness in the development and application of approaches. For example, many of the components of Integration and Implementation Sciences are most developed in the environmental area, so that consideration needs to be given not only to further enhancing the skills that have been developed in the environmental area but also to diffusing them into other areas[14].
- uniting the diverse core areas of Integration and Implementation Sciences may be difficult as they have different status, require different skills and often attract different personalities. The challenge of uniting model building and facilitation methods is an example.
- finding suitable locations within universities for Integration and Implementation Sciences - locations where there is a sense of fit and where the specialisation will prosper. This needs to be an exciting and rewarding area for research and teaching, in order to continue to attract good people.

Examples of Integration and Implementation Sciences in Action

The examples below provide snapshots of the research Integration and Implementation Sciences covers[15].

> *Bringing together slum-dweller organizations, NGOs, researchers, urban planners, and housing authorities in multi-stakeholder data-*

collection and planning processes that developed sustainable, "win-win" solutions to slum resettlement in Mumbai city[16]
Providing decision support to policy makers through models which incorporate stakeholder input accessed through participatory methods. Such Integrated Assessment has been used to address the impacts of global environmental changes on vector-borne disease, like malaria, globally, as well as for specific locations like Kisumu in Kenya[17]

Assisting in creating partnerships between relevant agencies to tackle health problems in developing countries, for example, between a private foundation and a pharmaceutical company to donate drugs for the treatment of trachoma and between health, transport, police and other agencies to tackle road traffic crashes[18]

Developing a process of co-mentoring for partnerships between respected Australian Indigenous community members and non-Indigenous researchers which has been successfully used to improve services for older Indigenous people[19]
Using transdisciplinary thinking to analyze complex historical and contemporary forces shaping the epidemic of heart disease in the Australian coalfields and to select points of critical leverage for community interventions[20]
Using participatory, structured, multivariate Concept Mapping methodology to help networks of public health practitioners and organizations conceptualize and address a wide array of health issues including HIV/AIDS, cervical cancer, end of life concerns, and lower prevalence chronic health conditions[21]

The theoretical and methodological skills an Integration and Implementation Sciences specialist brings to bear address the following practical issues:

- Scoping the problem, ensuring multi-disciplinary and multi-sector involvement, and making clear where the boundaries around the problem have been set and the implications of those decisions for inclusion, exclusion and marginalisation of stakeholder groups.
- Integrative functions, ensuring that different conceptualisations of integration are made apparent and that those most appropriate for the project in hand are chosen.
- Collaborative functions, ensuring that appropriate researchers and sectoral representatives are included, that their world-views are made explicit, that their interests are accommodated, that different strengths are harnessed, that communication mechanisms are strong, and that conflicts are appropriately mediated.
- Practical application, including transformation into policy or action, ensuring that those who can implement the research are part of the research process or kept closely in touch with it and that the political aspects of the research are dealt with.

Next Steps

For the specialisation of Integration and Implementation Sciences the reach its potential, considerable developmental work is required and many of the outstanding challenges have been presented earlier. The challenges are both intellectual and practical and essentially fall into three areas:

- strengthening the intellectual base of Integration and Implementation Sciences,
- promoting networking and collaboration between researchers and practitioners interested in Integration and Implementation Sciences, and
- embedding Integration and Implementation Sciences in universities[22] and in funding programs.

Conclusion

Integration and Implementation Sciences are critical for "integration", "policy relevance", "evidence-based practice", and "innovation", which are key concepts now driving research. The challenges are substantial, but the critical mass of researchers and approaches means that rapid development is possible. This promises intellectual excitement and fulfillment, as well as effective practical outcomes in tackling the complex social, environmental and technological issues human societies confront.

There is a growing network of researchers and practitioners interested in integration and Implementation Sciences. We invite you to join us.

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[2] UNCED 1992. *Agenda 21*. Online source. URL: http://www.un.org/esa/sustdev/agenda21text.htm
[3] OECD (1996) *The knowledge-based economy*, Organization for Economic Co-operation and Development, Paris, pp. 46; quotation from *p. 7*.
[4] Batterham, R. (2000) *The chance to change: final report by the Chief Scientist*, Commonwealth of Australia, Canberra; quotations from p 11and 41
[5] Gibbons, M., C. Limoges, H. Nowotny, S. Schwartzman, P. Scott and M. Trow (1994). The new production of knowledge. The dynamics of science and research in contemporary societies. London; Thousand Oaks, California; New Delhi, Sage; Nowotny, H., P. Scott and M. Gibbons (2001). Re-thinking science. Knowledge and the public in an age of uncertainty. Cambridge, Polity Press in association with Blackwell Publishers.
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[8] World Health Organisation (2002) World Health Report 2002. Reducing risks, Promoting healthy life. http://www.who.int/whr
[9] Board on Sustainable Development Policy Division National Research Council (1999) Our common journey: a transition toward sustainability, National Academy Press, Washington, D.C.; Cash, DW; Clark,

WC, Alcock, F; Dickson, NM; Eckley, N; Guston DH; Jaeger, J; Mitchell, RB; 2003 'Knowledge systems for sustainable development' Proceedings of the National Academy of Sciences, 100: 8086-8091.

[10] Professional associations which could be said to cover significant approaches in Integration and Implementation Sciences include the Association for Integrative Studies; the System Dynamics Society; the Society for Human Ecology; the International Society for Ecosystem Health; Action Learning, Action Research and Process Management; the Society for Values in Higher Education; Council on Health Research for Development; and the International Association for Conflict Management.

[11] These include Issues in Integrative Studies, Systems Research and Behavioural Science, Ecosystem Health, Public Administration, Global Change and Human Health, Action Research, and Integrated Assessment.

[12] The figure was developed by Lorrae van Kerkhoff.

[13] Given that consultants rely on the methods and other intellectual property they develop to make their living, incorporating these into the academy will also be a challenge.

[14] See, for example, the literature on sustainability science, eg Clark, WC and NM Dickson 2003 "Sustainability science: the emerging research program" Proceedings of the National Academy of Science, 100: 8059-8061

[15] More information about researchers and their projects can be found at http://www.anu.edu.au/iisn. Bear in mind that this represents only a fraction of researchers involved in Integration and Implementation Sciences.

[16] Batliwala, S. 2003 Bridging divides for social change: practice-research interactions in South Asia. Organization 10: 595-615; also www.sparcindia.org

[17] Martens, P. et al. (1999) Climate change and future populations at risk of malaria. Global Environmental Change, S9, 89-107

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[19] Dance, P.; Brown, R.; Bammer, G.; Sibthorpe, B. 2000 Needs for Residential Aged Care and Other Services by the Older Indigenous Population in the ACT and Region. Report for the ACT Office of the Commonwealth Department of Health and Aged Care

[20] Higginbotham, N., G. Albrecht and L. Connor, 2001. Health Social Science. A transdisciplinary and complexity perspective. Melbourne, Oxford University Press

[21] Trochim, W. (1989). An introduction to concept mapping for planning and evaluation. In W. Trochim (ed) A special issue of Evaluation and Program Planning, 12, 1-16
http://trochim.human.cornell.edu/research/epp1/epp1.htm Accessed 30 May 2003.

[22] An established academic specialisation can offer:

- a more clearly defined scope for Integration and Implementation Sciences and complementarities with existing disciplines and specialisations
- a more robust theoretical base which will be a well-spring of innovation
- a large and critical 'college' of peers to evaluate current and future research and practice.

These allow for both the cross-fertilisation of ideas and advancement of knowledge, as well as opportunities for quality control. Care must be taken to ensure that the specialisation does not become too narrowly defined and lose its richness and that it does not develop in a lop-sided way, for example, that mathematical modelling takes precedence over participatory techniques. Developing the specialisation includes:

- finding a location in the academy conducive to growth and the development of the ideas underpinning Integration and Implementation Sciences
- developing both undergraduate and graduate curriculum
- producing textbooks and systematic reflections on case studies
- building an overarching professional association and encouraging interlinkage between smaller existing professional associations
- building up top-ranking peer-review journals.

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