

6. Integration and Implementation Sciences: Building a New Specialisation

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Abstract

Developing a new specialisation—Integration and Implementation Sciences—may be an effective way to draw together and significantly strengthen the theory and methods necessary to tackle complex societal issues and problems. It would place complexity science in broader context and link it to a range of complementary concepts and skills. This chapter presents an argument for such a specialisation. It outlines three sets of characteristics which will delineate Integration and Implementation Sciences. First, the specialisation will aim to find better ways to deal with the defining elements of many current societal issues and problems, namely complexity, uncertainty, change and imperfection. Second, there will be three theoretical and methodological pillars for doing this: systems thinking and complexity science; participatory methods; and knowledge management, exchange and implementation. Third, operationally, Integration and Implementation Sciences will be grounded in practical application and generally involve large-scale collaboration. The chapter concludes by examining where Integration and Implementation Sciences would sit in universities and outlining a program for the further development of the field.

Introduction

Researchers, funders and research end-users are increasingly appreciating that new research skills must be developed if human societies are to be more effective in tackling the complex problems that confront us and in sustaining the sort of world we wish to live in. Researchers must collaborate and integrate across traditional boundaries. They must bring together academic disciplines, as well as becoming more involved in the implementation of research in policy, product and action.

There is now a critical mass of researchers who have turned their efforts to meeting these challenges. By working on real-world problems they have made theoretical and methodological advances to help deal with complexity, uncertainty, change and imperfection—the primary characteristics of the vital issues modern societies face. Developments have occurred in research on the environment, public health, business and management, national security, and other applied topics, but have typically been isolated, with little interaction and communication across these areas. There have been only low levels of intellectual

cross-fertilisation and learning, and limited exploitation of the significant synergies between approaches.

Mainstream research is progressively starting to embrace these new investigative imperatives, but is even more poorly connected to existing knowledge. This has led to considerable duplication of effort, reinventing, usually at less sophisticated levels, methods and frameworks that already exist.

The time is ripe for coalescence and co-ordination. An effective and efficient mechanism is to develop a new specialisation—Integration and Implementation Sciences. This involves bringing together and providing a clear identity and accepted place for a large college of peers, who can be both supportive and critical.

The vision for Integration and Implementation Sciences is to provide solid theoretical and methodological foundations to allow complex societal issues to be systematically addressed using evidence-based approaches. The three pillars are:

- systems thinking and complexity science, which orient us to looking at the whole and its relationship to the parts of an issue;
- participatory methods, which recognise that all the stakeholders have a contribution to make in understanding and, often, decision making about an issue; and
- knowledge management, exchange and implementation, which involves appreciating that there are many forms of knowledge and ways of knowing (diverse epistemologies), provides enhanced methods for accessing knowledge realising that both volume and diversity are current barriers, and involves developing better understanding of how action occurs, in other words, how policy is made, how business operates, how activism succeeds, and how action is and can be influenced by evidence.

Like statistics and epidemiology, the specialisation will advance through application to a diverse range of problems. Similarly, Integration and Implementation scientists will not necessarily have content expertise. Their work will complement, rather than replace, traditional disciplinary and specialist perspectives. Collaboration is therefore central to how Integration and Implementation Sciences operates. What Integration and Implementation scientists can contribute to these partnerships includes:

- enhanced skills in scoping problems and issues, 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;

- enhanced ways of thinking about integration and a range of integrative tools, including specific skills in systems-based modelling and participatory approaches;
- alternative conceptualisations of the research process, which may lead to different and innovative research approaches and the development of hybrid epistemologies;
- re-aggregation of knowledge and understanding that has been developed in separate disciplines and practice arenas;
- enhanced ability to identify and understand emergent properties, i.e., properties that disappear when a system is studied in disaggregated segments;
- enhanced understanding of policy, product development and action, and how these can be influenced by research;
- bridging between research and practice by helping develop new roles, such as boundary spanners and knowledge brokers;
- enhanced knowledge management and knowledge implementation tools;
- expanded ways of taking uncertainty into account and of managing less than perfect outcomes;
- expanded ways of encompassing change in both research and practice; and
- enhanced appreciation of how to improve collaborative processes in research, including 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.

No Integration and Implementation scientist will be expert in all of these skills. However, they will have a broad framework of knowledge encompassing all these aspects and deep knowledge of some of them. They will be able to bring in colleagues to fill skill gaps. And they will be able to recognise when leading edge theory and methods are being used, when breakthroughs in thinking have been made, and when wheels are being reinvented. This is identical to how other specialisations and disciplines operate.

This chapter aims to present a broad sweep of ideas about a new specialisation. I focus on the practicalities of what the new specialisation would involve and how it would fit structurally, rather than building the case for its need, or linking the arguments to the extensive discourse on the philosophy of science, the long-standing debate about the role of scholarship and universities in society, or discussions about the future of science. Readers interested in these more philosophical issues can refer to works on critical realism (for example, Mingers 2000), post-normal science (for example, Funtowicz and Ravetz 1993), and consilience (Costanza 2003; Wilson 1998), as well as seminal works by authors such as Kuhn (1970), Ravetz (1996) and Gibbons, Nowotny and colleagues (Gibbons et al. 1994; Nowotny et al. 2001). Further, I do not cite the extensive literature

underpinning each of the areas covered here. My aim is not to write a definitive treatise, but to spark discussion and stimulate action to build stronger links between the core methodologies and to embed them more firmly in academic structures.

Defining key elements of the social issues

I propose four key elements for the sorts of issues Integration and Implementation Sciences are designed to tackle.

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. Geographical and temporal scales can be huge. An important dimension of complexity is identifying and understanding emergence.

A necessary adjunct to complexity is *uncertainty*. In dealing with any complex issue or problem, there will always be many unknowns, including facts, causal and associative relationships, and effective interventions. Some unknowns result from resource limitations on research and some result from methodological limitations, while some things are simply unknowable. There are epistemological, ethical, organisational and functional aspects to dealing with uncertainty, ignorance and risk.

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

Perfect knowledge and solutions are impossible. *Imperfection* also has many dimensions. Dealing with complexity involves setting boundaries to the approach we take, and where we set boundaries is crucial in determining what is included, excluded and marginalised. Uncertainty and change also necessarily lead to imperfection. Further, social issues are deeply contextualised: an excellent solution in one person's eyes is anathema to another.

Theoretical and methodological pillars

The key theoretical and methodological foundations to Integration and Implementation Sciences are:

- systems thinking and complexity science;
- participatory methods; and
- knowledge management, exchange and implementation.

These provide a range of conceptual and methodological tools for dealing with complexity, uncertainty, change and imperfection, including modelling, decision and risk analyses, deliberative democracy processes, and principled negotiation processes. All are areas where considerable research has already been undertaken, but where the current situation is characterised by fragmentation and marginalisation.

Systems thinking and complexity science

While both systems thinking and complexity science concern themselves with looking at wholes, they encompass several schools of thought, which are noted for their indifference—at best—and—at worst—animosity to each other. There is not only a gulf between systems thinking and complexity science, but also within different branches of systems thinking. A major challenge would still seem to be to develop key overarching theoretical concepts that throw the commonalities and differences into sharper relief.

Participatory methods

The importance of participatory methods is based on recognition that the various stakeholders think differently about the same issue, and that exploring, sharing and synthesizing these different understandings enriches our knowledge about an issue. It can often trigger a new way to look at and contend with an issue. In addition, for some issues, an appropriate way of dealing with uncertainty and imperfection is to give the stakeholders a more direct role in making decisions.

Knowledge management, exchange and implementation

Knowledge management, exchange and implementation is a way of characterising a number of interrelated issues:

- It is a way of appreciating that there are many forms of knowledge and ways of knowing. These diverse epistemologies are important in three key ways: assisting researchers and practitioners to understand each other; appreciating that there are a number of ways in which research can be undertaken; and facilitating research that crosses disciplines.
- It provides enhanced methods for accessing knowledge. Researchers and practitioners are both confronted by and contribute to an information glut; the sheer volume of information makes it difficult to navigate. Information science is tackling this issue, for example, by improving cataloguing and search methods. These difficulties are compounded by the diversity in forms of knowledge.
- It is a way of developing better understanding of how action occurs, in other words, how policy is made, how business operates, and how activism

succeeds. This is particularly relevant to Integration and Implementation Sciences in terms of how action is and can be influenced by evidence.

Grounding in practical collaboration

The third, operational aspect of Integration and Implementation Sciences is that it has a firm footing in practical application and generally involves large-scale collaboration. As outlined above, this makes Integration and Implementation Sciences similar to disciplines such as statistics and epidemiology. The analogy with statistics, in particular, is drawn out further in examination of where this new specialisation fits in universities.

Where would Integration and Implementation Sciences sit in universities?

Although the theory and methods of Integration and Implementation Sciences are developed through engagement with practical problems, there is no home base to which breakthroughs can be reported and where they can be critically assessed. This is an important difference from disciplines such as statistics, in which such home departments play a critical role. The development of the specialisation of Integration and Implementation Sciences is a way of establishing such a home base.

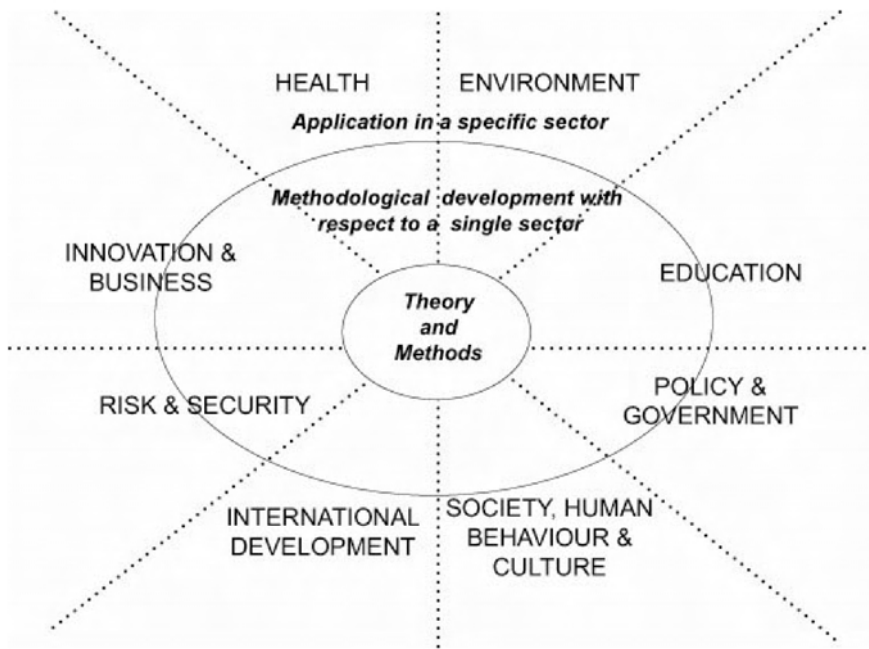
The lack of a specialist or disciplinary core also means that those engaged in Integration and Implementation Sciences lack a unifying identity. As a consequence, researchers mainly characterise themselves either through their area of application (for example, as human ecologists, environmental scientists or management specialists); or through a key approach or method (such as action researcher or system 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 more rounded skill sets. For example, while there is considerable overlap in the modes of operation of researchers using soft systems methods and action researchers, there is little crossover 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 would increase the chances that both would bring a more highly developed set of theory and methods to bear on the problems they deal with.

Figure 6.1 illustrates the relationship between the home base (the central circle) and the key sectors in which Integration and Implementation Sciences are applied

and developed. Some researchers will work predominantly in the home base, focusing 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 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).

Figure 6.1. The relationship between the home base and the key sectors for Integration and Implementation Sciences



A specialisation will also provide a one-stop shop for researchers seeking access to integration and implementation skills. This will meet a growing demand, as appreciation of the need for these skills increases. Where new researchers gain a foothold currently tends to be arbitrary, as it is extremely difficult to obtain 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 duplication of existing knowledge.

The same holds for policy makers and other practitioners seeking to link with researchers with Integration and Implementation Sciences skills. There is nowhere

for them to go to receive an overview of what Integration and Implementation Sciences can offer and to match needs with available approaches. If practitioners contact 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 point 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, they are not in a position 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 skills, or update existing ones, and where they can feed back lessons from their practice-based experience to invigorate and progress the development of theory and methods. 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.

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 such as biology, psychology, sociology and geography provide core training in statistics, particularly as it is relevant to the discipline involved, 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 certain 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. Nor is there 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 abilities), 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 such expertise. 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, as well as for individual staff and students.

Statistics provides another useful analogy, namely the comfortable co-existence of diversity. 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 in a particular area—for example, health. 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 or security.

The relationship between Integration and Implementation Sciences and traditional disciplines might be somewhat different from the relationship of statistics and other traditional disciplines. Those trained in Integration and Implementation Sciences and 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 elaborate

a wealth of theoretical, methodological and content knowledge. Further, the disciplines themselves recognise the importance of building effective ways to draw together their individual strengths. There may be a case here for reinvigorating multi-disciplinary as well as inter- and trans-disciplinary approaches, with a particular focus on different methods for integrating diverse discipline-based knowledge and methods.

Statistics does not, however, provide a complete analogy. Statistics is obviously a well-developed and defined academic area, with a solid mathematical core. There are a range of widely adopted standard techniques and an array of known challenges which stimulate ongoing research. Integration and Implementation Sciences is poorly defined, with no widespread agreement about what the field does or 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, the scope of Integration and Implementation Sciences is likely to be considerably broader than that of statistics. 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 in developing a new 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 downsides;
- constructing a coherent specialisation from disparate *bits*, many of which now have their own traditions. Some *bits*, such as participatory methods, principled negotiation techniques and information science, can potentially be fully encompassed within the new specialisation. Others, such as the mathematical development of complexity science, for example, may fit more comfortably within an existing discipline and might not sit well in the new specialisation. Redrawing boundaries and possibly reallocating resources are important components of this challenge;
- getting this specialisation accepted and implemented by those inside and outside the specialisation. Within the specialisation, challenges include the fact 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 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 as being 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 (Clark and Dickson 2003);
- uniting the diverse core areas of Integration and Implementation Sciences may be extremely difficult as they have different status, require different skills and often attract different personalities. The challenge of merging model building and facilitation methods is an example; and
- finding suitable locations within universities for Integration and Implementation Sciences—locations where there is a sense of fit and where the specialisation will prosper. In order to continue to attract good people this needs to be an exciting and rewarding area for research and teaching.

Next Steps

For the specialisation of Integration and Implementation Sciences to reach its potential, considerable developmental work is required. 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 and funding programs.

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; and
- a large and critical college of peers to evaluate current and future research and practise.

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 lopsided 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 curricula;
- producing textbooks and systematic reflections on case studies;
- building an overarching professional association and encouraging inter-linkage between smaller existing professional associations; and
- building up top-ranking peer-review journals.

Integration and Implementation Sciences are critical if we are serious about *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 we confront.

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