

# KNOWLEDGE CO-PRODUCTION IN CONSTRUCTION MANAGEMENT RESEARCH

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For decades scholars have been questioning the linear model of innovation. One of the most influential critiques places research at a historical turning point, with a choice to be made between two forms. The first, 'Mode 1', is the form sometimes caricatured as belonging in ivory towers. The other, 'Mode 2', is more recent, rooted in real-world contexts and conducted by trans-disciplinary teams of heterogeneous actors whose composition changes continually according to the developing demands of the practical problem they are dedicated to solving. In the UK and Europe, researchers in management and organization studies and other fields have turned to Mode 2 in their quest for relevance. A move to Mode-2 research, they argue, is the best way to reunite research, cut adrift in some fields by an incestuous academic fixation with scientific theorizing, with the practice of real-world practitioners. Recent signs suggest that a similar move – to what is commonly referred to now as 'co-production' of knowledge – is being proposed for construction management (CM). To obtain a first assessment of the merits of such a move, the case-study research reported here considers the trajectory of a chain of linked construction research projects of which several were funded by a research centre that strongly encouraged collaboration with industry. The findings suggest caution in the uncritical imitation of co-production and Mode-2 models for CM research.

Keywords: innovation, Mode 2, research methods, technology transfer.

## INTRODUCTION

The Mode-2 thesis advanced by Gibbons *et al.* (1994) places research at a historical turning point, with a choice to be made between two forms of what the authors term 'knowledge production'. The first, Mode-1 knowledge production ('Mode 1' for short), is the familiar academic form sometimes caricatured as belonging in ivory towers. It is internally divided into more or less independent and powerful self-perpetuating disciplines directed purely by academic curiosity and controlled by peer review. The other, Mode 2 knowledge production ('Mode 2'), is more recent, rooted in real-world contexts and conducted by trans-disciplinary teams of heterogeneous actors whose composition changes continually according to the developing demands of the practical problem they are dedicated to solving. In this picture, Mode 1 is a relic from the post-war organization of research and innovation, and while vestiges may contrive to sustain themselves precariously into the future, its current strongholds can expect to be supplanted more and more by Mode 2.

In recent years, advocacy of Mode-2 and related forms of knowledge production such as co-production in mainstream management and organization studies has spread to CM. The concomitant questioning of orthodoxies – of research methodologies and

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conceptions of the proper roles of research and innovation – strikes us as a healthy and welcome development. At the same time, we sense that some of the enthusiasm for new ways of doing CM research might be tempered if CM researchers were to consider some of the voluminous criticism that the Mode-2 thesis has attracted – criticism that has been curiously neglected by its advocates in mainstream management and organization studies.

In this paper we make a contribution to ongoing debates about the ways in which CM research is and ought to be done. The paper is broadly divided into two parts. In the first, we review advocacy of Mode-2 and similar forms of knowledge production, especially the co-production of knowledge, and the recent interest shown in them by CM researchers. In the second, we present a case study of a small body of related CM research projects that shows some non-traditional knowledge-production characteristics. Comparing this research with the co-production ideal leads us to caution against uncritical adoption.

## **KNOWLEDGE PRODUCTION**

In the post-war period, the many industrialized states, acknowledging the returns on the large investments they had made in research for their war efforts, stepped up their research spending. The relationship that developed between science and the state in this period has been termed the ‘social contract for science’. Politicians recognized the capacity of scientific research to deliver valuable innovations and funded it generously. In return, the self-governing scientific community undertook the research that was assumed would continuously stock the larder of economic growth.

But the contract weakened as doubts about the effectiveness of public investment in basic science grew from the 1950s and 1960s onwards, and by the 1980s, industrial and science policy were giving way to innovation policy. Governments experimented with technology foresight, with national programmes of 'strategic research', and sought to stimulate new linkages between universities and industry.

### **Mode 2 and its reception**

During the last two decades, accounts of the relationship between science, industry and the state have begun to talk of a new social contract (e.g. Etzkowitz and Leydesdorff, 2000; Funtowicz and Ravetz, 1993; Ziman, 2000). The account given by a sextet of authors in "The New Production of Knowledge" (Gibbons *et al.*, 1994) and elaborated further in a book by three of the original six "Re-thinking Science" (Nowotny *et al.*, 2001) has been one of the most influential. A bibliographic search conducted in 2007 for a review of Mode-2 knowledge production, the concept at the centre of their thesis, found more than 1,000 journal articles mentioning Mode 2 (Hessels and van Lente, 2008). Outside academe, it has also won much favour among policy makers.

Hessels and van Lente's (2008) review of Mode 2 indicates not only the unusual success that has been enjoyed by Mode 2. It also gives an idea of the critical reception it received in academic fields. Chief among the deficiencies highlighted by scholars in science and technology studies and the history of science were the paucity of empirical evidence and the poverty of their history (e.g. Etzkowitz and Leydesdorff 2000; Rip, 2000). Particular problems in this regard were the notions that research has its origins in Mode 1 and that Mode 2 arose from Mode 1 post-war.

The Mode-2 thesis got a welcoming reception, however, in management and organization studies. Two of its journals were among the 18 in all fields that carried

more than 10 citations of Mode 2 in 1996–2006. Why such enthusiasm? The answer is no doubt complex but one factor was unquestionably important. When it first began to pay attention to Gibbons *et al.* (1994), management and organization studies was in the throes of one of its recurring relevance crises. In short, many management-and-organization-studies scholars embraced Mode 2 as a new model for management-and-organization-studies research (e.g. Tranfield and Starkey 1998; MacLean *et al.*, 2002; Huff, 2001) for deliverance from irrelevance. Given the prominent part of transdisciplinarity in the Mode-2 thesis and in their promotion of it, it is ironic that one thing these scholars' citations reveal they have not done is heed the vocal critics of Mode 2 in other fields.

### **Co-production of knowledge and its mobilization in CM**

In the UK lately, much of the academic interest shown by management-and-organization-studies researchers in Mode 2 has been drawn into the orbit of 'co-production'. The term has been used from time to time as a shorthand for Mode 2 and sometimes apparently attributed to Gibbons *et al.* (1994) (e.g. Woolgar, 2000), though the authors of Gibbons *et al.* (1994) did not use it in their book and have not used it in subsequent publications on Mode 2. Its recent British flowering (in the usage in which we are interested<sup>2</sup>) follows work by one public research-funding body, the ESRC, in exploring new ways of conceptualizing and evaluating the extra-academic impacts of research in the social sciences (Davies *et al.*, 2005). It owes a further debt to ESRC-funded research by Louise Knight and Andrew Pettigrew, who have used the term prominently in various outputs from their research – workshops and conferences (e.g. Knight and Pettigrew, 2008; Pettigrew, 2008a), practitioner periodicals (Pettigrew, 2008b) as well as journal articles. Their usage has been picked up and repeated in recent reports about research and its impact (British Academy, 2008; ESRC, 2009).

Though they mention Mode 2, Knight and Pettigrew define co-production in more general terms, quoting a definition given by Denis and Lomas (2003: S2:1) – a definition the latter give not of 'co-production' but of 'collaborative research'. It explicitly jettisons any requirement for integration of disciplines: 'a deliberate set of interactions and processes designed specifically to bring together those who study societal problems and issues (researchers) with those who act on or within those societal problems and issues (decision-makers, practitioners, citizens), [which] excludes partnership when it is just for funding or access to research sites. The research may but need not necessarily be multidisciplinary.'

Until recently debates around Mode 2 and co-production have been largely absent from CM research. This is surprising given their prominence within management and organization studies. However, several leading CM researchers have recently opened up important issues relating to the connexion between research and innovation within the CM community (Harty and Leiringer, 2007; Green and Harty, 2008; Green and Schweber, 2008; Sexton and Lu, 2009; Green *et al.*, 2010). As a result, co-production is becoming a prominent flag under which a particular form of collaborative research is being advocated. In an invited presentation at a workshop run by Knight and Pettigrew in 2008, Stuart Green recommended a 'co-production' approach to research in construction management. Since then, 'current trends towards co-production research in the context of the built environment' have been reported (Green and Schweber 2008: 649), and this variety of collaborative research has been developed, firmed up and presented as a model in a subsequent conference paper (Green and

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<sup>2</sup> It is only one of several loosely related usages.

Harty, 2008) and in two journal articles, one linking it to theories of the middle range (Green and Schweber, 2008), the other to a variety of grounded theory (Green *et al.*, 2010).

This incarnation of co-production essentially combines the commitment to active involvement of practitioners in research that is found in Pettigrew and Knight's indirect definition (following Denis and Lomas, 2003) with selected elements from Mode 2. There is an egalitarianism to it, an emphasis on mutuality and reciprocity, on practitioners and academics having an equal say in such matters as the setting of objectives, of research scope and of agendas, all of which are acknowledged to be continually subject to change rather than fixed from the outset. There's also a participatory aspect to it, which the various authors contrast with an unreconstructed – or, as they call it, 'smash-and-grab' – way of doing management-and-organization-studies research (Green and Harty, 2008; Green *et al.*, 2010). Smash-and-grab researchers negotiate access to research sites, go in, collect their data, take it all back to their ivory towers, analyse it and publish their findings in a language their subjects would not understand in journals their subjects would never read. Co-production by contrast is more interactive, dynamic and iterative, demanding frequent researcher-to-practitioner feedback in particular.

A measure of the high value the authors attach to participation is their assertion that the benefits extra-academic collaborators get from research are to be found above all in their participation in the research process itself: 'to focus too much on the outputs from research is to misunderstand that the prime benefit of practitioners taking part in coproduction research lies in their participation in the research process[...] Participation in the research process is seen to provide exposure to new ways of thinking and a basis for challenging ingrained practices' (Green *et al.*, 2010: 118). What then of potential collaborators who do not already recognize this? The authors do not say.

The resemblance to Mode 2 is no accident. Green and Schweber (2008: 652) virtually equate them, saying 'co-production research' is increasingly used as a label for Mode 2. Nevertheless, there are important differences. To appreciate this, consider that a move to co-production or Mode 2 amounts to a redefinition of certain roles. In the case of co-production, the most obvious are those of researchers and practitioners. In either case this redefinition is not simply a new division of the labour, as might occur when re-organizing an industrial process to eliminate waste in the production of a given product. No. The product – the very knowledge to be produced – changes too; and the roles it plays and those played by universities, industry, research and innovation. Consider further that calls for co-production or Mode 2 – for these role redefinitions – appeal to the democrat in us. The new disposition of roles is depicted as a more democratic order, its superiority accentuated by contrast with an ancien régime – a régime characterized by unduly asymmetric roles that the 60-odd years since the linear post-war settlement have rendered obsolete.

From this perspective, the difference between Mode 2 and co-production is clear; it lies in the extent of the role redefinition and the nature of the new democratic order on the table. Co-production surpasses the ancien régime by extending to practitioners privileges once reserved to academics – the right to take part in the setting of goals for, and the design of, research projects and to participate actively in the research process. Who is to count as a 'practitioner'? This is not spelled out, but more often than not, they are industrial actors. The Mode 2 of Gibbons *et al.* (1994) and Nowotny *et al.* (2001) is more radical. First, in addition to inviting practitioners to join

academics at the table, it reserves places for others who have traditionally been excluded, including individuals and groups who congregate in 'hybrid fora' (Gibbons *et al.*, 1994: 67), such as are often created by public controversies relating to the environment, health, privacy and reproduction, or in 'agora' (Nowotny *et al.*, 2001: 201). They include interest groups and 'so-called concerned groups' (Gibbons *et al.* 1994: 7). Secondly, Mode 2's transdisciplinarity is of a more demanding kind. It 'must be accompanied by a mutual interpenetration of disciplinary epistemologies' (Gibbons *et al.* 1994: 29). In sum, co-produced knowledge 'serves the needs of two different audiences' (Green *et al.*, 2010: 117, 118). It bears the hallmarks of the interpretation of Mode-2 knowledge in mainstream management and organization studies. But knowledge produced in Mode 2 is 'socially distributed' (Gibbons *et al.*, 1994: passim) or 'strongly contextualized' (Nowotny *et al.*, 2001) and consequently, according to Nowotny *et al.* (2001: 167), 'socially robust'.

### **Mode 2 in CM**

While the group of scholars carrying this co-production flag are the most conspicuous, other researchers have been considering new paths of knowledge production for CM. Taking the inexorable rise of Mode 2 for granted, Gann (2001: 328), sees in it 'opportunities for the future of UK construction research and the creation and enhancement of the sector's technical competence'. Like the authors of Gibbons *et al.* (1994), he expects academic disciplines, characteristic of Mode 1, not to wither but rather to continue to nurture 'rigorous analysis and debate'. But integration of disciplines in research for problem solving would also be necessary (Gann, 2001: 329) too. Taking account of some of the management-and-organization-studies writing critical of Mode 2, Harty and Leiringer's (2007) assessment of it is a little more questioning of Mode 2. They conclude that 'wholesale transformations, for instance from Mode 1 to Mode 2 knowledge production, are neither universally desirable nor likely to occur' (Harty and Leiringer, 2007: 1582).

Concerned to improve the relevance of research and further weaken the hold of the linear innovation model – with its 'asset' view of knowledge, as they nicely put it – Sexton and Lu (2009) champion a species from another genus of collaborative research much written about in management and organization studies – actionable knowledge. For these authors, it holds special promise for effective co-production of knowledge with small construction firms. They link it to other varieties of knowledge production and to Mode 2 in one particular way. By way of a loose reformulation of the five characteristics to which Gibbons *et al.* (1994) tidily reduce Mode 2 in the introductory chapter of Gibbons *et al.* (1994), Sexton and Lu present it as an acid test of actionability. They thus conclude their article by claiming that the knowledge that arose from an action-research case study they were involved in was indeed actionable. They do not explain however what leads them to accept their reading of Mode 2 reduction as a test of actionability.

### **A CASE STUDY**

In the case study outlined below, we trace briefly the development of a small number of lines of CM research through a relationship between a large corporation and a university. These lines happened to converge and subsequently gave rise to the spinning out of a new firm in 2001. The firm is backed by patents and copyright protecting some of the knowledge produced through the research. By comparing the research as it was actually done with the co-production ideal advocated for CM research, we draw some tentative conclusions about co-production's place in CM.

What we know about this research we learnt through research we did on the impact of a large portfolio of research projects supported by a research centre. For that research, we selected four of the centre's research projects for detailed case studies, of which one was the most recent development of the research lines we are interested in here. The research centre had been created as one of several through which the funding body aimed to improve, among other things, the capacity of researchers to respond to the dynamic needs of industry. It was multidisciplinary; its scope included construction research.

Our study had both practical and more academic motivations. We wanted to report the centre's impact somehow to its funding body, which expected such a report. We also wanted to produce a formative assessment of the impact for the centre's researchers and their collaborators. The intention was to help them picture the diverse kinds of impacts their research made and thereby improve their ability to plan for, monitor and report research impacts in future research. The impact agenda is inescapable in the UK at present. Our more academic interest, meanwhile, was in whatever connexion we might find between the ways in which collaboration was organized in different research projects funded by the centre and the impacts of those projects.

For method, we relied largely on semi-structured interviews with researchers and their mainly industrial partners who had collaborated in selected projects funded by the centre and with research-centre managers and administrators. We also had access to a wide variety of documents relating to the work of the centre and its researchers. These included the centre's calls for proposals, the research proposals themselves and referees' assessments of them, annual research-project reports, patents arising from some of the projects and conference and journal papers reporting research results. For reasons of confidentiality, we have used pseudonyms in the case study.

### **The case**

With the encouragement and coordination of a manager at multinational engineering company EngCo, a strong collaborative relationship developed in the 1990s between EngCo and the university where he had obtained his first degree and PhD, Erewhon University. One result was research into a mathematical technique for optimizing the detailed design of buildings, begun by a student who left EngCo to do a PhD at Erewhon and then refined in further PhD research by an EngCo employee seconded to Erewhon. The latter produced prototype software that, in the words of another ANU employee, proved the concept but was 'bloody awful as a product'.

Another result of the EngCo-Erewhon relationship was the award of a PhD to another EngCo employee – (Smith) – for research mapping the design processes typical of the early stages of building projects. Smith had studied for his PhD while working as a researcher on secondment at another university. After graduating from Erewhon, Smith returned to EngCo and a new role in a new department, 'taking the products of all of this [EngCo-Erewhon] research and all of this investment and making it applicable to the business'.

These two lines of research coalesced when Smith was then seconded by EngCo to work with his former PhD supervisor at Erewhon, Bennett. Both had fellowships from a charitable foundation, through which they explored options for commercializing the EngCo-Erewhon research outcomes. Lengthy negotiations ensued in pursuit of one option, a joint venture between EngCo and Erewhon, but the decision was made eventually to spin-out with business-angel investment instead. Four employees – Smith and three others from the EngCo-Erewhon association – left EngCo to run the

spin-out. Their main business was to be licensing of IP to third-party software developers and providing process-modelling services for clients' building design processes. The business grew steadily to a complement of over 20 staff and, in spite of the economic downturn, has expanded overseas.

During their fellowships, Smith and his former PhD supervisor also co-wrote a proposal for a project (MANGO) that would build on the design-process-mapping research to devise a design approach that would vouchsafe the quality of buildings designed and constructed in building projects – as judged by all stakeholders – from conceptual design onwards. The proposal was successful and the resulting project was rolled into the research centre's portfolio of research around the time the centre was launched. Erewhon recruited another EngCo employee Vaughan to work as a research assistant on the new project. In time, the process developed in MANGO – which gives a formal voice to all who hold a stake in the design and function of any building in whose design it is properly used – was embodied in a computer program and added to the technologies licensed to the spin-out.

The centre later joined with a local authority to co-fund a further piece of research in this chain of projects. An action-research project, it placed Vaughan within a part of the local authority's building programme. The aims were: to transfer the innovative design approach that had been devised in the previous project to the local authority and to improve the robustness of the approach through exposure to the demands of real design practice. This project met with limited success. A simplified version of the MANGO process was developed, and the local authority reported that it had incorporated one element of it into its practice.

### **The case and co-production of knowledge**

The spin-out, its licence to use research-generated IP and its business model of licensing out IP – these are a few of the signs of successful Mode 2 knowledge production and perhaps co-production. So too is the apparent rootedness in contexts of application, developed as it was in a string of projects coordinated by an EngCo manager and carried out largely by five EngCo employees and ex-employees. But when four of them left to set up a spin-out independent of EngCo, the context shifted abruptly. In doing so, they were taking the first steps in an effort – successful, as it turned out – at fashioning a new context for the application of the new knowledge produced in the EngCo-Erewhon partnership.

The limited success of the action research in the local authority illustrates too that even an apparently stable context of application does little to guarantee smooth and fulsome knowledge transfer. A local-authority manager in the departments concerned regretted the fact that he had not been able to take full advantage of the on-site work of the researcher. He blamed it in part on his lack of freedom to assign a full-time member of staff to work with the researcher full-time throughout the action-research project. Moreover, in spite of the closeness of EngCo and Erewhon, their research appears certainly to have been steered a good deal by the curiosity of academics. In Bennett's account, the MANGO project began with an idea of his. He gave the project its initial form on paper as the bare outline for a proposal, hatched with Smith and another more academic Erewhon researcher. Only then was it circulated to attract the support of potential industrial collaborators (other than EngCo). Bennett's normal practice does include reshaping such embryonic research ideas to accommodate feedback from extra-academic collaborators that might affect the shape of the proposal eventually submitted. Nevertheless, in common with normal academic

engineering research practice, the idea is first given shape by an academic – an academic who has strong relationships with and a sympathy for industry but is an academic first. Unlike Mode 2, the research, then, was not wholly shaped by its context of application.

The point is reinforced by Smith's description of his role as an EngCo manager at the time – taking the output of the EngCo-Erewhon research and 'making it applicable to the [EngCo] business'. Here are heavy shades of the linear 'asset' model of innovation, with knowledge generated in academe then applied in industry. It is not pure co-production, in which industry recognizes that the prime benefit of participating in research lies in its participation in the research process.

The same point is echoed by the way in which the manager in the local authority where the action research took place accounted for the benefits of that subsequent project. He concentrated on the element of the MANGO process that his department now made use of; he spoke of having 'cherry-picked' this. He gave little sign of appreciating that the prime benefit of collaborating in research is participating in the research process itself; for him, the most significant outcome was the transfer of one research output.

Note that it was not until the MANGO process was formulated that the research assigned any substantial role to parties other than researchers and the industrial actors closest to the immediate context of application. In this respect, the research conformed for the most part to the loose two-audiences interpretation put on Mode 2 by mainstream management-and-organization-studies scholars and by CM co-production advocates. MANGO's incorporation of building occupants and other stakeholders into the design process broke the norm. And this was not only on paper; in the following action research project, the process was put to practical use in part of the host local authority's building programme.

## CONCLUSIONS

One possible response to the processual divergence of the research in question here from co-production or Mode 2 might be to regard it as a measure of how far it fell short of a collaborative knowledge-co-production ideal. This would be the case if its actionability were measured by Sexton and Lu's Mode-2 acid test, for example. We take a different view. We emphasize here that we are not Mode 1 diehards. We are not eager to extinguish all sign of Mode 2 and co-production in order to preserve science's purity or the divine right of academics to pursue curiosity-driven research.

On a cursory reading of Gibbons *et al.* (1994), the paucity, or rather the virtual absence, of an empirical base for the Mode-2 thesis – one of the more serious criticisms levelled by scholars in STS and history of science – may not appear to be of great consequence. Numerous researchers in management and organization studies have not been put off by it and persist in seeking deliverance in it from their subject's supposed irrelevance to practising managers. We hope we have made it clear, however, that it is a serious problem for any programme that takes the reductionist five-point summary of Mode 2 in the introduction to Gibbons *et al.* (1994), or variants of it, as a model that researchers and industry managers ought to model their research and innovation on. Gibbons and his co-authors were cautious enough in the writing of Gibbons *et al.* (1994) to avoid giving it the appearance of an out-and-out normative account of the new form of knowledge production they purported to identify and describe. And although there are numerous places in the book where the authors'

efforts at presenting their work as purely descriptive slide from is to ought, this, it strikes us, is no good reason for scholars to cite the book uncritically in support of appeals to fellow scholars to correct their irrelevant ways by turning to Mode 2.

In practice, research, even when conducted by industry-oriented engineering researchers – and we suggest they are usually more amenable to boundary-crossing collaborative research than are many natural scientists – is messy and risky. Collaborating firms may undergo management changes or modify their strategies. Spinning out a new business may radically alter relationships between research collaborators. Researchers are constantly to be found shaping and reshaping contexts of application, in part to prevent research from collapsing in such circumstances. Research may at times be of a kind that easily enables researchers to interest industrial and other collaborators in it and perhaps to entice them to participate actively in it. At other times, it may not. Research is rarely anything even approaching fully-blown Mode-2 or co-production in nature (pace Maclean *et al*, Sexton and Lu).

We suggest that CM scholars treat the Mode-2 thesis with the same critical respect they would accord to the work of fellow CM scholars. The fact it has turned the heads of policy analysts and policy makers, not to mention large numbers of management scholars, is, or ought to be, immaterial. We concur with many of its critics in STS. The serious problems – of empirical evidence and of historical blundering – are serious indeed. And they have practical consequences, not least for Mode 2 imitators. CM research practice is too heterogeneous to be shoe-horned into a Procrustean categorization recognizing just two forms, even if this dichotomization happens to be conducive to narrating knowledge production as evolutionary and progressive; to lend itself to the simultaneous legitimation of one form and tarring of the other as unfit for purpose, obsolescent; and to suit the purposes of makers of science policy concerned currently to tilt research funding in favour of relevance and extra-academic impact. We do not propose to throw out the baby with the bathwater. Perhaps some of the putative trends that Gibbons and his co-authors so cleverly macraméd into their Mode-2 thesis hold some water. But we do urge researchers impressed by the credentials of Mode 2 and co-production, Handle with care!

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