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Knocking on the Door: Policy, Agency and Path Creation in the Post-industrial City

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Abstract

At the time of the Millennium, Nottingham, a former manufacturing city in the English Midlands, faced serious challenges as a consequence of de-industrialisation. This was the context from which a new development path based on life sciences emerged. This paper explores the role of policy interventions and the agency of local actors in this path creation process. Kingdon's (1995) multiple streams framework (MSF) is used as an analytical framework through which to assess the interaction and local implementation of three related strands of national policy: regional policy, industrial policy (with an emphasis on clusters) and innovation policy and their role in the emergence of a life science cluster in the city. The case is explored with reference to the experience of other European cities that have faced similar structural challenges and sought to respond with development strategies based on life sciences.

Keywords:

Policy, life sciences, de-industrialisation, path creation, multiple streams framework, agency.

Caption List

Figure 1 - Multiple Streams Framework
Source: Adapted from Rossiter and Price (2013: 855)

Figure 2 - Nottingham Employment in Textiles Related Manufacturing
Source: Employment data from various surveys, ONS from NOMIS 15.11.2019.
Note discontinuities in data collection and sectoral classifications preclude compilation of continuous time series. Missing AES values modelled.

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Introduction

Biotechnology is just one of a number of high technology sectors where clusters, in the form of agglomerations of firms undertaking similar kinds of work and located within a specific geographical area, are to be found. Although the first biotechnology clusters emerged in the US, they have also become a feature of the biotechnology sector in Europe. The biggest concentrations are to be found in the UK, Germany, France, Switzerland, the Netherlands and Sweden (Terry, 2019). One such cluster located in the East Midlands region of the UK, forms the basis of this paper. A case study is presented that aims to analyse the process that led to the creation of a new development path and the emergence of a biotechnology cluster, together with the policy domains involved. It highlights the significance of temporal specificity and the role of agency.

Several studies (Chiaroni and Chiesa, 2006; Okamura and Nishimura, 2015; Su and Hung, 2009; Tippl and Todting, 2007) have highlighted the way in which biotechnology clusters vary considerably in their origins and early development. Su and Hung (2009) highlight the apparent dichotomy in the origins and evolution of biotechnology cluster creation. They differentiate between spontaneous clusters, that is ones that are the result of the spontaneous co-presence of key factors such as a strong life science research base, and policy-driven clusters which are triggered by the commitment of public actors willing to aid and support the setting of conditions for cluster creation.

While the most prominent examples of spontaneous clusters are to be found in the US, including in the Bay Area in California (Su and Hung, 2009) and Boston on the East Coast (Prevezer, 1998), clusters of this type are also found in Europe. Notable examples include Cambridge in the UK, Heidelberg in Germany and Marseilles in France (Su and Hung, 2009). In each instance established universities provided a strong research base that facilitated the formation of biotechnology start-ups to commercialize university derived intellectual property from the life sciences.

Policy-driven clusters feature prominently in Europe, reflecting a desire on the part of many European governments to follow the lead of the US and enable their economies to benefit from the growth of hightech industries like biotechnology. Policy-driven clusters typically involve the setting up of some form of science park or incubator, offering extensive life science laboratory

facilities for use by biotechnology start-up firms. The provision of specialist facilities of this kind is designed to encourage scientists to capitalize on their knowledge and expertise by launching a new venture within a protected environment where help and support are available. Here nascent start-up companies will have the facilities to carry out their research work.

Su and Hung (2009, p. 610) draw a distinction between policy-driven clusters motivated by a desire to deliberately foster the biotechnology sector in a particular region, and those that reflect a response to some form of 'industrial crisis' leading to economic decline in a particular location.. Such problems typically arise from the rapid decline of a specific industry sector or even a single large firm, especially where a region has hitherto been overly reliant upon such a firm for employment within its industrial base. Examples of clusters of this type are to be found throughout Europe. The demise of the textile sector led to initiatives to establish biotechnology clusters in Tampere in Finland (Läteenmäki, 2002; Sotarauta and Mustikkamäki, 2015) and Lodz in Poland (Woźniak-Malczewska, 2014), the decline of the steel industry led to similar measures in Styria in Austria (Trippl and Otto, 2009), while in Sweden and Switzerland it was re-structuring in the pharmaceutical industry that led to the development of biotechnology clusters in Uppsala and Basel (Chiaroni and Chiesa, 2006).

With industry restructuring policies the aim is typically to leverage existing competencies in the area such as those associated with a pharmaceutical industry or the healthcare sector, in an attempt to alleviate unemployment. As a result, the spin-off biotechnology companies spawned in this way may well employ an alternative to the drug discovery business model found in conventional biotechnology clusters. Instead they may endeavour to support the outsourcing of industrial research through the provision of contract research services for pharmaceutical companies (Smith et al 2017).

Chiaroni and Chiesa (2006) note that while research studies often go to considerable lengths to describe clusters much less attention is directed at the process whereby a cluster comes into being. Aspects such as the problems faced and key factors that enable growth often remain obscure. where the study of the development process is neglected. More recently attempts have been made to explore the complex interplay of factors that contribute to the development of new paths of

development linked to biotechnology. Carvalho and Vale (2018) notably utilise the concepts of institutional relatedness and bricolage to explore the interplay of agency and institutional factors in the development of a biotechnology cluster notable for its location in a peripheral region: the Portuguese Centro Region. Their description of the emergence of a cluster in an 'unlikely' peripheral region resonates to some degree with the case that is the focus of this paper.

This paper seeks to analyse the creation of a biotechnology cluster that was in part, the product of industry restructuring policy instituted in the wake of a crisis triggered by a pharmaceutical industry merger and the resulting closure of research laboratory facilities. The biotechnology cluster is located in Nottingham a former industrial city in the East Midlands region of the UK. The paper explores how a new development path leading to the creation of a biotechnology cluster emerged, and specifically the role of agency within a particular policy context. To do this we adopt Kingdon's (1995) multiple streams framework (MSF) comprising three streams of activity: problems, politics and policies, as an analytical lens. We focus on the interaction of three related strands of national policy: regional policy, industrial policy (with an emphasis on clusters) and innovation policy. These complementary policy domains formed a nexus that proved conducive to the form of path creation that we describe. Against this background, alignment of events in the three streams enabled a range of actors operating as policy entrepreneurs to mobilise resources in such a way that they could kick-start a novel process of regeneration. Significantly this involved not merely agenda setting, but enabling and empowering policy implementation. This led to a new development path for the city. Furthermore, we argue that the 'policy window' (Kingdon, 1995, p. 20) created by the coupling of the three streams of activity, was both temporally and place specific. We conclude by assessing the impact of this process on the economy of Nottingham and more widely through policy transference to other localities.

Method and conceptual foundations: The Multiple Streams Framework

Inspired by Cohen et al.'s (1972, p. 2) 'garbage can model' of decision-making in complex organisations, the multiple streams framework (MSF) was developed by the American political scientist John Kingdon (1984). Originally developed to explain agenda setting in government in the US, it has increasingly been used to explore decision-making at a variety of spatial scales in a

wide range of policy domains (Jones et al., 2016). The MSF breaks with conventional rationalistic and technocratic models of policymaking (Howlett, 2018) which focus on a number of more or less sequential stages. Instead the MSF portrays the process as one that is more complex and contingent (Ackrill et al., 2013), being the product of several semi-independent streams of intersecting and interacting events and actors.

One of the particular strengths of the MSF is the scope that it provides to explore which issues gain attention and when, and how actors are mobilized to participate in a given decision. It is particularly suited to the analysis of decision-making in the context of ambiguity[1]. However, some commentators (Howlett, 2018) have criticised the MSF arguing that, like other models of the policy-making process such as the advocacy coalition framework (ACF), it places too much attention on the front end of policymaking namely agenda setting. In contrast it is argued that other tasks in policy-making such as policy implementation, are often neglected by MSF theorists and receive scant attention (Howlett, 2018). This paper seeks to demonstrate that MSF can also be applied to the analysis of policy implementation with an emphasis on the agency of policy entrepreneurs.

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Insert Figure 1

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The MSF comprises five elements: the problem, politics and policy streams; together with the policy window and the policy entrepreneur (see figure 1). The problem stream refers to issues that capture widespread attention (Chow (2014), leading to pressure for them to be addressed. Issues come to the fore as a result of indicators, like rising rates of unemployment or homelessness, or 'focusing events' (Zahariadis, 2007, p. 72), in the form of sudden, attention grabbing occurrences (Birkland, 1998), such as natural or human induced disasters that suddenly bring an issue to the attention of decision-makers. The policy stream in contrast comprises candidate policy propositions available to address problems. Described by Kingdon (1995, p. 116) as a 'primeval soup', it is a stream in which ideas and solutions are formed, developed and ultimately either selected or rejected (Chow, 2014). As Zahariadis (2007) notes while many ideas may vie for

attention only a small number achieve serious consideration. The politics stream refers to the institutional and cultural context (Jones et al., 2016), or what has been described as the 'national mood' (Herweg et al., 2018, p. 24)).

While the three streams are conceptualised as independent, one of the central points of Kingdon's (1995) thesis was that in certain circumstances, perhaps driven by focusing events, the streams may come together. Such intersections are often unforeseen and unpredictable, hence the seemingly chaotic nature of the process. When this coupling of the streams occurs, then according to Kingdon (1995, p. 20) a 'policy window' or 'window of opportunity' (Ackrill et al., 2013, p. 872) opens, as the drama surrounding the focusing event attracts increased attention to the problem. Thus policy windows form opportune moments characterised by conditions conducive to action on the part of key actors, whom Kingdon (1995, p. 122) terms 'policy entrepreneurs'. For their part policy entrepreneurs provide what Jones et al. (2016, p.16) describe as, 'the necessary dose of agency' required to shape policy outputs.

Edler and James (2015, p. 1254) note that the way in which a policy entrepreneur is able to play his or her role depends on a variety of factors including: 'the institutional and constitutional context, the capacities and skills of the entrepreneur, the actor networks that are involved or can be mobilised, the initial cognitive and normative differences between the various actors influencing and shaping the decision making process, and the mechanisms by which decision makers can and will exert power'.

Policy entrepreneurs often have to act quickly as policy windows and the opportunities they present are often only open for a short time. The task of policy entrepreneurs in these circumstances often involves bringing individuals together in order to achieve agreement on a particular solution, driven by their desire to significantly change current ways of doing in their area of interest (Mintrom and Norman, 2009).

In applying MSF to the case in question a variety of primary and secondary sources have been utilized. Primary data collection took the form of semi-structured interviews with six key informants (Healey and Rawlinson 1993). They included two former staff members from

Boots/BASF, and managers from four life science incubators located in the UK, Finland and Poland, including the BioCity incubator in Nottingham. The data from these interviews was used both to trace out the development of the BioCity incubator and provide a degree of triangulation.

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To this body of evidence were added insights drawn from the participant observation (Hammersley and Atkinson 1995) of one of the authors who worked at the East Midlands Development Agency between 2001-2011 in roles that involved a range of activities touching on cluster policy initiatives[2]. The relatively long historical perspective adopted for this study required use of a diverse range of documentary sources (Scott, 1990) relating to national policy initiatives, local and regional strategies, the nature of Nottingham's local economy and briefing and policy documents produced by organisations involved in the BioCity development. Throughout, we seek to highlight similarities and differences between Nottingham's experience and those of other European cities that have pursued similar strategies in the face of structural change.

Case Study: Applying the Multiple Streams Framework

A recently published growth plan for the city of Nottingham (Nottingham City Council, 2012) prioritized life science as one of three growth sectors in which the city had a competitive advantage, noting its potential contribution to the development and growth of the city's economy. This emphasis on science reflected the recent emergence of an embryonic life science cluster within the city of Nottingham.

At the heart of this cluster is BioCity Nottingham, a life science and healthcare incubator opened in 2003. Now home to some 60+ life science businesses that vary in size from small start-up and spin-off firms to more mature enterprises. BioCity Nottingham is unusual in that it was neither purpose-built nor based on the campus of and directly operated by a university. Instead it is an independently operated facility housed in the former research laboratories of Boots' Pharmaceutical division.

The origins of the BioCity life science incubator and hence Nottingham's embryonic life science cluster coincide with the point at which the three streams of the MSF, namely problems, politics

and policies, began to converge in the late 1990s. It is important to note that each stream functioned on multiple spatial scales. In part this was a consequence of the emergence, at this time, of a regional tier of government in the UK comprising devolved administrations in Scotland and Wales and Regional Development Agencies and Regional Assemblies in England.

Problem stream

Historically Nottingham was pre-eminently a textile centre (Wells, 1966) and in the early years of the twentieth century the city's famous Lace Market area was the leading global centre of the machine lace industry (Crewe and Beaverstock, 1998). Lace making reached its peak just prior to the 1914-18 war when there were more than 200 firms (Chapman, 1997; Tiesdell, 1995) employing 22,000 workers in and around the city (Chapman, 1997, p. 482). However, the interwar years brought dramatic changes in fashion that reduced lace making to a shadow of its former glory. During the 1920s alone employment in lace making halved (Chapman, 1997). Fortunately, much of this sharp decline was offset by the growth of other branches of the textile industry, most notably hosiery and knitwear (Chapman, 1997). By 1931 employment in hosiery for instance had more than doubled compared to pre-war (Wells, 1966). The clothing sector also expanded helped by the growing popularity of ready-made clothing.

Hosiery and knitwear continued to be relatively prosperous for nearly 40 years after World War Two. A key factor was the large number of firms in the Nottingham area that acted as suppliers to the leading multiple retailers such as Marks and Spencer (Garmise, 1995) and consequently benefited from the latter's growth. Some of the larger firms did migrate from the city to purpose-built units in the central and northern parts of the county (Totterdill, 1992). But by the late 1970s major changes were underway. The industry started to face intense competition from overseas, brought on by the rapid expansion of textile production in countries of South Asia and the Pacific Rim. Initially this took the form of competition from imports from countries like Taiwan and Korea (Roberts et al., 1990). During the early 1980s this extended to offshoring labour-intensive operations leading to the loss of thousands of jobs (Totterdill, 1992). There was also increased competition from European countries like Italy and Germany. Between 1971 and 1981 employment in textiles in the Greater Nottingham area declined from 30,700 to 17,200 (Roberts et al., 1990, p. 146).

Faced with a dramatic decline in employment in the textiles and clothing sectors, Nottingham City Council commissioned researchers from Trent Polytechnic to carry out a study of Nottingham's local economy in May 1982 (Totterdill, 1989). This highlighted the fragmented structure of the sector with a large number of small firms reliant on supplying large multiple retailers, leading to a reluctance to innovate in design terms (Trent Polytechnic, 1983). In response, the city council set up a Fashion Centre in the city in 1984 (Totterdill, 1992) modelled on a similar scheme in London (Davenport and Totterdill, 1986). Offering showroom and exhibition facilities and managed workspaces, the Centre was designed to enhance the design capabilities and assist manufacturers in the marketing of their products. Throughout the 1980s Nottingham City Council continued to give priority to the textile and clothing sector (Totterdill, 1989) with a range of small-scale initiatives to support local firms.

Despite these measures textiles and clothing continued to decline in Nottingham. The last quarter of the twentieth century was a period of continuous decline as imports undercut UK produced items and firms increasingly outsourced production to low cost economies in the Far East. Cutbacks were especially steep in 1989-91 and 1998-2000 (Chapman, 2002). Employment in textiles and clothing in Greater Nottingham declined from 18,450 in 1984 to 10,422 by 1997 (Galt, 2000). Figure 2 shows that this decline continued and accelerated after the Millennium.

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Insert Figure 2

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The decline in textiles was for a time masked by the rise of 'new industries' in the form of bicycle manufacture, tobacco and pharmaceuticals. By the 1960s, these industries formed a significant presence alongside the textile sector (East Midlands Economic Planning Council, 1966). This led some observers to describe Nottingham at this time as a city with 'a well-balanced employment structure' (Wells, 1966, p. 405) and 'a robust manufacturing base' (La Court, 1992, p. 49). The city appeared to have avoided what Bailey and Cowling (2011: 349) describe as a 'mono-sectoral profile'. Its broader, seemingly resilient, spread of industries enabling it to escape the problems

that befell other UK cities heavily dependent on a single sector. Others were more circumspect, describing the city at this time as 'still living on its 20th century glories' (Beckett, 2008, p. 1)

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Insert Table 1

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During the course of the 1980s several of the major firms in the city's new industries were subject to changes in their governance structure (table 1), as they were acquired by large multinational corporations. These governance changes caused the locus of decision making in these firms to move away from the city. As one local commentator noted, 'Some … are raising concerns about Nottingham's overdependence on a small number of large employers, most of whom are controlled from boardrooms elsewhere in the world' (Totterdill, 2000, p. xiii). The full implications of this became apparent during the 1990s, as employment in two of the city's supposed new industries declined rapidly.

Bicycle maker Raleigh was one leading Nottingham company that saw its three main export markets disappear in quick succession (Rosen, 2002), leading to dramatic cutbacks in both production and the labour force. In 1978 Raleigh employed 9,000 in the city making some 2 million cycles a year, but by 1986 production had halved and the workforce was down to 1,800 (Rosen, 2002, p. 111). A decade later Raleigh ceased manufacturing cycle frames altogether and its last factory in the city finally closed in 2002 with the loss of 300 jobs (Seaton, 2002).

At the tobacco manufacturer Players it was a similar story of plant closures and redundancies. Acquired by Hanson Trust in 1986, the cigarette manufacturer was forced to rationalize and reorganize as increasing concern for health issues led to declining sales. In the latter half of the 1980s Players made 3,000 redundant and closed five factories in the city (Chapman, 1997, p. 492). Production was transferred to a purpose-built factory on the outskirts of the city but even this facility eventually succumbed when in 2014, it was announced that this plant too would close with the loss of 500 jobs, finally ending the city's links with the tobacco industry (Kollewe, 2014).

Other leading firms in the city fared little better. Royal Ordnance which employed 2,500 skilled engineering workers in the 1960s became a public corporation in 1985 with headquarters in Chorley in Lancashire. Two years later it was acquired by BAE Systems for £188.5m. The ending of the Cold War brought cutbacks to defence spending during the 1990s and BAE Systems duly began to rationalize. In 2000 production of small arms transferred to Barrow-in-Furness (The Engineer, 2000), whereupon BAE Systems announced the closure of the Nottingham site.

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Consequently, by the Millennium, Nottingham's industrial structure looked very different from two decades earlier. This was reflected in the changing employment structure of the region which exhibited a very marked decline in manufacturing employment (see figure 3). As one local commentator observed, 'Since the 1980s we have been made painfully aware of the gradual erosion of the city's industrial base' (Beckett, 2010, p. 1). A senior city councillor writing in a review of Nottingham's prospects was blunt describing how 'De-industrialisation and its accompanying increase in unemployment, helped create an extensive underclass' (Chapman, 2000, p. 21).

Not only had employment in the textile sector, once the heart of the city's economy, declined dramatically, so too had employment in two of the city's three new industries. Only the pharmaceutical manufacturer Boots appeared to be relatively unscathed by the de-industrialisation that had swept over the city in the final years of the twentieth century. However, here too governance changes and corporate restructuring had been taking place. A key milestone was the mid-1990s sale of its pharmaceutical division to the German chemical company BASF.

Nottingham was far from alone in experiencing structural change of this magnitude and significance during the closing decades of the twentieth century. The causes may have been various, but Lodz (Walker 1993), Tampere (Kostiainen and Sotarauta 2003) and Styria in Austria

(Trippel and Otto 2009) all experienced a similarly precipitous decline in their traditional industrial base at this time.

Politics stream

There were major developments in the politics stream during the course of the 1990s. The biggest of these was at the national level in the coming to power of New Labour in 1997. At a stroke there was a massive change in personnel and policy direction as the Conservatives who had held power for 18 years were swept out of office by New Labour. Into power came Blair, Brown and Prescott with very different ideas about the running of the economy. This mirrored a significant shift in the national mood as neo-liberal ideas about the primacy of markets and market forces gave way to the 'third way' and a 'modernizing agenda' in which there was scope for the pursuit of partnerships between the private and public sectors.

The change of mood at the national level was mirrored by change at the local level where new institutional arrangements emerged. Nottingham City Council gained unitary status in 1998 and from this point onwards would seek to fashion a more positive future for the city through taking an increasingly active role in economic development. The publication of the city council's growth plan (Nottingham City Council, 2012) is but a recent indication of this shift.

Probably the biggest change to local institutional arrangements was the setting up of the Regional Development Agencies (RDAs) in 1999. This had major implications for economic development at the local level. They not only had a specific remit to promote economic development at the local level, for the first time there was an agency able to exert a significant influence on the development of the local economy. Bodies like the East Midlands Development Agency (EMDA) had a remit and resources to deliver economic development projects. They also had a growing capacity to influence other local actors. Nottingham was particularly fortunate in that EMDA was based in the City. Not only that, it arrived on the scene at exactly the point in time when the problem stream was throwing up major challenges for the local economy. By accident of location, it is also noteworthy that EMDA's Apex Court offices overlooked the former Boots Pennyfoot Street laboratories – hence when problems arose surrounding the site's future, they could hardly fail to register on the agendas of senior decision makers within the Agency.

Policy stream

In the policy stream in the years immediately after 1997, we observe the emergence of three distinct policy currents that would provide crucial ingredients on which local policy entrepreneurs could draw as they sought to respond to the challenges with which they were faced: New Labour regionalism, a more active orientation towards industrial policy, and a renewed focus on innovation policy. These policy currents were by no means unique to the UK – finding expression in a number of related European Union policy domains addressing themes such as cohesion, innovation, clusters and latterly associated with the burgeoning field of Smart Specialisation (see for example Bailey and De Propris 2019).

Throughout Labour's years in opposition, its shadow regional affairs spokesman John Prescott, a man widely recognized as 'a committed regionalist' (Harrison, 2006, p.936), pressed the case for a focus on regional policy. In 1995 Prescott was instrumental in establishing a Regional Policy Commission chaired by former European commissioner for regional policy, Bruce Millan (Pilch, 2003). The commission reported the following year concluding that the regions were underperforming relative to international comparators and argued that regional policy was 'centralised, prescriptive, piecemeal and inconsistent' (Regional Policy Commission, 1996: v). It advocated establishing regional development agencies (RDAs) in each of the English regions together with a new focus on regional policy.

Following Labour's election victory in 1997, prime minister Tony Blair pushed forward with an ambitious agenda for the regions, which included the establishment of RDAs. Modelled on similar bodies that already existed in Scotland and Wales, they were responsible for drafting regional economic strategies. In so doing they drew on a broader range of policy instruments than had hitherto been available. While continuing to seek inward investment, they now accessed policy instruments that emphasized indigenous resources (Dawley, 2014).

Indigenous growth was to be achieved by encouraging knowledge transfer from universities to regional economies and promoting an 'entrepreneurial culture' (Hudson, 2011, p. 1005) in higher education. This form of innovation policy drew heavily on the notion of 'academic capitalism'

(Brown, 2016, p. 189). Originating in the United States and given academic credibility through the concept of the 'triple helix' (Etzkowitz and Leydesdorff, 2000, p. 109), this was the idea that academics should participate in innovation and be encouraged to commercialise their research via 'greater engagement with their local entrepreneurial milieu' (Brown, 2016, p. 190).

This left unresolved the question of how regional economic strategies were going to bring about knowledge transfer. Hudson (2011) notes that the answer to this came from an industrial policy idea that was much in vogue at the time - clusters. Popularised by the American economist Michael Porter, clusters are localised concentrations of firms working in related fields and cluster policy aimed to identify appropriate clusters and then provide them with support to enable them to expand and grow, thereby promoting national competitiveness. Building on earlier work by Alfred Marshall on industrial districts (Marshall 1920), Porter first advocated clusters in 1990 (Porter, 1990) when he identified them as a major determinant of a country's national competitive advantage. In the following decade cluster policy was enthusiastically embraced by policymakers at all levels (Pitelis, 2012) ranging from the OECD and EU to national and regional governments the world over.

In the UK clusters were keenly endorsed by New Labour as part of a renewed and re-invigorated emphasis on regional policy. In a break with regional policies of the past New Labour adopted 'spatial Keynesianism' (Swords, 2013, p. 5), emphasising more flexible supply side measures, such as clusters. According to Swords (2013, p. 1) cluster policy 'came to dominate local and regional economic development policy' at this time.

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At the national level this preoccupation with cluster based industrial policy is clearly evident in a succession of Department for Trade and Industry (DTI) sponsored White Papers and research reports (see table 2). The 1998 White Paper: Our Competitive Future: Building the Knowledge Driven Economy, identified cluster development as a key driver of regional prosperity and

development. This view of clusters as key economic drivers was further reinforced by the 2001 White Paper: Opportunity for All in a World of Change. The latter did more than simply assert the importance of cluster based industrial policy, it gave a specific responsibility for implementation to the RDA:

> 'To remove constraints and highlight the potential for growth of successful clusters, the Government has asked Regional Development Agencies to produce strategies for success for their regions, drawing on their regional strategies and using information such as the clusters map to identify further potential centres of growth.' (DTI, 2001, p. 8)

The pervasive influence of 'cluster thinking' is further demonstrated by the publication of the DTI's Economics Paper Number 3 (Porter & Ketels 2003). This research report, although critical of previous UK Government attempts to map clusters on the basis of the 'ad hoc cluster definitions' used, is notable for highlighting the specific potential of life science clustering in the UK. It did this on the basis of the example provided by the Boston Life Science Cluster (Porter & Ketels 2003) and evidence generated by the Sainsbury Review of the UK biotechnology sector (DTI, 1999).

The impact that this national cluster policy discourse had on local RDA policy and practice can be traced in both the strategies and action plans published by EMDA (see for example the regional economic strategies of 2000, 2003 and 2006) but also in the prodigious volume of internal briefing documents, memoranda, presentations, working papers, speeches and correspondence devoted to this subject – particularly in the period between 2001 and 2003[3].

Illustrative of this genre of RDA documentation is a policy position paper dated 29th August 2001 and prepared in advance of EMDA's annual public meeting of that year. This document is noteworthy in that it demonstrates the influence of national policy on EMDA strategy and practice. It notes that,

> 'The recent DTI report 'Business Clusters in the UK-A First Assessment', a national clustering study, outlines the importance of cluster development within a knowledge driven economy. However, more importantly, it provides robust statistical evidence that supports

EMDA's cluster development programme and emphasises the need to target economic growth opportunities.'

It further documents the emerging interest in life sciences (although they are termed 'healthcare industries'). It also highlights the priority given to university/business links and the development of 'business incubation programmes' with the specific objective of supporting cluster development. Elements that would later coalesce in the development of BioCity - when the opportunity arose.

A Policy Window opens

While the three streams: problems, politics and policies often operated on different spatial scales, during the 1990s they were increasingly moving towards convergence. The coupling of the streams in this way provided scope for the opening of a policy window, thereby creating an opportunity for new ideas and potential solutions to emerge. Problems were mounting at the local level as the city faced a sharp decline in its manufacturing base. Problems were also emerging at the international and national levels within the pharmaceutical sector as well. At the same time in the politics stream, new institutional players were emerging at the local level. They increasingly had both the mandate and the means to become involved in the problem stream in ways that had not existed in the past (Smith, Rossiter and McDonald-Junor 2017). Similarly, in the policy stream new ideas were coming into vogue.

It was a decision taken not in Nottingham but in Ludwigshaven in Germany that was to prove the focusing event that threw open the policy window. In 1999, barely four years after it had acquired Boots pharmaceutical division, BASF's senior management decided to undertake another strategic review (Milner, 2000). There were factions within the company who still felt that, *"BASF was fundamentally a chemical business"* (former Boots/BASF scientist). As a result of this review in April 2000 BASF decided to sell its pharmaceutical business and Lehmann Brothers was brought in to oversee the sale.

A number of pharmaceutical firms initially expressed an interest, but no buyers emerged: "*what became very clear quickly was that nobody wanted the Nottingham site"* (former Boots/BASF scientist). This dragged on for months and the staff, especially those in the Nottingham research

laboratories, faced an increasingly uncertain future. In November 2000 BASF announced 200 redundancies in Nottingham. Then quite suddenly in December it was announced that the American pharmaceutical giant Abbott, which had previously shown no interest, had agreed to purchase BASF's pharmaceutical business for $6.9billion (Abelshauser et al., 2004). The deal involved the acquisition of the intellectual property (i.e. the drugs and drug pipelines) developed in the former Boots laboratories, but not the Nottingham site or its staff. Hence echoing restructuring of the pharmaceuticals industry elsewhere in Europe, notably at Uppsala in Sweden and Basel in Switzerland, BASF announced that the site would close the following spring and that the remaining 350 staff would lose their jobs. The loss of so many highly skilled jobs and the closure of an iconic building so closely associated with the city's industrial base proved to be a critical juncture. Directing attention to the wider problem of the decline of manufacturing in Nottingham's industrial base, it presented an opportunity for various actors 'to push their pet solutions*'* (Kingdon, 1995, p. 165).

Policy Entrepreneurs

Given Abbott's reluctance to acquire the Nottingham site, the most obvious solution, finding a buyer interested in its continued use as a research facility, was clearly a non-starter, *"nobody wanted the site when we tried to sell it for its existing purpose – that was clear"* (former Boots/BASF scientist). Similarly demolishing the buildings, cleaning up the site and selling it to a developer, also proved to be a non-starter. Much of the site was contaminated following years of industrial use. Remediation to a standard commensurate with alternative commercial uses was prohibitively expensive.

Meanwhile months of uncertainty surrounding the future of the Nottingham research laboratories had led some senior scientists to consider forsaking the security of paid employment and setting up on their own by establishing a spin-off company. There already were a small number of life science spin-off companies in the city. Pharmaceutical Particles Ltd for example, was a spin-off from Nottingham University and the Royal Free Hospital in London set up in 1990 and specializing in early clinical drug development. Some ex-BASF scientists had even got as far as establishing nascent businesses offering contract research services to the pharmaceutical industry. One group had formed themselves into a company called Renasci Limited and were providing contract

screening and expert services in the field of obesity and diabetes treatments. One of the biggest challenges for scientists eager to take the spin-off route was finding appropriate laboratory facilities where they could carry out their work. As one of the interviewees noted in relation to such facilities, *"they are like gold dust… you either get them in universities or you are a large pharmaceutical company"* (former Boots/BASF scientist). The scientists at Renasci were fortunate. They persuaded BASF's management to allow them to continue to remain on the Nottingham site renting laboratory space on a temporary basis.

Against this background another potential solution began to emerge in the soup of ideas surrounding the newly opened policy window. This was the idea that the redundant buildings on the Nottingham site might be re-purposed by converting them into some form of life sciences incubator that would rent specialist laboratory facilities to embryonic life science businesses. Life science incubators were a comparatively new idea in the UK at this time. Most were small facilities located on university campuses and owned and operated by the universities themselves. As such they generally catered for university spin-offs. There were no such facilities in the East Midlands region. In general incubators were then located within established biotechnology clusters such as the 'golden triangle' (Smith and Ehret, 2013, p.66) of Cambridge, London and Oxford.

For BASF's management this potential solution had a number of attractions. It was a way of off-loading a redundant asset, and yet at the same time it offered the prospect of preserving some of Nottingham's science expertise and some of the associated jobs. It was also a creative response to another plant closure in the city, though it was a solution surrounded by risk and uncertainty. There was no precedent in the UK and it was difficult to see how it could be implemented. However, BASF's management came up with a novel way forward. BASF gifted the buildings, along with all the equipment like air conditioning, a manufacturing facility for early stage clinical trials and 16 medicinal chemistry laboratories (Connon, 2003) to Nottingham Trent University (NTU), the City's former polytechnic.

As far as the university was concerned the offer of the site was one thing, what to do with it quite another. Although NTU initially envisaged converting some of the space into teaching facilities, BASF's management was insistent that as part of the deal the spin-off businesses being established

by ex-BASF employees should remain and continue their work. As a result, the idea of conversion to teaching accommodation was quickly dropped and instead Ray Cowell, the university's vice chancellor, accepted the idea of using the facility as a life sciences incubator.

However there remained the problem of just how to do this, since the university had neither the expertise to run such a facility nor the funds to carry out necessary refurbishment. At this point a new institutional actor became involved, namely the East Midlands Development Agency (EMDA), the newly established regional development agency. While conversion to teaching accommodation was not consistent with the agency's economic development priorities, conversion into an incubator housing science-based start-up businesses was. Not only that, it came at a time when the Agency was under considerable pressure to implement the government's new policies for clusters and academic entrepreneurship.

Hence the solution that eventually emerged involved three institutions. BASF initiated the process by gifting the laboratories to NTU while at the same agreeing to underwrite the operating costs until the University was ready to take it over. NTU was notably entrepreneurial in both accepting the site and then agreeing to allow the facility to be used as a life sciences incubator. EMDA played a key brokerage role, requiring the involvement of both local universities and agreeing to fund the refurbishment of the facility, estimated at some £9 million over five years - on the condition that it was then operated by a joint venture comprising itself and both of the city's two universities.

Meanwhile when it became clear that BASF was divesting itself of the facility, there was considerable interest from small life science companies seeking to follow the example of Renasci and renting laboratory space within the facility. One Cambridge based company went so far as to offer to rent the entire R5 Chemistry building. As one of those involved in managing the transition to a life science incubator noted, despite nothing having been advertised, "*they were knocking on the door*" (former Boots/BASF scientist), requesting information about prices and availability. In the event it wasn't until 2003 that phase 1 of the BioCity Nottingham incubator was formally launched. This part of the facility comprised some 35,000 square feet and was fully occupied within two years (Smith and Ehret, 2013). Phases 2 and 3 followed in 2006 and 2009, by which time at 120,000 square feet the incubator was the largest such facility in the UK.

Temporal specificity

Central to Kingdon's (1995) conceptualisation of the policy window is the temporal dimension and the idea that such opportunities to effect a change of policy direction arise at certain times rather than others. This begs an obvious question: could BioCity have been established had this opportunity arisen in the years before or after 2003? In other words, were the policy entrepreneurs, capabilities and resources that were mobilised in 2003 present in the locality at other times?

If we consider the local situation in 1995 when Boots were in the process of divesting themselves of their pharmaceutical division, it is clear from both interviews and documentary sources that their principal focus was selling this operation as a going concern. Similarly, there is no evidence, prior to the establishment of EMDA and the unitary Nottingham City Council in 1998 of equivalent institutional capacity and resources to those deployed later in 2001-3. More positively, capabilities linked to the health sector and the local universities were present.

Moving forward to 2012 – the year in which EMDA was abolished - it is similarly difficult to identify the kinds of resources and capabilities that could be deployed in 2001-3. While the City Council had by this point developed a significant internal economic development function, the D2N2 Local Enterprise Partnership (LEP) was still in the early stages of development – lacking both the personnel and resources analogous to those available in 2001-3. The climate of public sector austerity at this time also raises serious question marks over the ability of local actors to brigade the necessary funding. Furthermore, the national policy environment was very different. In 2012 it is difficult to discern the equivalent of the almost hegemonic policy discourse associated with 'Porterian clusters' that characterised industrial policy in the years either side of the Millennium. More practically, the existence by then of similar life science incubators would have deprived BioCity of the 'first-mover advantage' it enjoyed in 2001-3.

Impact

A decade and a half on from the initial opening of the BioCity incubator, it is evident that its impact in terms of establishing a new development path for Nottingham's economy has been considerable.

It is now home to some 75 companies who between them employ 650 staff (Brown, 2014). With a 95 per cent occupancy rate it is perhaps not surprising that in 2017 a major new purpose-built extension, the Discovery building, funded by the city council and the D2N2 LEP, was opened providing a further 50,000 square feet of laboratory space. The largest of the firms to occupy the new building, Sygnature Discovery, established at BioCity in 2005 now employ some 200 staff. This has helped to make BioCity the UK's largest life science incubator.

The incubator's impact stretches further than the laboratory space that it provides or the number of tenant companies within it. In 1999 the Sainsbury Report (DTI, 1999) into biotechnology clusters in the UK, did not include Nottingham or any other part of the East Midlands region among the 10 areas of the UK that were home to biotechnology clusters. A year earlier Shohet (1998, p. 221) had similarly noted that, 'despite highly rated bioscience university departments with strong collaborative links with industry', Nottingham along with its East Midlands neighbour Leicester, was one of the areas of the UK, 'where relatively few biotechnology start-ups are to be found'. Similarly, BioCity's chairman, Glen Crocker, noted that prior to the opening of the incubator, 'there wasn't much in the way of small life science early stage companies in Nottingham' (Nottingham Post, 2012).

In contrast the East Midlands region is today home to more than 200 life science firms, more than 80 of which are located in Nottingham (see table 3). While Nottingham cannot match the leading cities in the so called golden triangle' such as Cambridge, nonetheless it does now rival important regional centres of life science activity such as Manchester (see table 3). The presence of many life science firms not just within the incubator itself but in the city at large reflects BioCity's success in attracting and supporting nascent biotechnology firms and establishing a life science development path for the city. The city doesn't possess a biotechnology cluster on a scale to rival the traditionally leading UK life science centres such as Cambridge, Oxford or London, but a notable biotechnology and life sciences cluster has clearly been established in the city (Crocker, 2019).

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Insert Table 3

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This growth in biotechnology and life sciences in the city has also been reflected in the policy priorities of agencies responsible for economic development in the locality. Back in 2005 Nottingham's potential in terms of the development of life science activity was recognised nationally when it was one of only six cities in the country to be designated a Science City by the UK government (Times Higher, 2005). The following year in 2006 the East Midlands Development Agency (EMDA) in its regional economic development strategy (EMDA, 2006) for the region identified bioscience/health as one of four priority sectors predicted to make the greatest contribution to the East Midlands economy over the lifetime of the strategy. Similarly, regional economic strategies for the East Midlands region (EMDA 2003, 2006) and the strategic economic plans of the Local Enterprise Partnership for Nottingham and Derby (D2N2,2013, 2016) also identified this sector in similar terms (Rossiter 2016).

There is a further way in which the BioCity incubator has had a significant impact, not merely within the East Midlands region but nationally. When first established in 2003, the BioCity incubator was unique within the UK. It pioneered the development of a novel type of incubator involving the transformation of redundant research laboratories of a pharmaceutical company into a biotechnology incubator, operated by an independent company. Prior to this biotechnology incubators in the UK tended to be relatively small purpose-built facilities located on university campuses and operated by universities (Smith and Ehret, 2013). Since then the BioCity model has been applied across the UK as concentration within the pharmaceutical industry has led to mergers and acquisitions (Owen, 1999), the rationalisation of research facilities and the closure of research laboratories. This has led a number of other cities in the North of England and Scotland to seek to replicate the Nottingham approach to life science-based development.

Table 4 shows the model pioneered at BioCity in Nottingham has been applied across the UK. Not only has this led to an expansion of biotechnology incubator capacity but the growth of the biotechnology sector generally. Indeed there is evidence of direct transfer of policy and practice from Nottingham to other cities in the Midlands and North of the UK – either directly through the

activities of BioCity and its staff[4] or indirectly where research touching on the Nottingham experience has been used to inform plans to develop incubator capacity elsewhere[5].

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Insert Table 4

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Conclusion

The case study has shown that the Nottingham biotechnology cluster was the product of industrial restructuring following a lengthy period of de-industrialisation that culminated in a crisis within an industrial sector that formed an important element within Nottingham's industrial base. In this it mirrored biotechnology incubators established in other parts of Europe such as Basel in Switzerland, Lodz in Poland, Tampere in Finland and Uppsala in Sweden. In the case of both Basel and Uppsala the similarities are especially striking since they too were triggered by laboratory closures following restructuring in the pharmaceutical industry.

The application of the MSF reveals significant differences between BioCity and these other life science clusters when it comes to the process behind cluster creation in particular the way in which agency was exercised and by whom. Chialoni and Chiesa (2006, p. 1074) note that in Basel and Uppsala the key role in the initiatives that led to the establishment of the cluster was undertaken by what they describe as, 'a central actor specifically created to promote and manage the restructuring process'. In contrast the case study makes clear that in Nottingham there were multiple actors and institutions involved in this process.

These actors comprised three groups, all of whom acted as policy entrepreneurs whose agency was instrumental in the creation of the incubator at the heart of the biotechnology cluster. The groups comprised BASF's UK management, the regional development agency EMDA and a group of

industry-based scientists several of whom had worked for BASF/Boots but who had established or were keen to establish biotechnology start-up firms.

The agency exercised by BASF's UK management took the form of their bold decision to give away their Nottingham research laboratories as a 'gift' to one of the local universities. Without this decision, which was unprecedented in the UK, the venture would never have got off the ground. The advocacy of BASF's UK management appears to have been critical in persuading the company's senior managers in Ludwigshafen that this was a viable option and one that would actually minimize the company's liability. Nor was this all that their agency entailed since BASF's UK management was also instrumental in persuading the German parent company to underwrite the operating costs of the laboratories while they were being refurbished.

Another institutional actor whose agency was important was EMDA, the local development agency. Not only did it provide valuable financial support to enable the project by funding the refurbishment of the laboratories, it also exercised agency through its role in brokering the involvement of both of the city's universities. Given the sometimes difficult relations between the two universities at the time, EMDA's influence was significant in brokering an agreement by which both institutions would participate in the development of the incubator.

The third group of actors and possibly the most important in terms of agency were the industrial scientists from BASF/Boots who had established biotechnology start-up firms and were keen to rent laboratory space at the Pennyfoot Street site. Their agency was particularly notable. Striking out to set up their own biotechnology start-up firms was a bold move at this time, especially since they were using a business model based on the provision of research services rather than the more conventional drug discovery model found in other life science clusters in the UK. Their agency was evident in their appreciation of the scope for applying their skills and expertise to the provision of contract research services. In the process they demonstrated an awareness of the increasing use of outsourcing of industrial research activities by major pharmaceutical companies. At the same time they showed a willingness to take risks, something that was perhaps atypical for scientists whose careers to date had taken the form of employment in industry.

Since the establishment of BioCity, cluster policy has been subject to considerable criticism (e.g. Martin & Sunley 2003) and so too has thinking in relation to industrial and innovation policy evolved. The kind of top-down policy led interventions characteristic of cluster policy around the Millennium (Swords 2013) have been supplanted by more nuanced policy approaches that recognise the importance of building on place specific assets and capabilities if new development paths are to be fostered – particularly in lagging or peripheral regions (see for example Barzotto et al 2019). They also seek to foster a process of entrepreneurial discovery within which state and private sector actors collaborate in order to identify new opportunities and activities to develop. These perspectives are central to the increasingly influential body of thought associated with Smart Specialisation (Foray 2009) that has become central to industrial and innovation policy across Europe – and particularly so during the EU's 2014-20 Programming Period (McCann & Ortega-Argiles 2019).

Reviewing the BioCity/Nottingham case with the benefit of some chronological distance, it is evident that, despite being established during a period in which policy-led or top-down approaches to cluster policy were common, it was the product of a more complex dynamic. Central to this dynamic was an interplay between top-down policy intervention, local circumstance and action. The national and regional policy context was important, but so too was a temporally specific blend of place based assets and capabilities and crucially the entrepreneurial agency of local actors. To this extent, the case may be seen as anticipating themes that were later to emerge in association with the concept of Smart Specialisation. It also highlights a need for further research to better understand the complex interplay between policy, place and agency in the path creation process and, specifically, the need to better understand these processes as they apply to cities facing the long-term consequences of de-industrialisation.

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Notes

[1] Ambiguity here is distinguished from uncertainty following Feldman (1989)

[2] Will Rossiter was research manager and then head of strategy at EMDA 2001-2011.

[3] Author's collection/EMDA Knowledge Bank archive held by Nottingham Trent University.

[4] BioCity is now directly involved in the management of incubators and/or the provision of related services in a number of other locations including Glasgow, Manchester and Newcastle.

[5] The authors and colleagues from Nottingham Business School have undertaken contract research that has been used to inform incubator planning and development elsewhere.