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Title

Science and technology in the service of the State – policy towards mission-oriented research in a changing world

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Mission-oriented science and technology – Government funded S&T activity in direct support of the goals or missions of the state – has a long history and accounts for a great deal of public spending on S&T. Such mission-oriented research - in fields such as defence, health and agriculture - has its own distinctive institutions and organizational structures to generate and apply knowledge that can be thought of as comprising a mission-oriented research system (MORS).

Foray et al (2012) argue that this mission-oriented research has tended to be overlooked by academic analysts of science and technology policy. Economists have tended to focus on public support of R&D as a response to "market failure" whilst scholars of science, technology and innovation policy have focused on instruments to stimulate economic growth. At the same time, several authors have argued that the mission-oriented research system is changing in response to stresses and dynamics stemming both from the world of public policy (Cox et al, 2001) and from the changing nature of S&T (Nowotny et al 2003, Nedeva 2012).

Against this background, how can MORS adapt to the changing nature of the missions that they face? How can they open-up to new sources of knowledge and expertise? Will traditional approaches be sufficient or will new ones be required? We contend not only that mission-oriented research and MORS have been under-investigated but that they have also been under-conceptualised. Our own studies of defence research (James, 2007; James, 2009) and research by other innovation scholars (Laredo and Mustar, 2000; Cox et al, 2001; Gassler et al, 2008, Stenberg and Nagano 2009; Polt, 2011; Crow and Bozeman, 1998; Bozeman, 2012) show differences not only in the conceptualization of mission orientation but also in the actors, institutions and knowledge bases involved. This suggests that there are may be different types of mission-oriented research system but we lack a widely shared existing typology to characterise these differences.

MORS have traditionally been oriented towards discrete and clearly defined objectives, have tended to be national rather than international in scale and have become strongly institutionalized and closed over time, most strikingly in the case of defence. MORS may be facing stresses and dynamics stemming from changes in the nature of missions, public policy and the nature of knowledge production and capability development (Foray et al 2012, Polt 2011; Mowery et al 2010; Bozeman, 2012). With regard to changes in missions, policy makers have always faced "wicked problems" (Churchman, 1967; Rittel and Webber, 1973) but today's "grand challenges" (in fields as diverse as climate change and security) increasingly spill over the boundaries of traditional policy systems (witness the changing conceptualisation of "security" as expressed in, for example, HM Government, 2010 and Ministry of Defence, 2012). They also spill over national boundaries. Such "grand challenges" are increasingly being incorporated into explicit public policy rationales for public S&T funding (Aho et al, 2006; Omenn, 2006; Mowery et al, 2010) in a funding environment characterised by low growth/no growth and fiscal austerity. At the same time, MORS are facing changes in the nature of knowledge production. Science and technology, and their exploitation, are increasingly global activities (Royal Society 2011, Edler and Flanagan 2011), raising questions about traditional national governance and funding models (Nedeva 2012). The 'open science' movement is becoming increasingly important with its emphasis on the accessibility of scientific research and data through the publishing of open research, emphasis on open access publication

models, encouragement of scientists to practice 'open notebook' science, 'citizen science' and other means of communicating or democratising scientific knowledge (David, 1998; Nielsen, 2012). Meanwhile 'open innovation' is becoming an increasingly common mode of developing and exploiting technology (Chesbrough, 2003).

If MORS are to continue to deliver what is required of them by policy makers, then they must adapt to these new conditions. Mission-oriented research performing organisations/actors simultaneously play roles in multiple and overlapping systems – the policy systems of their 'client' ministries, their national research and innovation systems, and international science and technology systems. For example, the UK Ministry of Defence's S&T policy acknowledges that the S&T knowledge and expertise it will need in the future will be increasingly open and global and necessitates engagement with "non-traditional" sources such as small and medium sized enterprises (SMEs) and universities (Ministry of Defence, 2012; Government Office for Science, 2011a; Ministry of Defence, 2007; Ministry of Defence, 2005). Similarly, the UK Department for Environment, Food and Rural Affairs (DEFRA) – like MOD a major funder and user of science - has been grappling with prioritising the S&T it will need in the short term whilst maintaining the research capacity that might be needed to underpin research, technical services and advice in the longer term (Office of Science and Innovation, 2006).

All this raises questions as to the ability of these MORS to change. Engaging with and making good use of external scientific advice is a challenge facing all MORS. Defence and security MORS have additional barriers to engagement (Government Office for Science, 2011a). Inertia, path dependence and lock-in have been found to characterise research and innovation systems as structures institutionalise around certain tasks (Malerba, 2002). Our own research on two decades of reform and change in UK and European public sector research organisations (Cox et al, 2001, James 2009) shows that change is uneven, often comes slowly and may have unanticipated consequences for the performance of the system. Today, in the current context of budget decline and fiscal austerity, there may be a particular tension between meeting short term needs and longer term goals around maintaining or reshaping research capacity. Starting from the assumption that mission-oriented research systems underpin the capacity to mobilise knowledge and expertise in order to support public policy and the provision of public/collective goods (Nedeva and Flanagan, 2005) and drawing upon relevant frameworks proposed by Laredo and Mustar (2000) and Crow and Bozeman (1998) we explore the challenges and opportunities MORS are facing and where the potential constraints and lock-ins may be located.