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Creating and Sustaining a Scientific Specialty: A Sensemaking Sensegiving Approach

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Abstract

How do scientists create a new scientific specialty and sustain it in a fast changing and complex environment? Research on scientific and intellectual movement (Frickel and Gross, 2005) and on boundary work in science (Gieryn, 1999) are particularly suited to study the emergence of new scientific specialties. However, as highlighted by Granqvist and Laurila (2011), although both of these streams acknowledge the influence of indirect pressures, they further describe how individuals demarcate their activity from religion, state and engineering (Gieryn, 1983) than deeply problematise their role in the emergence of a new scientific field. In their study of the emergence of nanotechnology in the US, Granqvist and Laurila (2011) use a framing approach in order to describe the influence of futurist visions on the emergence of a new field. Frames help events to be meaningful and 'function to guide to organise experience and guide action (Benford and Snow, 2000: 614). Frames and the very related process of sensemaking (Fiss and Hirsh, 2005) have been used to explain how individuals order their environment in emerging contexts (Granqvist and Laurila, 2011) but little attention has been paid to the full process of ordering and influencing the environment – described by Gioia and Chittipeddi (1991) as sensemaking and sensegiving. Although sensegiving is important in the process of boundary shaping (Santos and Eisenhardt, 2009), it has been neglected by the literature of emerging scientific fields. In such context, creating and sustaining a new scientific activity, scientists face numerous challenges such as gathering funding, publishing valid scientific outcomes, enrolling (Latour, 1987) and training new PhD students, being visible and recognised towards both the scientific community and the funding agencies, being legitimate and the like.

In order to address this issue, we based our research on a qualitative analysis of six sensemaking-sensegiving processes in the area of nanoscience and nanotechnology. The latter presents a fruitful fieldwork as its status of established field as not been settled yet and it is characterised by multiple scientific disciplines (Heinze et al. 2007) that are more or less overlapping (Meyer, 2001). Moreover, massive funding has been poured in the area of nanoscience and nanotechnology (Roco, 2005) which makes it a favourable emerging environment. By being dependent on external funding (Laudel, 2006), scientists have to make sense of the funding environment and which calls for funding they can apply for in order to both create and sustain the activity. We collected data from six teams – sensemaking-sensegiving processes – in order to understand how the activities have been created and are now sustained (see Table 1 page 6, for the presentation of the six teams). We then,

interviewed the individuals both policy makers and individuals in the funding agencies in order to have a fair picture of the area of nanoscience and nanotechnology and of the different actors – scientists and their teams, policy makers and funding agencies – that are involved in this area (see Table 2 page 7, for a presentation of the policy makers and funding agencies). Data has been analysed following three steps (Maitlis and Lawrence, 2009): (1) construction of narratives made of raw data such as documents and quotes from the interviews, (2) identification of the sensemaking and sensegiving processes and the different actions that are related to the internal (PhD students) and external (policy makers, funding agencies and the scientific community) influences, (3) focus on answering the research question (see figure 1 page 8, for the data structure).

We showed that scientists create a new vision that encompasses and aligns the expectations of all the actors that are directly, like the PhD students, or indirectly, like the policy makers, involved in the creation of a new scientific disciplines. This first step – sensemaking process – is characterised by the identification of an opportunity that can come from the *scientific community*, a disagreement with the current paradigm (Kuhn, 1970), the *political sphere*, a funding opportunity in an environment characterised by scarcity and competition (Laudel, 2006); or the *society*, fear of nanotechnology and risk assessment. This new vision is then materialised in different actions that characterise the new activity such as the *creation of new entity* labelled 'nano' in order to claim this new area of science and shape new boundaries (Santos and Eisenhardt, 2009), *a new type of publications* that tend to reach very generalist journals like Nature or the journals that characterise the community that is being transformed. This materialised new vision is then diffused towards the funding agencies, policy makers, scientific community, and educational systems in order to establish the position and shape the boundaries (Santos and Eisenhardt, 2009) of the new activity in the emerging field among the different actors – sensegiving process. Within this emerging and fast changing and complex environment, the two processes are intertwined on a day-to-day basis in order to adapt the activity to the environment: search for new funding or research opportunity, adaptation of the PhD students that are hired (different backgrounds), different journals targeted, broadening or narrowing of the research scope, etc. (see figure 2 page 9, for the representation of the sensemaking and sensegiving process).

Senior scientists have now to deal with multiple goals such as getting funding, being recognised in the scientific community and training PhD students to scientific research. These goals can be conflicting and the research activity has to be constantly adapted to fit the requirements of the funding agencies. By creating new boundaries, they create a new entity that encompasses the requirements from the funding agencies, the research community and the training of PhD students. The shaping and reshaping process enables scientists first, to be visible towards the different actors and second, to adapt their research activity by integrating new resources to their entity around a core expertise or knowledge. Sensemaking and sensegiving are materialised by the integration of new resources (funding), new projects (PhD students with different backgrounds). These processes are not only engaged at the creation of the new entity but also in day-to-day adaptations. So, sensegiving is an essential process in the creation of a new scientific specialty and therefore both sensemaking and sensegiving processes have to be taken into account in order to understand how scientists shape new boundaries and establish their new position in the emerging field.

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Table 1: Presentation of the cases

Team	**Alpha**	**Beta**	**Gamma**	**Delta**	**Epsilon**	**Omega**	**Total**
Specialty	Understanding the toxicity of the nanoparticles with human, mammalian and fish cells, and algae.	Studying the chemical interactions on semiconductors surfaces in order to improve their electrical properties	Understanding the electromagnetic properties of certain nanoparticles through computational simulation	Understanding how nanoparticles behave within human cells in order to use this properties to cure diseases	Investigating the growth and the study of semiconductors and nanostructures by using multiple characterisation techniques	Studying the electronic, chemical and structural properties of semiconductor surfaces by using radiation source	
Environment	multidisciplinary	monodisciplinary	monodisciplinary	multidisciplinary	monodisciplinary	monodisciplinary	
Research	experimental	experimental	Both simulation and theoretical work	experimental	experimental	experimental	
New entity	yes	no	yes	yes	no	no	
Professor	1*	1*	1*	1*			**4***
Lecturer	1				1*	1*	**2***
Postdocs	2	1	6	5		1	**15**
PhDs	6	2	3	1	3	3	**18**
total	**10**	**4**	**10**	**7**	**4**	**5**	**40**

* Team leader

Table 2: Presentation of the external stakeholders

Bodies	**Policy makers**	**Funding agencies**				**Total**
		Academe	Industry	Environment	European Commission	
Role	Establishing the main directives for nanoscience and nanotechnology, and science and technology in general	Funding academic research project mainly in the areas of biotechnology, information and communication technology and energy	Supporting companies and funding academic research project that aim at developing and/or to transfer a technology into industry	Funding projects that create knowledge and expertise in the area of environment and health, water quality and waste management	Funding projects that fall under the category of nanoscience, nanotechnology, materials and new technologies	
nano	2	1	3*	1	3*	6
S&T policy	1					1
Total	**3**	**1**	**3**	**1**		**8**

* The three interviewees in charge of the development of nanotechnology and technology transfer with industry are also the national delegates for the European Seventh Framework Programme. They thus have been interviewed in quality of both roles.

Figure 1: Data Structure

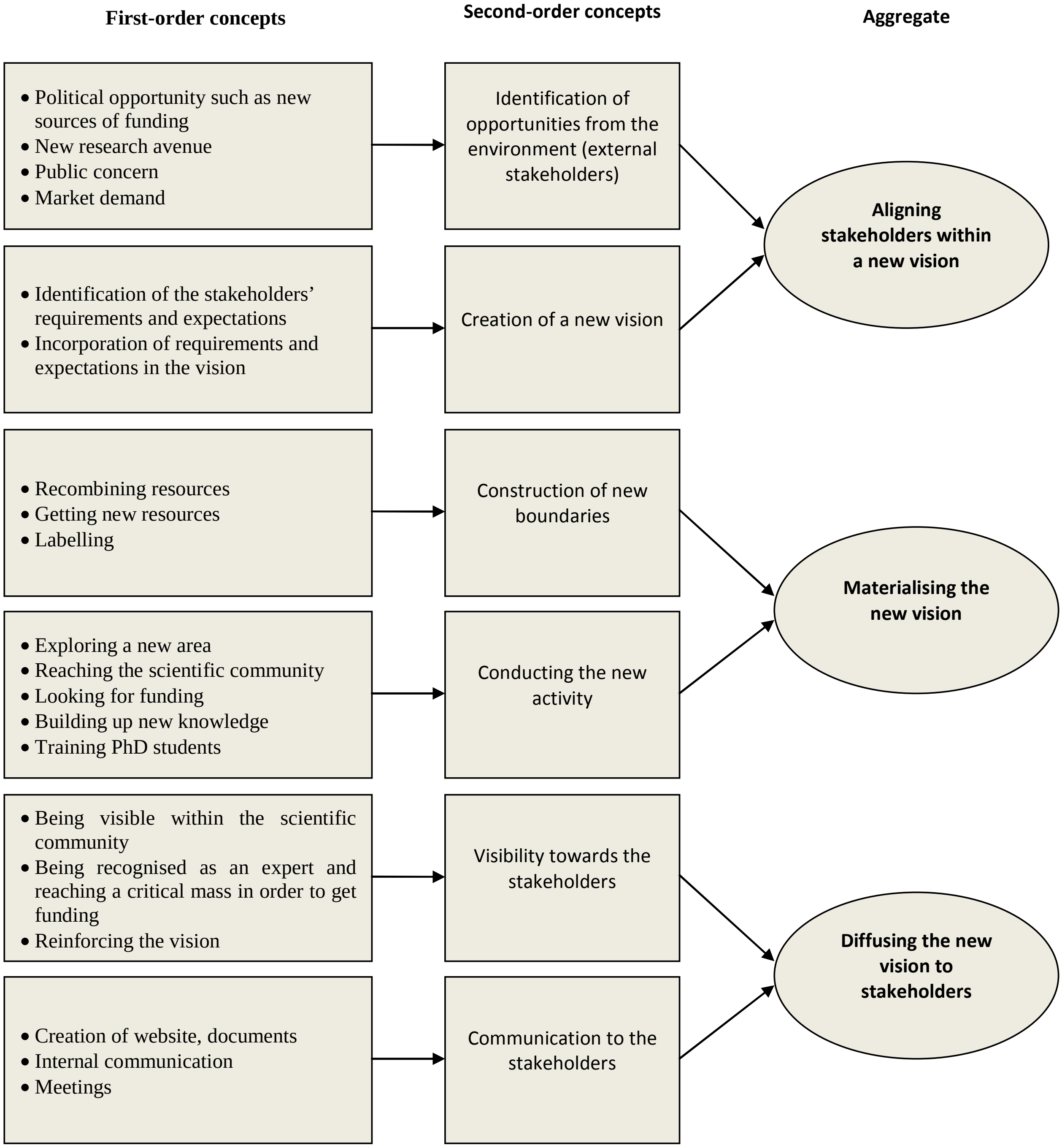

Figure 2: Sensemaking and sensegiving as intertwined processes