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Direction, not destination: Institutional work practices in the face of field-level uncertainty

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ABSTRACT

Though field-level uncertainty represents a common challenge, research seldom addresses how institutional work that aims to influence institutional change occurs in the face of uncertainty. We study institutional work practices in a field beset with high uncertainty. Focusing on a field-configuring event in the semiconductor industry, we show how institutional work is possible through practices of dealing with uncertainty that do not eliminate the basic uncertainty but nevertheless configure the field and institutionalize a common direction without specifying a final destination. We find evidence of the open-endedness and collectiveness of institutional work and we contribute to the microfoundations of institutional theory conceptualizing a set of four practices of dealing with field-level uncertainty purposefully but not purposefully, i.e., bootstrapping, roadmapping, leader-picking, and issue-bracketing. We highlight the reciprocal relationship between practices and uncertainty, focus on the coordination of institutionalization, and distinguish between events in fields marked by high versus low uncertainty.

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1. Introduction

Research on institutional fields tends to neglect uncertainty as it does not appear to be a problem, because institutions, by definition, are assumed to solve this problem and reduce uncertainty (Greenwood, Suddaby, & Hinings, 2002; North, 1990). Uncertainty also seems to be unproblematic for “institutional entrepreneurs” (DiMaggio, 1988) that are supposed to be projective actors who, also by definition, would have a clear vision of the institutions they wish to create and are unaffected by doubt (Bartley, 2007). However, some authors point out that “the exact nature of the relationship between uncertainty and institutional entrepreneurship is [...] not clear” (Hardy & Maguire, 2008: 203). The concept of institutional work (DiMaggio, 1988; Lawrence & Suddaby, 2006) allows us to study institutionalization with a view to the practices involved. In this article, we investigate how, against the background of field-level uncertainty, the general struggle for institutional innovation is not just one of power and coercion, but is rather one of overcoming a lack of knowledge and coordination.

We address this issue by means of an exploration of institutional work conducted in the field of semiconductor manufacturing. Institutional change in this field mainly revolves around the technological paradigm of producing computer chips, which involves a complex set of relationships between actors and artefacts, taken-for-granted understandings and material resources committed. This field represents a prime example of an “opportunity hazy field” (Dorado, 2005: 402) in which actors have developed practices of driving field-level innovation processes forward both in spite of, and in the productive use of, uncertainty. One such practice is convening (Dorado, 2005) and it can be analysed systematically with Lampel and Meyer (2008) concept of “field-configuring events” (FCEs). The semiconductor industry uses FCEs frequently (e.g. Müller-Seitz, 2012; Müller-Seitz & Sydow, 2012; Schubert, Sydow, & Windeler, 2013; Sydow, Windeler, Schubert, & Möllering, 2012), which is an important entry point for our investigation of institutional work. Hence we address the following research question: How do actors use field-configuring events to engage in institutional work when they face field-level uncertainty?

We explore the connections between institutional work and FCEs with an empirical study of which practices employed are employed at such FCEs in the face of uncertainty. We highlight the

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purposive open-endedness of institutional work and shift the emphasis from individual actions towards shared practices and the pragmatic coordination of institutionalization. Our research contributes to the conceptual refinement institutional work, because we suggest a subtle but important difference between *purposive* and *purposeful* action, which refers to the degree of intentionality involved in institutional work. Moreover, we highlight specific practices of ignoring, denying, displacing, and suspending uncertainty as actors engage in collective institutional work. At the same time, we discuss the implications for fields that are marked by uncertainty to a greater or lesser degree. Our overall message, as captured in the title, is that institutional work in the face of uncertainty often requires collectively finding a direction without necessarily having a clear destination.

2. Theoretical background and aims

2.1. Institutional work in the face of uncertainty

We position our study in the literature on institutional work that is interested in the everyday actions of actors and how they might influence institutionalized rules (Lawrence, Leca, & Zilber, 2013; Lawrence, Suddaby, & Leca, 2009). Practices can be understood – drawing, among others, on Giddens (1984) – as situated patterns of action organized around shared, yet malleable, practical understandings in time–space. They are a key element of the institutional work concept as they transcend, by definition, individual action but are nevertheless conceptually rooted in assumptions about agency. Lawrence and Suddaby's (2006: 215) definition of institutional work rests on the “the purposive action of individuals and organizations aimed at creating, maintaining and disrupting institutions.” We adopt this general definition and, at the same time, it is the aim of our study to explore the meaning of “purposive” in this definition and to connect it to field-level practices of dealing with uncertainty. As we show, the key question is how actors engage in institutional work when specific intentions are both difficult to form and urgently required in the face of uncertainty.

While others have asked which conditions enable or trigger institutional work, i.e., make it more likely (e.g., Hardy & Maguire, 2008; Lawrence, 1999), we propose to study how particular conditions influence *how* institutional work is performed. In particular, we argue that institutional work is marked, to a greater or lesser extent depending on the field, by the condition of uncertainty understood in the Knightian sense of the actors' inability to know and assess the possible futures (Knight, 1971). Dorado's (2005) notion of “opportunity hazy fields”, where agency is problematic, is similar to the condition of uncertainty we have in mind. The institutional work concept needs to include the constraining and enabling potential of uncertainty. Take for instance the field-level uncertainty surrounding crises like epidemics which some actors might use, or abuse, to foster their causes (e.g. Müller-Seitz, 2014).

Uncertainty is commonly treated as an undesirable contextual issue that needs to be managed (as ‘risk’) individually (Renn, 2008) or, ideally, eliminated through institutions (North, 1990) and institutional compliance that “reduces ambiguity and uncertainty” (Greenwood et al., 2002: 59). However, Beckert (1999: 782) claims that “uncertainty represents a crucial variable for the explanation of institutional change.” He further suggests that under conditions of field-level uncertainty and institutional instability, a creative form of agency may be triggered in order to regain certainty. Beckert's (1999) argument that the desire to eliminate uncertainty can also give rise to strategic action is supported by other authors who theorize that “uncertainty in the institutional order provides considerable scope for institutional entrepreneurs” (Maguire,

Hardy, & Lawrence, 2004: 659). Zimmerman and Zeitz (2002: 422) even argue that strategic action aimed at acquiring legitimacy for new practices is “more likely to be successful when there is uncertainty in the environment.”

We build on these concepts and investigate a case where field-level uncertainty is used to mobilize actors and get them to engage in collective institutional work. We are interested in the kind of case where all actors are supposed to move in the same direction despite uncertainty about the most desirable destination. We build on the idea that institutional work involves “a wide range of actors” (Lawrence & Suddaby, 2006: 217; Wijen & Ansari, 2007). Thus we contribute to research on distributed agency in institutional contexts (e.g. Lounsbury & Crumley, 2007) and show how actors collectively find new ways of doing things when no-one knows what will work and the field is “opportunity hazy” (Dorado, 2005).

2.2. Field-configuring events and institutional work

We further develop Dorado (2005) idea of convening as a “resource mobilization process” in opportunity hazy fields by drawing upon Lampel and Meyer's (2008: 1026) idea of FCEs, understood as “temporary social organizations [...] that encapsulate and shape the development of professions, technologies, markets, and industries.” We assume that such events can be occasions for addressing field-level uncertainty and engaging in collective institutional work. They allow us to tap into practices that are otherwise difficult to observe, and to explore “social microcosms that can foreshadow and simulate an unrealized shared vision of a focal technology, market, or industry” (Lampel & Meyer, 2008: 1030). We are particularly interested in how institutional work at FCEs supports coordinated investments in the institutionalization of a new field-level technological paradigm with wide-ranging social and economic implications beyond the technological features as such.

Previous research shows how conferences served as field-configuring events for institutionalizing a particular technological option, thus reducing uncertainty for all actors in the field (Garud, 2008). Zilber (2007) presents a case of institutional maintenance at a conference that aimed to reduce the collective uncertainty after a crisis following a high-tech bubble. Schüßler, Rüling, and Wittneben (2014) study United Nations climate conferences that are potential, but difficult, events for achieving institutional change in a highly complex and uncertain field. Extending these studies, we presume that conferences are the kind of events that represent opportunities to study in vivo “the old conundrum of agency and structure” (Lampel & Meyer, 2008: 1034) with a particular focus on the condition of field-level uncertainty. Hence our overall research question, put more precisely, is: How do actors use field-configuring events to engage in institutional work when they face field-level uncertainty as a constraint and, at the same time, as a medium for such institutional work?

3. Research setting and methods

3.1. Empirical setting

Previous studies document that the semiconductor manufacturing industry, as a field, is characterized by high uncertainty (Browning & Shetler, 2000). The uncertainty stems in the first place from the radical changes in the technological trajectories being pursued (Brown & Linden, 2009; Sydow et al., 2012). The high uncertainty is related to finding technical solutions in the narrower sense and also involves strong economic and institutional dimensions of uncertainty regarding the required investments and the reliability of any new paradigm established. Against this backdrop, ever since the 1980s actors have been aware that they cannot

pursue novel technological trajectories on their own, but that they need a field-level response (Browning, Beyer, & Shetler, 1995). A field-level response was particularly needed in the late 1990s when a collective search for the ‘next generation’ of lithography (NGL) was pushed for. At the time, optical lithography was the dominant technology for making ever more powerful computer chips but had long been expected to reach its physical limits. The technology relied on machines known as steppers that use light, lenses, and masks to burn the pattern of a chip onto silicon plates called wafers (see Brown & Linden, 2009). This complex system technology contains high-tech subsystems from many different suppliers. The identification of an NGL would ensure the continued improvement of computer chip performance in line with ‘Moore’s Law’ (a productivity projection published in Moore, 1965), in which the number of transistors on leading-edge chips doubles about every eighteen months. The rapid pace of product performance improvements created a strong sense of urgency among actors in the industry who shared the assumption that the enhancement of existing optical lithography could not be continued forever. Actors faced the dual uncertainty of technology and timing, because they did not know which alternative technologies would be feasible and at what point NGL tools might be required or available for mass production (Appleyard, Wang, Liddle, & Carruthers, 2008; Linden, Mowery, & Ham Ziedonis, 2000). The declared goal was to reduce the high uncertainty for the field as a whole and this was achieved, at least in the minds of actors who participated in NGL conferences, by identifying a common technological direction:

“In August 2001, ISMT held the fifth and final NGL workshop. We believe we have achieved the goal of narrowing the NGL options and facilitating a technology decision. The results have been consistent; EUVL and EPL have remained the top two options to develop into manufacturing tools” (Dao, Mackay, & Seidel, 2002: 31).

We focus on the field-configuring event mentioned in this quote, i.e. the Fifth SEMATECH Workshop on Next Generation Lithography (Fifth NGL Workshop) which took place in Pasadena, California, on August 28–30, 2001. This was the final conference in a series of similar consensus-building events, and speakers therefore made references to conclusions reached at previous conferences, particularly the one immediately prior to it (Fourth NGL Workshop, Reston, Virginia, September 25–26, 2000). It was organized by the International SEMATECH consortium – the leading global consortium in semiconductor manufacturing, comprising at that time thirteen organizations representing about 50% of the worldwide semiconductor market (Browning & Shetler, 2000). According to the workshop documentation (SEMATECH., 2001: 75), the Pasadena event brought together 183 representatives from 70 organizations active in semiconductor manufacturing, including chipmakers (20%), equipment and materials suppliers (48%), and research and development centres (32%), and all participants were from the northern hemisphere (North America 59%, Asia 26%, Europe 15%).

3.2. Research design

Field-wide conferences are interesting for our study for several reasons: As mentioned in the introduction, Dorado (2005) theorized conferencing or “convening” as an overarching practice of dealing collectively with uncertainty and we set out to investigate this empirically. In doing so, we looked for the lower-level practices within the overall practice of “convening” at the Fifth NGL Workshop. Hence, we distinguish the holding of (a series of) conferences as a practice from the sub-practices involved within a single

conference or FCE. Prior studies of recent developments in the semiconductor industry have also noted the role of conferences (e.g. Müller-Seitz & Güttel, 2014; Schubert et al., 2013; Sydow et al., 2012) but have not zoomed in to the same level of detail as we do in this study regarding specific practices at conferences.

The Fifth NGL Workshop in particular is interesting because it took place at a time when the actors were confronted with challenging conditions affecting the whole industry. Moreover, the workshop was the final part of the NGL Workshop series and it aimed explicitly at narrowing down the technological options available and concentrating the investments made by the industry in order to reduce uncertainty. Hence, this workshop stood out in terms of the level of uncertainty assumed *as well as* the level of effort expected to be invested to deal with it. Participants recognized that conferencing would not necessarily lead to the best technological option in ‘objective’ terms, which would still be uncertain, but claimed nevertheless that “a lot is gained already when it is agreed to concentrate all forces on one technology that stands at least a good chance to succeed” (interview with optics supplier).

Drawing on Lampel and Meyer’s (2008) conceptualization for our research design, the Fifth NGL Workshop matches the characteristics of an FCE, i.e., diverse actors assembled in a location for a limited period of time to make sense collectively, using ceremonial and dramaturgical activities. We assumed that it is likely that institutional work takes place and can be observed at such an event. Again, the Fifth NGL Workshop was most suitable as it was most clearly aimed at shaping the future of the whole industry. The event theme was “Working toward Commercialization,” and its explicit objective was “developing recommendations that will focus industry resources on the commercialization of NGL” (SEMATECH., 2001: 1). Commercialization, here, means that a possible new paradigm actually becomes institutionalized. Hence we decided to focus our data collection and analysis on this event that the organizers hoped would configure the future of the semiconductor field. The stated intention behind the Fifth NGL Workshop was collective uncertainty reduction and our main analytical interest is *how* this was actually done, i.e., which kinds of practices of dealing with uncertainty in order to perform institutional work could be found at the event.

3.3. Data sources

Our analysis of the Fifth NGL Workshop in Pasadena draws upon two consecutive research projects involving seven researchers (2003–2010 and 2010–2013) and was geared towards understanding more specifically the way organizations collaborate in inter-organizational networks in order to face technological uncertainty in the semiconductor industry. One of the authors was a member of both projects while the other was formally only part of the first project but associated with the second and contributing data from complementary field work.

To analyse the Fifth NGL Workshop as a site of institutional work, we used three different sources to gain a deeper understanding and different perspectives: first, we make use of 135 semi-structured interviews (average length: 60–90 min) conducted in the course of the two projects that we have been involved in over a period of more than ten years. Among the participants were representatives from SEMATECH (44), suppliers (40), chip manufacturers (25) and other consortia (9), as well as senior civil servants, research laboratories and consultants (17). At first, we identified interviewees by ‘snowball sampling’ and initial contact partners were asked to identify other potential respondents involved in coordinating field-wide activities. The interviews addressed how the field of semiconductor manufacturing had evolved over time, who the key actors had been and which central activities had

served to coordinate the field. Roughly half the interviews are particularly relevant to our specific study here because they relate directly to field-configuring events. The others mainly gave us general information about the field and its current pressing issues, but already in our first, very general interviews the great importance of events, and especially the Pasadena workshop, surfaced without our prompting. The ongoing nature of the research gave us an opportunity to compare earlier assessments of the Fifth NGL Workshop against later interpretations. Hence, the findings presented here are the result of an ongoing learning process by the research team as interviews were conducted continuously over many years.

Secondly, we drew on archival data. These mostly comprised the publicly available Final Report of the SEMATECH NGL Task Force (SEMATECH., 2001) and the entire set of presentations from the event. We also included materials from the four previous NGL Workshops as well as other events hosted by SEMATECH, leading organizations (e.g., Intel), or networks (e.g., the International Technology Roadmap for Semiconductors) as background to our analysis. The third type of source we used were internet searches and the *Lexis Nexis News* archive (English language) to gather any press releases or similar announcements issued on the conference, in order to assess how the event was interpreted publicly across the field (e.g., in media such as *Semiconductor International*). These kinds of documents are interesting precisely because they are not neutral but are rhetorically charged – thereby revealing institutional work practices (Müller-Seitz & Sydow, 2012; Suddaby & Greenwood, 2005).

3.4. Data analysis

Data were analysed in an iterative fashion by the research team members using the data generated. There were three stages in the data analysis which we separate for analytical purposes, although in fact these were closely intertwined. We split them here for presentational reasons (see Fig. 1 for an overview).

In the first stage we coded the interview and archival data related to the Fifth NGL Workshop. The coding of the data was undertaken to reconstruct the subjective interpretations of the actors involved, in line with the methods used in similar previous research on FCEs (Garud, 2008; Lampel & Meyer, 2008; Schüßler et al., 2014; Zilber, 2007). The material was examined with the aim of gathering general descriptions of the event together with perceptions of uncertainty. These first-order categories were data-driven and resulted in some overlap that needed screening and further analysis. For instance, the term “showstoppers” refers to in-vivo coded remarks about potential technological hurdles that could not be overcome and that might terminate a technological trajectory. Other instances of this included codes such as “roadmap” or “technical champion”. These in-vivo generated codes had a certain face-value meaning but required further interviews to be undertaken in order to better understand the distinct practices associated with these codes and how they relate to the problem of uncertainty.

In the second stage, we used the in-vivo first-order categories to sensitize us for the practices engaged in by the actors during the Fifth NGL Workshop. These second-order themes were researcher-induced. The process of defining them was supported by two

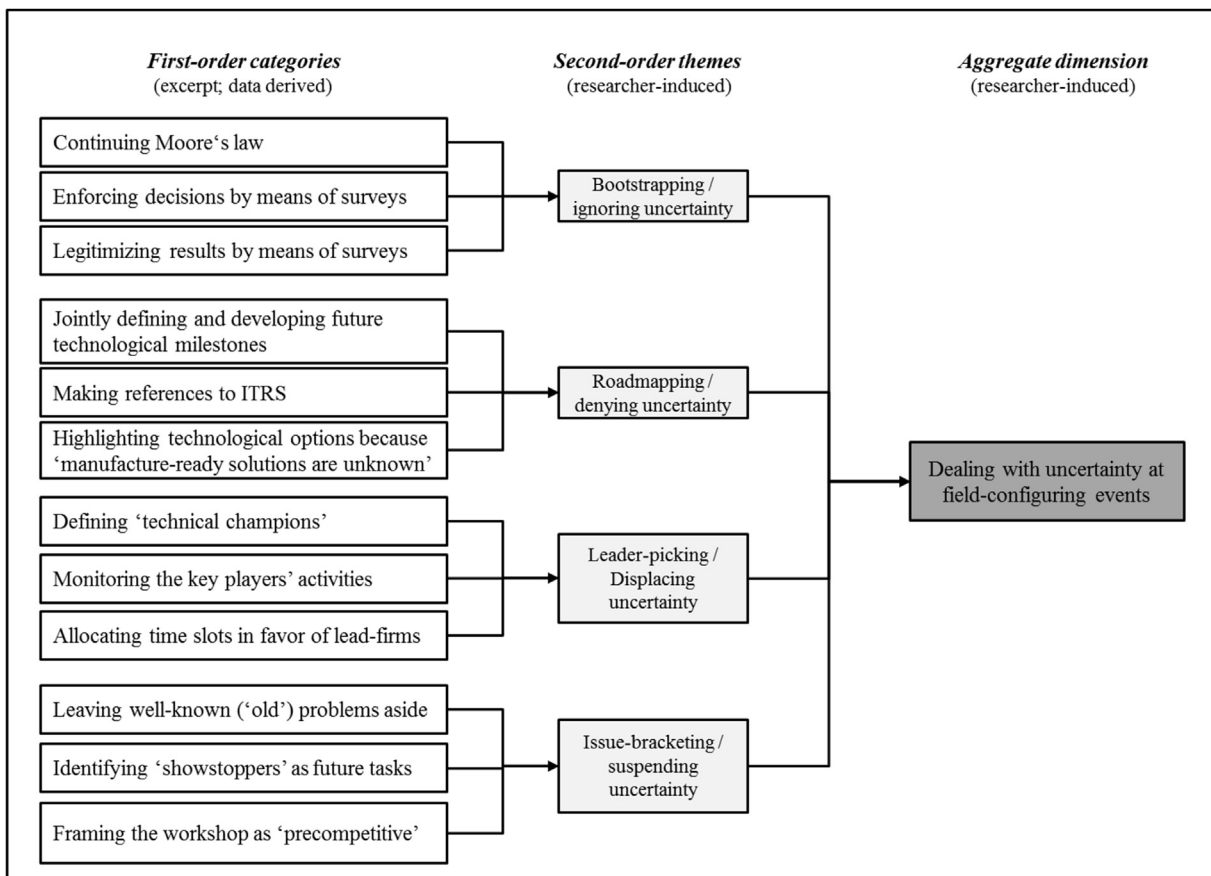


Fig. 1. Emergent data structure.

assistants of the research team who were trained to code the data independently with regard to the practices employed. Joint discussion allowed us to analyse the practices employed from different perspectives. The resulting coding scheme was consolidated by two members of the research team who constructed a set of mutually exclusive categories (cf. Fig. 1).

Table 1 offers illustrative data concerning the different practices used to deal with uncertainty. The labels are meant to convey the mechanisms underlying the practices and they were inspired either by the terminology used in the field (roadmapping, leader-picking) or by an appropriate imagery (bootstrapping, bracketing), but not by any particular theoretical source. For instance, we came to see the “surveys” conducted by the event organizers not just as opinion polls (face-value interpretation) but as a form of bootstrapping (researcher-induced interpretation).

4. Findings

4.1. Dealing with uncertainty at the fifth NGL workshop

We analysed how actors in the semiconductor industry address field-level uncertainty and engage in institutional work at conferences. We identified four practices of institutional work in the face of uncertainty, namely bootstrapping (i.e., reaching conclusions without conclusive evidence), roadmapping (i.e., defining future technological milestones), leader-picking (i.e., using and reinforcing momentum), and issue-bracketing (i.e., excluding or postponing topics). These practices are not mutually exclusive and can occur at the same time and in combination, but for analytical purposes we present them separately whilst, together, they capture the key practices of collective institutional work at the Fifth NGL Workshop.

4.2. Ignoring uncertainty: bootstrapping

Bootstrapping denotes self-starting action and plays on the image of pulling oneself up by one's own bootstraps. We found evidence for this practice in those activities that would enable participants to reach agreed conclusions without conclusive evidence. This practice is most evident in the survey conducted by the

conference organizers. It was the most striking feature of the Fifth NGL Workshop (and of all the previous ones since 1997) and is recalled most vividly by participants (e.g., interview with optics supplier). Towards the end of the final day, the workshop agenda included a session roughly 1 h in length in which participants gathered to complete an anonymous survey using a comprehensive set of questions on the different technological options, including the summary question: “If your company had to choose only one option today, what would your company choose?” (SEMATECH., 2001: 10, 7–46). This was essentially an opinion poll that “takes a pulse” (*EE Times*, 13th September 2001) among the 29 chipmakers, 29 suppliers, 12 R&D institutes, and 6 other organizations participating in the conference. A total of 76 surveys were completed, of which 45% were from North American, 30% by Asian, and 25% by European delegates (SEMATECH., 2001: 12), “in order to capture the opinion of decision makers in this industry at this point in time” (interview with chipmaker). The results of this survey were presented to the participants the same day, at the end of the Conference Dinner.

After dozens of presentations detailing the progress made on the different technological options but which notably also mentioned the many unresolved issues that still existed, participants could not have had more than a tentative opinion on the future of lithography and would have been very much biased in their views by their own prior investments. By getting the participants to actively engage in the survey, however, these tentative opinions were turned into concrete percentages: survey results suggested that conference-goers had “decided” to go with EUVL because this had won an absolute majority of votes for the most advanced method of manufacturing computer chips. It was also allegedly “decided” through the survey that the EPL option would continue to be pursued, while all other options appeared to have been abandoned. The following interviewee confirms this – at least superficial – sense of a consensus but does not recognize the flaws in how it was reached:

“It takes a while until you reach consensus [...] the actors agree upon what they think, what they have heard, what [...] has been presented and whatever information they have at hand and they agree upon what the biggest risks are for a specific technology.” (interview with SEMATECH executive)

Table 1
Practices of institutional work: relating data to mechanisms and labels.

Practice of institutional work	Definition	Mechanism of dealing with uncertainty	Data source	Illustrative evidence
Bootstrapping	Self-starting action, concluding without conclusive evidence	Ignoring uncertainty	Interview data	“Based upon the survey results all of the 130 people came together on the third day to discuss issues in detail and [...] people voted in line with the principle of narrowing the options; they just said, it's impossible for this industry to develop four technologies in parallel and they really tried to find out what the moods were in the marketplace, of opinion leaders” (interview with chip maker)
Roadmapping	Assigning dates to events though the future is unknown	Denying uncertainty	Archival data Interview data	Document relating to EUVL data in the ITRS at the Fifth NGL Workshop (2001): “Continuing progress demonstrated – No showstoppers.” “I may put something on a roadmap without knowing how I'm going to get there, but at least I will seriously pursue it.” (interview with optics supplier)
Leader-picking	Making others go ahead, following the key actors	Displacing uncertainty	Archival data Interview data	The “Proposed EUV mask table for ITRS 2001” assigns as of 2001 future technological milestones for the years 2006, 2007, 2010, 2013 and 2016 (ITRS 2001 backup slide prepared for the Fifth NGL Workshop). “Everyone was well aware that the technology that wins allows everybody else to join in” (interview with chip maker)
Issue-bracketing	Putting problems aside, postponing and excluding	Suspending uncertainty	Archival data Interview data	Fifth NGL Workshop document relating to EUVL support: “All European key players participate.” “When the key decision was made [...] that this will be the path to go ahead, this path would be a bumpy road.” (interview with chip maker) Critical issues are identified as tasks for the future, but the overall message is positive: “Significant progress is being made ...”, but need for “closing gaps” and “more effort” identified (SEMATECH., 2001).

Nurturing the presumed field-level consensus, the followings unqualified statement topped the list of results from the Workshop: “The NGL options have been narrowed to EUVL and EPL” (SEMATECH., 2001: 1, 6). Interestingly, these two options emerged as survey favourites at every NGL Workshop since 1998 (see Dao et al., 2002), showing that the conferences and surveys were designed to generate, sustain, and ideally reinforce momentum in the face of uncertainty. With the 2001 survey, SEMATECH advised that the commercialization of EUVL and EPL should be accelerated (see SEMATECH., 2001: 2, 6, 77–78). Workshop participants, mobilizing their own agency, could use the result to justify their own future actions, even though they would sense that it was not binding and had been reached in an attempt to defy uncertainty. An optics supplier remarked: “The survey is better than nothing. It is not perfect, of course, but it is extremely sensible to do at least this.” The same respondent told us that the survey results were taken seriously “also because there was nothing else” (interview with optics supplier) and another respondent pointed out that “many firms based their further investment decisions or new projects on the conference results” (interview with chip manufacturer).

This was reinforced by the fact that the survey results were announced by the organizers at the concluding Conference Dinner – a ceremonial element of this FCE – and expected with excited anticipation and suspense, because “it was not the case that everyone knew the results in advance” (interview with chipmaker). The survey gained “a kind of cult status” among participants and the presentation of results at the Conference Dinner “underlined the importance and mutual bonds” (interview with an optics supplier). Bootstrapping here focused actors very much on the present (“choose only one option today”) to strengthen the momentum in the quest for a field-level solution.

Online media in particular reported almost verbatim the results of the conference as SEMATECH had framed them (e.g. *Business Wire*, September 13, 2001), sometimes using headlines that would send an even stronger message than the SEMATECH press release itself. *Electronic News*, *EE Times*, *Embedded*, *PR Newswire*, and others highlighted the survey results and thus reinforced the bootstrapping effect of this practice across the field, reaching also those actors who had not participated in the event themselves. We could not find any sources that challenged the conclusions from the conference, though there were some more balanced reports later on in *Embedded* (25th February 2002) and critical statements in *Semiconductor International* (1st January 2004). Other commentators continued to make claims that pushed for EUVL as the evident solution, e.g.:

“The Extreme Ultraviolet Lithography (EUVL) technology is transitioning from the basic research and technology demonstration phase into commercialization. [...] The remaining challenges have been identified and laboratory and industrial support are continuing to reduce the risks for developing beta and production tools.” (Gwyn & Silverman, 2003)

It seems that this kind of bootstrapping works well especially when everyone is desperate to find something to hold on to; thus uncertainty is both an issue and a condition for its own bootstrapping solution.

4.3. Denying uncertainty: roadmapping

Roadmapping has a strong tradition in the semiconductor industry (see e.g., Schubert et al., 2013) and it was used widely during the Fifth NGL Workshop as well. Roadmapping implies dealing with uncertainty by assigning dates to desired future states. The result is

a projection of the journey along a yet unexplored route; thus it is unlike the tried-and-tested roadmap one can buy for a car trip, but the term suggests similar reliability. We take the label ‘roadmapping’ in-vivo from the terminology used for this practice by actors in the field. Roadmapping, and in particular making references to roadmaps at an event like the one we study here, is a simple but effective technique used to make informed guesses about uncertain future states and to assign a chronological order to the events necessary to reach a future goal. For example, the Final Report stated that “production tool shipments [would be] starting in the 2004–05 timeframe” (SEMATECH., 2001: 1). The roadmaps referred to standardized “nodes,” i.e., different stages in the development of NGL. All participants at the Fifth NGL Workshop understood that they were not merely talking about how to solve technological problems in principle; for the institutionalization of a new technological paradigm, timing was an essential issue (SEMATECH., 2001: 14). Hence participants pointed out the proper timing of their own contributions.

The coordination effect achieved by roadmapping did not depend on the actual level of consensus about the dates. All participants still had a private opinion and their own organization-internal roadmaps, but publicly everyone referred to the main roadmap, the International Technology Roadmap for Semiconductors (known as ITRS), and this was recognized to be the most influential tool to offer guidance for the whole industry. Participants at the Fifth NGL Workshop made shorthand references to the ITRS and positioned themselves on this map (e.g. SEMATECH., 2001: 2, 6). For example, Nikon presented a detailed slide with its “EUVL tool development plan.” These are not merely attempts at basic planning; roadmapping activities are evidence of how actors struggle with field-level uncertainty and actually deny it, at least for the near future, by presenting what looks like a very clear plan, even if it is still qualified as “tentative” in smaller font on the same presentation slide as in the case of Nikon just mentioned. Roadmaps point to the future and participants are encouraged to imagine, and commit to, future states: “I may put something on a roadmap without knowing how I’m going to get there, but at least I will seriously pursue it” (interview with optics supplier). Thus, roadmapping is influential even though actors recognized its socially constructed character. Again, uncertainty is not just the problem to be solved by a roadmap but is also the condition that enhances the broad acceptance of the roadmap, at least superficially.

4.4. Displacing uncertainty: leader-picking

The practice of leader-picking is defined here as the practice of using and reinforcing the momentum of some actors so that other actors will follow them. Leader-picking was evident at the Fifth NGL Workshop when all participants were collectively referred to by SEMATECH as “the world’s leading lithography experts” (SEMATECH., 2001: 77). However, they were not all considered equally important. Some chipmakers and their collaborators were labelled “Technical Champions”. They represent small groups of leading firms working on the development of the main technological options and who would report on the current status at the workshop. The “Technical Champion” label was specific to the NGL field and introduced by SEMATECH who also nominated the champions (interview with chipmaker). Even if the expression “champion” sounds more glamorous than the actual role played by these firms (interview with optics supplier), they were in a highly exposed position at the conference, “not only during the presentations but also in discussions, during breaks and, in the evening, at the bar” (interview with chipmaker).

Other participants were members of the NGL Task Force and as

such were entitled to make recommendations to SEMATECH and the industry as a whole at the end of the Workshop (SEMATECH., 2001: 5). This means that some actors had the chance, but also the responsibility, to take the lead in the face of uncertainty. The leader-picking label that we use here is intended to capture the language of leadership and champions used in the field and how the leaders were collectively constructed and elevated so that they were not so much taking the lead as being given it.

It is notable, for instance, that as part of the leader-picking practice, the three tool suppliers ASML, Canon, and Nikon were mentioned by name in the Final Report (SEMATECH., 2001: 1, 6) as the actors spearheading the commercialization of EUVL and EPL. With a combined market share of 88% of the lithography market (Linden et al., 2000: 106) these so-called system integrators played an undisputed leading role. Still, their explicit mention in the report further focused the attention on them. In an interview with a chipmaker we learned that at that point in time a clear commitment from the system integrators was very important. It would also mean that all other conference participants (and subsystem suppliers in particular) could follow these three actors, i.e., they could channel their own resources in a complementary direction to the path these firms were taking: “In the weeks after the Workshops we would watch very carefully if any firm adapted its direction” (interview with chip manufacturer). As a subsystem supplier explained: “My feeling is that you have to watch who the key players are and what the key players are doing” (interview with mask supplier). And an optics supplier said that the commitment of leading tool manufacturers would “motivate their suppliers to pick up speed, too.” We recognize the pattern: in the face of uncertainty, leaders are particularly welcome and are more easily accepted.

4.5. Suspending uncertainty: issue-bracketing

The practice we call issue-bracketing acknowledges the fact that topics are sometimes either excluded from the agenda altogether or they are highlighted but then postponed (i.e., suspended) until an unknown point in time after the end of the conference. Hence, critical issues are acknowledged to cause uncertainty, but they are then consciously put aside for later consideration. Therefore, this practice is different from the three practices described above, which essentially ignore uncertainty (bootstrapping), deny it (roadmapping), or displace it (leader-picking).

At the Fifth NGL Workshop, each report on the great progress made by actors in different areas would regularly be followed by lists of disclaimers and unresolved issues that were often quite long but still relatively subdued. These disclaimers were constant reminders that no NGL option was guaranteed to actually become viable. Yet this did not stop the NGL Task Force, SEMATECH, or industry leaders from announcing in 2001 that the overarching objectives had been met, i.e., the NGL options ranked, with the favoured option of EUVL being identified.

Issue-bracketing usually took the form of postponement, when actors suggested that certain issues should be considered later. It also occurred when actors were discouraged from bringing up “old” issues that had previously been “solved”, e.g., at the previous NGL Workshop (see SEMATECH., 2001: 2). This practice thus spanned several interconnected events in the NGL Workshop series and it was collective in the sense that participants would accept the bracketing of certain issues and, more importantly, they saw the necessity of bracketing to allow the industry to move forward.

The Fifth NGL Workshop was a so-called “pre-competitive” activity, meaning that the participants intended to act on their common interest in finding technological solutions. This can be read as another variant of the practice of issue-bracketing, wherein the issue of future competition was nominally bracketed out of the

discussion at the conference. In truth, though, the event had at least a potential to influence competition within future NGL markets. The presentations made by suppliers can be interpreted as business-to-business marketing at an early stage:

“The conferences are not only scientific places, where all the scientists are showing the smallest details of their research. There is also a marketing aspect playing a role.” (interview with research centre representative)

Some suppliers like Lasertec and Seiko gave presentations with more advertising than technical information and all firms sought to present themselves in a favourable light to potential business partners, of course, but on the whole most participants maintained the fiction of a “pre-competitive” R&D event.

One result of the survey that went against the original consensus-building objective of the organizers was included in the Final Report but not given much emphasis. In response to the question “When should the industry fund only one NGL technology?”, more than 50% of respondents answered “Never” instead of picking a specific year (SEMATECH., 2001: 38). A sizeable minority of 33% also did not agree that the output of the NGL Workshop was a fair and accurate representation of the industry consensus (SEMATECH., 2001:44). This limited convergence was bracketed out in summary presentations and press releases later on. Perhaps one of the biggest surprises at the conference was that a new, less advanced option known as 157 nm lithography won considerable support and threatened to reduce the momentum of the favourite EUVL and EPL options (see *EE Times*, 13th September 2001), but this development was not even mentioned in the official conference reports. Finally, some very fundamental challenges to the whole NGL movement were virtually excluded, or very much side-lined, at least in 2001, such as the question of whether Moore's Law really could continue indefinitely (interview with chip maker).

In the survey at the end of the conference, 51 out of 76 respondents agreed with the statement, “The major outputs from the NGL Workshop(s) fairly and accurately represent the lithography industry consensus” (SEMATECH., 2001: 44), and a large majority of participants agreed that their firms supported and valued the NGL Workshops (SEMATECH., 2001: 45). This indicates that participants took the conference output seriously and thus deemed it likely to influence their further institutional work efforts. However, an organized event like the Fifth NGL Workshop can suggest a direction but – even when bracketing out the minority opinions – conferences like this cannot guarantee a true consensus that all actors will enact with the same level of enthusiasm. During the conference, however, this is precisely what most participants wanted to believe. The more overwhelming the uncertainty one faces, the more one is prepared to bracket out anything that stands in the way of a clear direction.

5. Discussion and theory development

Our study generates three important findings on what practices of institutional work are employed at FCEs in the face of uncertainty. First, although actors across the field faced very high technological and economic uncertainty, they worked to overcome the institutional uncertainty and participated in activities designed to generate momentum in a particular direction, even though the final destination, i.e. the exact shape of the future institution in the sense of a broad technological paradigm, could not be known. Confirming Beckert (1999), we found that actors went beyond practices that would serve to reduce uncertainty objectively and engaged in practices that would use uncertainty as an opportunity and reduce uncertainty only superficially. Even though the particular event

studied here may represent a specific case, actors in other industries might deal with field-level uncertainty in a similar fashion.

We have considered practices of institutional work in this study where the “purposive action” that is at the heart of the concept of institutional work can be seen in a combination of an unclear purpose with a very clear urge to move forwards. Our findings offer a refinement of the concept of institutional work, because we suggest a subtle but important difference between “purposive” and “purposeful” action, which lies in the more specific intentionality attributed to the latter but not to the former. There is indeed an important and analytically valuable difference in meaning between purposive and purposeful, which Chia and Holt (2009) also draw on in their work on “strategy without design.” The Merriam-Webster Online Dictionary (retrieved October 14, 2017) confirms the practical relevance of this distinction: Purposive can mean “serving or effecting a useful function though not as a result of planning or design”; it can also mean “having or tending to fulfill a conscious purpose or design” and, in this meaning, it is synonymous with purposeful, i.e. “intentional”, “full of determination”. The key difference in meaning, we argue, lies in the clarity of the “design” pursued. We propose to describe institutional work as “purposive” when a plan or design is absent or very vague and to describe it as “purposeful” when such a plan or design is strongly and clearly present.

Notwithstanding Lawrence and Suddaby’s (2006; Lawrence et al., 2009) idea that all institutional work is to some degree intentional in a broad sense, researchers on institutional work can use our insights in the future and indicate more precisely whether any observed instance of institutional work can be regarded as merely “purposive” or also “purposeful”. Similarly, Muzio, Brock, and Suddaby (2013: 708) point to “the degree of variation in reflexivity and agency in processes of institutional work.” We may expect that higher levels of uncertainty trigger practices of institutional work that entail more purposive, rather than purposeful, actions, because uncertainty makes it difficult for actors to form clear intentions.

Second, following on from the previous point, we can delineate contours of FCEs as occasions for institutional work in the face of field-level uncertainty (see also Dorado, 2005; Müller-Seitz & Güttel, 2014). Lawrence et al. (2009: 10) state that “little is still known about the concrete practices employed by actors in relation to institutions” and our findings serve to increase this knowledge. Specifically, we show how FCEs help actors in field-level institutionalization processes to cope with uncertainty collectively (see also Lounsbury & Crumley, 2007). We found remarkable practices of ignoring, denying, displacing, and suspending the unfavourable conditions of uncertainty for industry-wide institutional change that actors engaged in collectively. We refer to these practices as bootstrapping, roadmapping, leader-picking, and issue-bracketing, respectively. They played an important role at the event we analysed, but they were neither newly created at this event nor unique to it. They were carried over from previous events and from activities outside the bigger events, they were familiar to the participants, and they were mobilized to deal collectively with uncertainty without ‘objectively’ reducing it. Thus it is these rhetorically-charged practices, rather than individual strategic

actions, which lower the degree of perceived uncertainty (Suddaby & Greenwood, 2005).

Third, building on the previous point, we acknowledge the very high field-level uncertainty in the semiconductor industry and the fact that other events might take place in fields marked by less uncertainty. Hence we suggest that a general distinction is needed between FCEs where the field-level uncertainty is perceived to be either high or low. Tentatively, FCEs in the context of low field-level uncertainty should have a more ceremonial character. Typical examples are the Booker Prize (Anand & Jones, 2008) or the Olympic Games (Glynn, 2008). In contrast, our study can be positioned as an FCE marked by high uncertainty in an “opportunity-hazy field” (Dorado, 2005). Comparing these two forms, we presume that primarily ceremonial events reflect the lower field-level uncertainty, as for example when the Booker Prize is awarded or a fixed set of qualified athletes take part in the Olympic Games. The contenders compete in a well-established game. The focus is on past (Booker) or present (Olympics) achievements, leading to an award ceremony. Since the contest as such is institutionally reproduced, these events are closely connected to the category of institutional maintenance (Lawrence & Suddaby, 2006), i.e. they keep the field-level uncertainty at a low level, though individual participants might still perceive uncertainty as to their chances to reach an individually desirable outcome (e.g., Gold Medal).

In contrast, FCEs of the type discussed in our study are characterized by high field-level uncertainty reflected in the lack of clarity as to which actors and technological paradigms are actually relevant. Here, the game is still being established and practices of sense-giving, rather than sense-making, occur. FCEs in a field marked by high uncertainty will tend toward institutional creation or disruption work, especially when maintenance as mere continuation is explicitly ruled out as an option, like in the semiconductor industry that searched for the ‘next generation’ of lithography. It can be framed as a pre-competitive arena, i.e. the new rules of the game are still being developed, albeit against the history of previous institutions. In highly uncertainty contexts, though, actors collectively look for future developments instead of the past or present. They still draw on past achievements and some present institutions are maintained so that the disruption is perceived as manageable though it will bring lasting changes for the field as a whole. Table 2 offers a stylized summary of these ideas. The two forms of FCE express a continuum and we call for a gradual understanding of field-level uncertainty as a condition for institutional work.

In sum, as our findings show, a clear vision of the desired future is not a requirement to engage in institutional work practices, nor is it a realistic representation of the conditions under which actors relate to institutions still in the making. Rather than preventing agency, uncertainty might be enabling and triggering agency as well, giving rise to practices geared towards coping with it (Müller-Seitz, 2014) and not primarily toward reducing it as documented in much previous research (Renn, 2008). As Dorado (2005: 402) proposed, in “opportunity hazy fields” we can expect to see processes of “institutional convening [that] may jumpstart processes leading to institutional change” which, as we emphasize, do not require a specific, pre-defined outcome. Our research underpins the

Table 2
Contrasting field-configuring events characterized by low versus high degrees of uncertainty (stylized depiction).

FCE Features	FCE in a field marked by low uncertainty	FCE in a field marked by high uncertainty
Uncertainty of actors	Fixed set of actors	Partially unknown set of actors
Temporal orientation	Past and present (sensemaking)	Future (sensegiving)
Primary Institutional Work orientation	Maintenance	Creation or disruption
Mode of competition	Competitive	Pre-competitive

view that actors shape new institutions indirectly (Phillips, Lawrence, & Hardy, 2004) and they do so when they seek ways to proceed in the face of uncertainty. They are mindful of emerging institutions, but their institutional work is open-ended. Moreover, practices of institutional work employed also reflect how uncertainty is perceived. There is a reciprocal relationship between uncertainty and the practices of institutional work aimed at dealing with it.

6. Limitations and outlook

In common with all research of this type, our study has several limitations. First and foremost, condensing raw data and transforming them into more abstract researcher-induced categories requires something of a creative leap (Langley, 1999). However, we grounded our observations in the subjective interpretations of the actors and went back to the field to refine our conceptions. Second, we drew upon secondary data as indirect evidence of the practices used at the FCE. Note, though, that it would be misleading to try to reconstruct “what really happened” in Pasadena during the event. The data used are remnants from the field and it was neither possible nor intended on our part to maintain a fully detached stance as researchers. We interpreted in the most meaningful way the actors’ different perspectives on FCE-related practices of institutional work in the face of field-level uncertainty.

Another limitation is that this study was focused deliberately on the last conference in the series of NGL Workshops. An extension of this initial work could first analyse all five events in detail and trace any developments in the four practices over time. Allowing for some variation in the specific techniques employed (such as the survey at the end of the conferences), researchers could also study how often the practices identified here are common at other conferences and, more generally, at other FCEs as a function of the level of uncertainty perceived in the field.

For managers and others involved in institutional work, we suggest that actors need to decide for themselves, depending on their position and interests, whether they can use the practices of bootstrapping, roadmapping, leader-picking, and issue-bracketing to their advantage. All of these practices do not reduce uncertainty objectively but mainly subjectively and superficially, which implies the risk that uncertainty might return when the veil of functional collective self-deception is lifted. Hence, we make no normative claim about these practices, but we argue that they demand our attention and we acknowledge recent attempts at fathoming the moral underpinnings and implications of institutional work (Lawrence et al., 2013; Nilsson, 2015). Institutional work practices can offer a pragmatic, purposive way of proceeding and do not imply the purposeful execution of a strategic plan with a clearly defined end-goal. This line of thinking contributes to the conceptual clarification of institutional work as practices that comprise actions that are more open-ended and varied than those that have been discussed as institutional entrepreneurship (e.g., Battilana, Leca, & Boxenbaum, 2009; Hardy & Maguire, 2008), without becoming unlimited and thus meaningless. Institutional work in the face of uncertainty is about providing direction, even when the destination is unclear: “All deliberation is a search for a way to act, not for a final terminus” (Dewey, 2007: 193, original emphasis).

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