Schafft Wissen: Gemeinsames und geteiltes Wissen in Wissenschaft und Technik: Proceedings der 2. Tagung des Nachwuchsnetzwerks "INSIST", 07.-08. Oktober 2016, München

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Herausgegeben von
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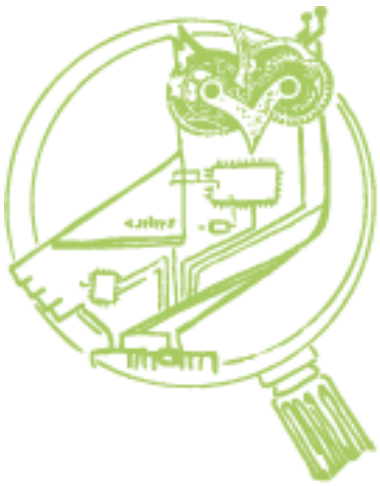

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Geleitwort

Initiiert an einem Bielefelder Küchentisch, blickt das Interdisciplinary Network for Studies Investigating Science and Technology (kurz: INSIST) auf eine mittlerweile fünfjährige Geschichte zurück. Der Anspruch der Beteiligten war von Anfang an, Nachwuchsforscher*innen, Studierenden und allen Interessierten, die sich für Fragen der Geschichte, Philosophie und Soziologie der Wissenschaft und Technik und angrenzende Felder interessieren, eine Plattform zum thematischen wie auch informellen Austausch zu bieten. INSIST versteht sich als *bottom-up* organisierter, offener Rahmen für das Ausprobieren und die gemeinsame Umsetzung neuer Ideen, als Interessenvertretung für Nachwuchsthemen und auch als Möglichkeit zum Knüpfen von Praxiskontakten.

Wie fruchtbar neben dieser Offenheit auch die Schaffung von Kontinuität sein kann, zeigt die Tatsache, dass aus der ersten INSIST-Nachwuchstagung, die 2014 in Berlin stattfand, inzwischen eine Konferenzreihe geworden ist. Am 7. und 8. Oktober 2016 fand in München die zweite Tagung mit dem Titel „Schafft Wissen: Gemeinsames und geteiltes Wissen in Wissenschaft und Technik“ statt – diesmal mit großzügiger Unterstützung des Munich Center for Technology in Society (MCTS) der Technischen Universität München.

Neben einer inspirierenden Keynote von Prof. Dr. Ulrike Felt (Universität Wien) bot diese Konferenz in zehn interdisziplinären Panels ein breites Spektrum an Themen und viel Raum für kritische Diskussionen. Alle Beiträge einte das gemeinsame Interesse an den vielfältigen Aushandlungsprozessen, denen wissenschaftliches wie technisches Wissen in verschiedensten Kontexten der Produktion und Kommunikation unterliegt. So ging es in den Vorträgen unter anderem um die Wechselbeziehung zwischen Wissen und Öffentlichkeit(en), Wissen und Politik, Wissen und Körper sowie Wissen und Digitalisierung. Daneben wurden Orte des Wissens, aber auch sozio-experimentelle Wissens(an)ordnungen und Fragen der Teilhabe an Wissen bzw. der partizipativen Wissensproduktion diskutiert. Darüber hinaus wurde die Nachwuchstagung durch eine Ausstellung mit Collagen von Laura Voss (MCTS) bereichert, die in ihrer Auseinandersetzung mit Innovation und der Produktion von Wissen und Technologie wissenschaftliches und künstlerisches Arbeiten in einen fruchtbaren Austausch bringt.

Zur INSIST-Tagungsreihe erscheint hiermit nun auch der zweite Band der Proceedings-Reihe. Ein Teil der Vorträge wurde von den Autor*innen zur Veröffentlichung ausgearbeitet und hat ein Peer-Review-Verfahren durchlaufen. Wir bedanken uns ganz herzlich bei allen Autor*innen, Reviewer*innen und Herausgeber*innen für ihre unermüdliche Arbeit – und freuen uns schon jetzt auf die dritte INSIST-Nachwuchstagung, die im Oktober 2018 in Karlsruhe stattfinden wird.

Julia Engelschalt & Franz Kather, Universität Bielefeld
Sprecher*innen von INSIST

Editorische Notiz

Die hier versammelten Beiträge der zweiten INSIST-Nachwuchstagung 2016 „Schafft Wissen: Gemeinsames und geteiltes Wissen in Wissenschaft und Technik“ reflektieren, wie auch die Proceedings zur ersten INSIST-Tagung, sowohl die Bandbreite an Themen, die aktuell in der Wissenschafts- und Technikforschung diskutiert werden, als auch die rege Beteiligung unterschiedlichster Fachrichtungen an diesen Diskussionen.

Um – bei allem Wunsch nach Interdisziplinarität – der disziplinären Verortung der einzelnen Autor*innen gerecht zu werden, haben wir uns entschieden, die Zitierweise, die bibliographischen Angaben und fachspezifischen Gepflogenheiten im Textsatz weitgehend beizubehalten und lediglich im Layout zu vereinheitlichen.

Die Reihenfolge der hier zusammengestellten Artikel reflektiert weder die zeitliche Abfolge der Vorträge im Verlauf der INSIST-Tagung, noch soll durch die gewählte Anordnung eine qualitative Wertung vorgenommen werden. Vielmehr möchten wir auf diese Weise die Vielfalt und Unterschiedlichkeit der größtenteils in deutscher und erstmals auch teils in englischer Sprache eingereichten Texte unterstreichen.

Eine künstlerische Rahmung für den Band bilden ausgewählte Collagen von Laura Voss, die während der Tagung in München ausgestellt wurden. Entsprechend beginnt der Band mit einer Erläuterung dieser Arbeiten unter dem Titel „Technologie und Collagekunst“ (*Voss*). Im weiteren Verlauf des Bandes markieren die Collagen eine lose thematische Gruppierung der Textbeiträge in fünf Schwerpunkte: Popularisierung von Wissen im historischen Kontext (*Odenwald, Bauer*); Wissen in Experimentalanordnungen (*Funk, Borbach*); Wissensgemeinschaften (*Gaentzsch, Fritz, Seitz*); Wissen und Organisationen (*Coban, Deisner & Grieser, Kressin*); und schließlich Technik und Narration (*Rothenhäusler, Meinecke & Voss*).

Wir möchten uns an dieser Stelle bei allen Autor*innen für ihre Einreichungen bedanken. Alle Beiträge haben ein anonymes Peer-Review-Verfahren durchlaufen. Daher gebührt unser Dank auch den Mitgliedern des Review-Teams für ihre konstruktiven Anmerkungen und Verbesserungsvorschläge. Für die Möglichkeit der Online-Publikation im Social Science Open Access Repository (SSOAR) danken wir außerdem dem GESIS Leibniz-Institut für Sozialforschung.

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The Relationship between Openness and Closedness in the FabLab. A Differentiated Typology of Possible Relations between Institutional Logics

Jana K. Deisner & Chris Grieser

1. Introduction: Openness in the FabLab

FabLabs are open workshops which, in principle, provide access to expensive high-tech machines to anyone interested in using them. They are commonly associated with the idea of openness as well as democratic and decentralized access to means of production (Wirth/Meier 2013, Rosenfeld Halverson/ Sheridan 2014). In our study, we regard the FabLab as a specific kind of shared machine shop (cf. Dickel et al. 2014). Open workshops are "open" in the sense that there is public access to the machines, in contrast to closed access to machines which typically characterizes company production lines. Even though access to the machines in a FabLab is limited by several boundaries (users usually have to attend an introductory session and pay a fee), they can be seen as an expansion of access to the means of production and invention. Similar arguments can also be found in some of the more enthusiastic literature on the Open Source and Open Hardware movement (ibid.). But besides access to the machines, open workshops and especially FabLabs are seen as places of sharing knowledge among users and developing prototypes collaboratively. Therefore, they are also open regarding the sharing of knowledge. As a FabLab founder told us, even companies coming to the Lab for their developments cannot keep their knowledge "closed" from other users, because the building is open and everybody can see what they do.

The Fab Charter[1] specifies this idea for FabLabs by claiming that "Fab labs are available as a community resource, offering open access for individuals as well as scheduled access for programs." As a community resource, which is open to everyone, FabLabs are seen as a shared good which must be protected from being misused and exploited for commercial purposes: "Commercial activities can be prototyped and incubated in a fab lab, but they must not conflict with other uses,

1. The Fab Charter: http://fab.cba.mit.edu/about/charter/ (last access: March 18th, 2017).

they should grow beyond rather than within the lab, and they are expected to benefit the inventors, labs, and networks that contribute to their success" (ibid.).

As often stated in the literature on Open Source, Open Access and governance mechanisms, openness and the ideals of free sharing are contradictory to notions of commodification and appropriation of goods (e.g. Raymond 1999, Holtgrewe/Werle 2001, Franzen 2014, Volkmann et al. 2014, O'Mahony 2007, Gläser 2003, 2007). Therefore, the following statement of a co-founder of a FabLab, in which he emphasizes that there is no contradiction between commercial use and open collaborative invention at his FabLab, appears puzzling: "It is not really an expression of our social conscience that we keep things open, but rather an intentional business practice. For me, that does not exclude that a bigger number of people can benefit from our work. For me, both belong together" (FabLab co-founder #1, transl. the authors).

This remark raises the question of how the apparent contradiction between openness and closedness is resolved at the FabLab, leading the co-founder to state that the FabLab benefits from the ideals of sharing as well as the ideals of commodification. The explorative, qualitative study presented here was thus guided by the question of how macro-level structures, i.e. the logics of openness and closedness, are implemented on the meso and micro levels of the FabLab and its developers. With our article, we hope to contribute to the understanding of open workshops such as FabLabs by developing a heuristic typology of the relationing of heterogeneous locis in practices. By doing so, we aspire to follow up on neo-institutionalist work on the relation of heterogeneous institutional logics.

We began our empirical endeavour with three explorative interviews in different open workshops during which we asked representatives about the basic "philosophy" of their workshops. Essentially, there are three different types of open workshops (see table 1): first, there are business-orientated open workshops which see themselves as start-up incubators and thereby legitimate the relatively high fees they charge for membership and the use of machines. Other than that, there are hackerspaces which are distinctly against commercial interest of any form and should not be used as co-working space. These two cases show that even among the open workshops, the ideals of sharing and the commodification of inventions are perceived as somewhat incompatible. Both incubators and hackerspaces position themselves between the two norms, but on opposite ends of the continuum. However, as the previous quote by the FabLab co-founder illustrates, FabLabs position themselves right between incubators and hackerspaces. According to the founder's description, they even reject the idea that there is a tension between openness and closedness. Thus, we decided to further investigate the FabLab as a social system which enables collaborative innovation by supporting open exchange and commodification of knowledge at the same time.

	Start-Up Incubator Workshops	FabLabs	Hackerspaces
selectivity of members	open to companies only, private individuals not welcome	companies as well as private individuals welcome	open to private individuals only, companies not welcome
desired application	commercial use desired	commercial as well as non-commercial use allowed	commercial use frowned upon

Table 1: Typology of open workshops, based on explorative interviews

We conducted four guideline interviews in total: two with the co-founders of a FabLab, and two with leaders of projects conducted at the FabLab. The projects were selected based on recommendations of the FabLab founders, a short explorative phase in the FabLab, as well as the projects' varying degree of integration in the FabLab. The interviews were coded iteratively, starting with a broad focus on typifying practices of developing something new in the FabLab, expanded inductively by the information we gathered from the analysis.

In the following sections of this article, we will first review the existing research on openness and subsequently present our own framework for handling heterogeneous logics based on previous research on institutional logics. Afterwards, we will apply our framework to the case of collaborative invention at the FabLab, illustrating how only a differentiated perspective that distinguishes types of relationships between heterogeneous logics enables us to understand the process of collaborative invention at the FabLab.

2. Previous research on openness and closedness, and institutional logics

Four main bodies of research are relevant to our concern: (1) research on conceptions of openness in general, (2) research on open source software projects stating a contradiction between the open sharing and private appropriation of knowledge, (3) work on open innovation explaining how openness can be used for purposes of appropriation, and (4) literature on institutional logics as the generalization of openness and closedness, where we focus on investigations of the different types of relationships which can exist between two logics.

2.1 The Relationship between openness and closedness

For the sake of clarity, it is necessary to elaborate the often ambiguously used terms "openness" and "closedness." By "openness," we denote the institutional logic of open access to or publication of all knowledge necessary to develop a material object, software, or artwork, along with the use of "open licenses" that en-

sure that the benefits of that knowledge cannot be appropriated by an individual or a company. Furthermore, membership in the respective developing community is unrestricted and based upon self-identification (cf. Benkler 2002: 367). Both characteristics can be found in the self-description in the Fab Charter cited above. They are further emphasized by orders written on a wall in the lab: "Help each other!" and "Got a question? – Ask the person next to you!" In contrast, the term "closedness" will be used to describe restrictive access to knowledge, the use of exclusive licenses such as patents and copyrights, as well as forms of selective membership. Practices of closedness can also be found in the FabLab. On the one hand, the Fab Charter allows companies to use the FabLab even if their goal is to register a patent, as long as they acknowledge/compensate everybody who contributes to their development and "grow beyond rather than within the lab" (ibid.). On the other hand, there are some areas where membership is selective. For example, users have to attend an introductory session before they may use the machines, and they have to pay for using the machines unless they have a special contract with the lab.[2] We understand openness as well as closedness to be specific institutional logics, i.e. bundles of complementary institutions associated with a certain social realm (Friedland/Alford 1991, Thornton/Ocasio 2013).

Generally speaking, there are two different positions on openness and closedness in previous research. The first position assumes that classic business models of openness and closedness are contradictory and incompatible by nature, and that the existence of one logic in a domain excludes the other. The release of open source code is seen in opposition to proprietary software licensing practices (Raymond 1999, Holtgrewe/Werle 2001), and the organization of scientific publications in open access systems is regarded as an antipode to publication by traditional publishing companies (Franzen 2014, Volkmann et al. 2014). Moreover, the demand for openness is not only associated with questions of access, but also with a new form of social production. Open source communities are seen as a form of governance based on solidarity and a sense of community, distinct from traditional governance modes like markets or hierarchies (e.g. O'Mahony 2007, Gläser 2003, 2007). This claim is also corroborated by empirical cases like the Homebrew Computer Club. Here, the emergence of business interests in the open developing community of the personal computer quickly replaced the ideal of openness as the engineers began to keep their knowledge to themselves (Meyer 2003: 14p.). From this perspective of contradictory logics, we should expect that FabLabs lean towards either openness or closedness to avoid contradictions, similar to hackerspaces and start-up incubators.

The second position presumes that the logics of openness and closedness can support each other in a somewhat harmonic symbiosis. Most of this literature is well known under labels such as "open innovation" or "collective invention," where ideals of openness are discussed as being beneficial for business. As a re-

2. Our understanding of openness corresponds to the handling of knowledge and membership in the logic of science as described by Merton (1973 [1942]), while our understanding of closedness corresponds to the logic of the economy.

sult, companies that implement open logics can increase their performance and profits (e.g. Allen 1983, von Hippel 2005, Chesbrough 2006, Pénin 2008). More recently, research on open source communities has discussed the economic benefit private companies can have from sponsoring them, e.g. by selling products which are complementary to the software. It is noteworthy, however, that the products themselves are not necessarily open (e.g. Osterloh/Rota 2007, Raasch et al. 2008, Schrape 2015, Adler 2015). We could thus regard the FabLab as such a company, selling a service (access to machines) that is complementary to data which are openly produced in the maker community (e.g. blueprints). However, with regard to the exchange of knowledge among users and the collaborative invention in the FabLab, the situation is more complex. People help each other without expecting a direct reward, and they develop products together which only one of the parties involved might sell in the future. Therefore, there seems to be more than a simple relationship between openness and closedness. To further illuminate this, we draw on neo-institutional theory regarding heterogeneous logics. By interpreting openness and closedness as institutional logics, we find some fruitful studies which we will examine in the following subsection.

2.2 Different relationships between institutional logics

Generalizing the phenomenon of openness and closedness as institutional logics allows us to tap into the theoretical insights of a broader body of research and transfer knowledge from other empirical cases. The term "institutional logic" was coined by Friedland and Alford (1991), describing bundles of reciprocally related, symbolic and material structures that take certain forms of coordination. Out of all the literature on heterogeneous institutional logics, we are particularly interested in studies on multiple or competing logics as they describe various possible relations between logics.

An important branch of research broaches the issue of changing dominant logics in a social system (Thornton/Ocasio 1999). Those studies often focus on the causes of that change. Examples are change driven by social movements (Rao et al. 2003), or change that can also take place without social movements but by specific selection of practices by a certain environment (Berman 2015). Further research stresses that the change of the dominant logic does not necessarily result in a complete replacement of the former "incumbent" logic, as the old logic continues to exist in a weakened form. (Reay/Hinings 2005, Heinze/Weber 2015). Nonetheless, these investigations suggest that the existence of multiple institutional logics in the same social system leads to tension and conflict.

Other studies show that the introduction of a new logic does not necessarily lead to the displacement of the old logic but rather to some sort of hybridization of both logics. Labelled as synthesis, compromise, blending, or hybrid logic, these studies show that the two logics are "merged" in some way (e.g. Jay 2013, Battilana/Dorado 2010). Considering the conception of logics displacing each other, some studies also show how in the process of replacing an old logic, the new logic is altered by the old one (Meyer/Hammerschmidt 2006, Have-

man/Rao 1997). While these studies can be interpreted as showing an outcome in which both original logics are altered and therefore somewhat weakened, they can also be interpreted as an indication that logics can somehow coexist peacefully.

A far smaller branch of literature on institutional logics explicitly discusses the topic of non-conflicting relationships between heterogeneous logics. Some scholars conclude that "institutional theorists have largely emphasized conflicts between contradictory logics and their representatives [...] we know a lot about how they are kept apart, little about how they coexist, and virtually nothing about how they can positively feed off each other." (Smets et al. 2015: 932). Nonetheless, these studies are of importance as they describe other forms of relationships between institutional logics: inside a social system, heterogeneous logics can be separated to avoid tension and conflict. This insight has been labeled either as compartmentalization (Kraatz/Block 2005), segmentation and demarcation (Smets et al. 2015), or selective coupling (Pache/Santos 2013). Moreover, there are cases where both logics profit from each other's presence, a phenomenon labeled as bridging (Smets et al. 2015), or cases where a new dominant logic somehow "subdues" the former logic, leading to some sort of instrumentalization (Meyer/Hammerschmidt 2006: 1012). Finally, McPherson and Sauder (2013: 186) remark that instead of conflict or separation, they observe a "steady coexistence of multiple frameworks without signs of threat to the integrity of any".

This leads us to the problem of distinguishing between different types of relationships that institutional logics can generally have. While some studies construct a typology of organizational responses to handling multiple logics (e.g. Oliver 1991, Reay/Hinings 2009), our concern is not only production and reproduction of practices on the micro level, but also the outcome at the meso level, namely the resulting relation of the co-existing logics. In this respect, some authors have already tried to explicitly or implicitly derive typologies from their case studies: bridging and segmentation have been distinguished as two oscillating types (Smets et al. 2015). By describing selective coupling as a way of handling conflicting logics, others differentiate it from decoupling and compromising (Pache/Santos 2013). Besio and Meyer (2015) use their case studies to distinguish decoupling (some sort of internal separation of logics) from translation (some sort of hybridization or instrumentalization) and Petschick, Schmidt, and Norkus (2013) discuss how the two logics they studied are actively separated in the beginning but later weakened each other. By discovering the steady and peaceful coexistence of multiple logics in the drug court, McPherson and Sauder (2013) emphasize that other than replacement, blending, and segregation, logics can also co-exist in some sort of non-interference.

3. Alternative approach: The distinction between different types of relations between institutional logics

While we generally support the approach of investigating the situational and concrete use of institutional logics, often described as the study of "logics on the ground" (McPherson/Sauder 2013: 166pp.), we want to identify three key shortcomings in the aforementioned research on the relationship between logics in general and the relation between openness and closedness in particular. First, the relationships are often implicitly normative. More specifically, the relationship between openness and closedness is either described as an inherent contradiction or as a harmonic symbiosis without contradictions. Both simplifications tend to stem from normative conceptions on the part of the authors: "good" openness must be protected from the "bad" economic logic of closedness; openness can be justified to managers by its expected economic value (van Hippel 2005), closed business models are tolerated if they indirectly contribute to the community that supports openness. Second, most studies only consider one possibility of how heterogeneous logics exist together. When a typology of different possible logic relationships is constructed, those typologies are mainly derived inductively without an attempt to generalize the findings. Hence, they do not ensure in any way that the types of relation they observe are exhaustive or transferable to other empirical cases. Third, even the more sophisticated studies tend to be overly simplistic: while recognising that the relationship between two logics can take on more than one form, they assume that one form of relationship between logics dominates an entire system. In that sense, they run the risk of ig-noring the possibility that multiple logics are situationally handled in the very same system at the very same time.

To tackle these shortcomings, we developed a framework of six types of relations that two institutional logics can form. While this typology is partially derived from our empirical work on openness and closedness in FabLabs, it is also constructed deductively to ensure that it exhausts all logical possibilities (see table 2).[3] Moreover, it is informed by previous research on what happens when heterogeneous logics come together.

3. The completeness of our typology is ensured as we derived the types from a 3x3 matrix for every possible combination of weakening, indifference and reinforcement of logics. Of the resulting nine possibilities, three have been removed as they are only mirroring cases. The remaining six have been slightly modified, e.g. to reflect that there are two forms of indifference between logics.

Indifference of logics	**Ignorance**	The logics do not influence each other in any way.
	Isolation	The logics cannot coexist without tension. Therefore, they have to be actively separated.
Weakening of logics	**Replacement**	One logic partially or totally replaces the other logics, there is no co-existence.
	Neutralization	The logics are both weakened in their functionality by their co-presence.
Reinforcement of logics	**Instrumentalization**	The functionality of one logic is increased by instrumentalizing the other logic.
	Symbiosis	Both logics reinforce each other in productive coexistence.

Table 2: Typology of possible relations between two institutional logics

The value of this typology does not only derive from its completeness, but also from the fact that it is flexible enough to integrate the existence of only one logic in a certain domain as a result of the complete replacement of one logic by another, as in the case of the Homebrew Computer Club (cf. Meyer 2003: 14). Furthermore, three of the six types presume a rather contradictory relationship between the logics (isolation, replacement, neutralization), while the other three imply a relationship free of contradictions (ignorance, instrumentalization, symbiosis). Hence, our typology does not take any normative stance and leaves the concrete nature of the relationship of two logics conceptually open to empirical research. At last, we would like to emphasize the general transferability of this framework to the discussion on other institutional logics, despite the fact that it was originally developed in the context of the openness/closedness debate.

The typology fits with the overall assumptions of structuration theory as our underlying theoretical perspective. The relationship between logics can be understood as (un)intended consequences of intentional actions (Giddens 1984: 5, referring to Merton 1936). In essence, actors pursue their specific goals in local actions and produce or reproduce a certain relationship between overall logics to which they consciously or unconsciously refer in the course of those actions. Our framework thus does not describe practices of "relationing", but rather focuses on "relationing" in practices. Nevertheless, there is the possibility that, particularly in organizations, actors actively monitor and consider the consequences of practices in their reflexive structuration (cf. Ortmann et al. 2000).

4. The logic relation of openness and closedness in the four aspects of collaborative invention in the FabLab

Our theoretical framework helps to illuminate what happens to the logics of openness and closedness in the context of the FabLab. To structure our empirical data, we distinguish four different aspects of collaborative invention in the FabLab.

Based on the descriptions by our interview partners that correspond to findings in the literature on innovation processes (Braun-Thürmann 2005, Godin 2006, Gürtler/Meyer 2013, Möller 2010), we came to the conclusion that the process of collaborative invention is based upon four interrelated aspects: (1) the development of technical competence which is necessary to enable the different users of the FabLab to use the machines in a meaningful way; (2) the creative-intuitive generation of ideas or selection from a pool of existing ideas; (3) prototyping as the iterative-experimental process of tinkering with a material object (this also includes the provision of spaces and machines); and (4) the externalization of results which includes licensing, mass production, (free) distribution and any form of publication.[4] In this section, we will show how the relevant practices of each of those aspects of invention establish a certain relationship between the logics of openness and closedness.

The development of *technical competence* happens through multiple practices: the project members can participate in formal workshops which are offered by the FabLab and where they are instructed on the use of the different machines. But there is also an informal exchange of knowledge between different users of the FabLab, which is often emphasized to be even more important than the workshops. During random encounters, users often ask each other how they achieved a certain effect and hence learn how to use the machines in a certain way. The FabLab facilitates this, not only by providing machines, but also by creating a coworking space characterized by a certain spatial order almost without any separating walls. However, since physical space is scarce, the FabLab founders select project teams based on a certain "mind-set" of sharing ideas as well as the diversity of topics on which the groups are working. The principle of getting knowledge in form of people into the FabLab explicitly includes corporations. As one cofounder stated, "these people are always a benefit for our community because we can learn from them" (co-founder #2). However, while working at the FabLab, even companies have to follow the same rules, work in an open space, and are encouraged to share their ideas. Allowing corporations into the FabLab is therefore not seen as an introduction of "closed" mind-sets but as a way of introducing people's special knowledge into the FabLab. Formal workshops and carefully reflected informal knowledge exchange are complemented by the FabLab employees, who formally assist the projects on an on-demand basis, as well as by extensive feedback from the users to the FabLab employees on certain uses of machines and on which machines the FabLab should order next. It is also worth mentioning that some projects seem to use the FabLab as a pool from which they recruit new project members as they can get to know the people and their mind-set by working next to them in the FabLab.

The development of competence shows that on the level of institutional logics, there are two things going on. We can identify a replacement of the logic of closedness by the logic of openness. Keeping knowledge to yourself is inter-

4. We agree with the criticism of a linear conception of innovation (e.g. Godin 2006, Braun-Thürmann 2005) and emphasize that the four aspects do not necessarily need to occur in this order.

preted as incompatible with the open sharing of knowledge. Even companies working in the FabLab have to comply with the local rules of openness. At the same time, the spatial necessity to select projects is used creatively as an instrumentalization of closedness for the ideals of openness: membership in the FabLab community is not selected on a basis of an open or fair principle, such as democracy or random selection, but on very restrictive decisions made by the FabLab founders. But, as they strictly select FabLab projects and companies based on the "mind-set" of the individuals, they contribute to the exchange of knowledge in the FabLab, thus reinforcing the functioning of the openness logic. (With slight differences, many practices of idea-generating overlap with the practices of developing competence and consequently have the same effect in bringing both logics of openness and closedness into a relationship. They are therefore not presented at this point.)

Other than the exchange of knowledge within the community, the vast opportunities for experimenting and for "playing around" are stated as a major reason for working in the FabLab by members of all projects we interviewed. The FabLab enables affordable possibilities of experimenting with machines, while an industrial workshop would charge at least 1000 € for just one prototype (project leader #2). The FabLab provides multiple options for using the machines: from a pay-as-needed basis to flatrate-type subscription models. One FabLab co-founder also emphasizes that collaborating with business firms not only brings more knowledge into the FabLab community, but also has financial advantages. Companies are welcome to make profits from their products developed in the FabLab as they also must pay high fees. This money is used by the FabLab to provide their community with even more machines, spaces and support – companies essentially subsidize private individuals working in the FabLab on their projects. One founder acknowledged that they accept "business-to-business contracts because you cannot build a FabLab on the shoulders of a community. [...] the idea is that we support companies with our work and expertise; and in turn, we can support the community with the money we get from them" (co-founder #1). Furthermore, as the FabLab seems to be some sort of "consulting firm" for other companies, they also rely on the esoteric knowledge of their community. In one case, a FabLab founder asked the director of a fashion project whether she could consult a company on fashion technology.

What we see on the level of prototyping seems to be a very harmonic symbiosis of the logics of openness and closedness: companies are allowed to license and privately appropriate the products they develop in the FabLab in spite of the culture of sharing and open knowledge. But they pay for that right, and the money is used to finance the FabLab's community and infrastructure, both of which are the basis for the ideal of openness. The fees the companies pay could be interpreted as a modern "selling of indulgences." Companies benefit from the knowledge and particular expertise of the FabLab while the FabLab community benefits from the money it needs to stay alive as a community. Openness and closedness not only coexist, but both logics strongly benefit from each other's presence as the

open FabLab community would lack the funds for their infrastructure without the companies; and as the companies would lack ideas and esoteric expertise without the open FabLab community. Taken together, the several practices presented here clearly establish a symbiosis of openness and closedness.

Finally, the FabLab also provides a specific framework for the externalization of developments. Even though the FabLab nurtures a culture of open knowledge sharing, peculiarly, the founders as well as the project directors at the same time emphasize the notion that an idea belongs to an individual person: "It is clear to them that this is *my* idea and not 50 percent theirs and 50 percent mine" (project leader #2). "Well, there is intellectual property and when a developer or inventor builds something, it belongs to him, this is the German law [...] Even if someone develops something in this environment [the FabLab], it is still his property." (co-founder #1) While this appears to be paradoxical at first glance, this conviction actually enables the FabLab to tolerate closed and open appropriation of things developed in the FabLab. Users can profit from shared knowledge and still register a patent of their product. The notion of individual authorship legitimizes the practice of commercial appropriation by enabling intellectual property. The FabLab is seen as a place for experimentation; licensing belongs to a phase of development that takes place outside the FabLab (co-founder #2).

By separating access to knowledge from the appropriation of knowledge, the FabLab assigns rules of openness to the former whereas it is officially indifferent concerning future appropriation and thus tolerates the closed logic of commercial licensing. The separation of access and appropriation therefore leads to the separation of openness in the realm of knowledge sharing and (potential) closedness in the realm of appropriation. The somewhat contradictory practice of separating access and appropriation constitutes an isolation of the two logics that stabilizes the co-existence of both in the context of the FabLab. Without this isolation and the subsequent possibility of commercial appropriation, corporations would be far less incentivized to work in the FabLab. This would ultimately hinder the functioning of the aforementioned practices of prototyping and development of competence. The different aspects of collaborative invention bring the logics of openness and closedness into a relationship through the adoption of different practices (see table 3) – but the specific interrelation of these practices is what enables the FabLab to function.

	Development of competence	**Finding of ideas**	**Prototyping**	**Externalization**
Role of the Fab Lab	creates a community of open-minded people	creates a community of open-minded people	provides expensive infrastructure	separates access and appropriation of knowledge
Local relationship of the logics	replacement of closedness with openness instrumentalization of closedness through openness	replacement of closedness with openness instrumentalization of closedness through openness	symbiosis between openness and closedness	isolation of openness and closedness

Table 3: The different logic relationships between openness and closedness concerning the different aspects of collaborative invention in the FabLab

5. Conclusion: Towards a more complex conception of openness

We can see how the users and employees in the FabLab successfully form a space of open exchange of knowledge in those situations of the development process where it is needed, whereas it enables the appropriation of the results of the development and the knowledge necessary for exploiting the rewards of the invention. The development of technical competence and the generation of ideas are associated with practices of sharing knowledge among the members in informal situations. Both are clearly distinguished from the externalization of a product, where we find practices of closing knowledge for protecting rewards.

In conclusion, we can identify a replacement of closedness with openness, an instrumentalization of closed practices for the ideal of openness, and a productive symbiosis between an open FabLab community and companies aiming for commercial products. All this is stabilized through the separation of access to and appropriation of knowledge, which is basically an implicit isolation of the logics of openness and closedness. Replacement, instrumentalization, symbiosis, and isolation – locally, the tension between openness and closedness is handled in various ways through several different practices which, taken together, enable the FabLab and the different actors to work on their individual goals.

Former assumptions that openness and closedness are either incompatible or reciprocally beneficial must be rejected in favour of a more differentiated approach that pays attention to the effects of concrete, local practices. The notion that only one type of relationship between two logics dominates a certain social system must also be rejected, as our research clearly shows that multiple forms of logic-relations can co-exist within the very same system at the very same time – and it is this carefully reflected relationship of heterogeneous logics which enables all the associated actors to work on their inventions in the FabLab.

While our original endeavor was to illuminate the case of the FabLab as a special social system with an apparent contradiction between openness and closedness, we hope that our work can help to understand the relationship between openness and closedness in general. Instead of assuming a relationship of complete conflict or peaceful symbiosis, a more differentiated framework might help to understand how two logics co-exist. Furthermore, our heuristic might also be useful to scholars of institutional logics. By constructing a typology that seems to unify and incorporate various previous findings on the meso level of logic relationships, our framework could also be a contribution for understanding the manifold relationships of institutional logics beyond conflict, blending, and segmentation.

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