THEORIZATION AS STRATEGY:

HOW ACTORS SHAPE THE DIFFUSION OF NEW TECHNOLOGIES

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ABSTRACT

This paper examines how actors can affect the diffusion of new technologies through theorization, i.e. by socially constructing the rationale. We trace how discursive battles around the theorization of a new technology affected the extent to which it diffused in two countries. The empirical study draws on longitudinal, primary data on the theorization of prefabrication in the Danish and the French construction industry from 1945 to 1965. Our findings show that actor groups engaged in discursive battles around the means and the ends to be privileged in the theorization of prefabrication. The outcome of these battles manifested in the adoption of standards that, once they became legally binding, determined the extent to which prefabrication diffused in the two countries. After conducting a validity check for alternative explanations, we specify how actors can use theorization as a strategy to affect the diffusion of new technologies.

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After an initial bust of diffusion, new technologies sometimes fade away as a fad and fashion while they at other times continue to diffuse. Decades of diffusion research have illuminated standard diffusion trajectories, including different stages of diffusion (Johnson et al 2006, Rogers 2003 [1962], Greenwood et al. 2002), common channels of diffusion (Strang and Meyer 1993; Lounsbury 2001), and forces that increase diffusion (Tolbert & Zucker 1983; DiMaggio & Powell 1983; Lawrence, Winn and Jennings 2001; Leblebici, Salancik, Copay and King 1991). While they illuminate recurring patterns of diffusion, these studies say little about the contribution of actors. If actors influence whether new technologies follow an inverted u-shaped curve of diffusion (Strang and Macy 2001) or, alternatively, an s-shaped curve that levels off into institutionalization (Lawrence, Winn and Jennings 2001; Rogers 2003 [1962]), then how do they do so?

A common response is that the diffusion pattern follows from the efficiency of a technological innovation. If it seems to work better than alternative technologies, then it will continue to diffuse; Otherwise it will eventually be replaced by a superior technology (e.g., Strang and Macy 2001). A number of examples provide counter-evidence to this proposition. For instance, even when an innovation is objectively inferior to available alternatives, as exemplified by the QWERTY keyboard, users and potential adopters may still favor it because of network externalities and lock-in effects (Rogers 2003 [1962]; David 1985). Moreover, it can be so difficult to assess the performance of a new technology in the early stages of diffusion that efficiency reflects beliefs rather than facts.

Our study points to the importance of these beliefs, notably to the social construction of the rationale that underpins a new technology. New technologies are not born with a

rationale; they acquire it (Zucker, 1986; Scott, 1987; Rao, 1994; Suchman, 1995). Edison experienced this phenomenon when he first introduced electrical lighting and was met with indifference to his new technology. Potential consumers could not make sense of electrical lighting and so they discarded it (Hargadon & Douglas, 2001). After Edison reformulated his invention in familiar concepts and embedded it in practices related to gas lighting, electrical light came to make sense to consumers and it promptly diffused. A similar pattern faced Kodak's roll-film camera, which had to be actively embedded in mainstream discourse and existing practices before it was recognized as a relevant and useful aspect of social life (Munir & Phillips, 2005: 1672). Similarly, Zilber (2006) showed how evolving collective interpretations of high tech affected the diffusion of Israeli high tech. While a rationale is hardly sufficient, it is certainly a necessary condition for the diffusion of a new technology.

Theorization refers to the process through which new technologies gain their rationale. Theorization consists in formulating the rationale of a new technology in general and attractive terms, whereby others are encouraged to adopt it. Greenwood, Suddaby and Hinings (2002) showed that innovations do indeed diffuse more easily if they are theorized, and if the theorization is endorsed by public authorities or professional organizations. Theorization is thus an important feature in the diffusion of a new technology, a feature that requires the engagement of actors. While previous literature provides some examples of successful theorization, failure studies are rarely reported in the literature. The neglect of failure cases makes it difficult to determine which theorization strategies and field conditions lead to diffusion and which ones do not (Leca et al., 2008). Our study attempts to remedy this shortcoming by comparing a failure case with a success case. By failure, we mean a theorization that failed to stimulate the diffusion of the new technology, while success refers to a theorization that gave momentum to the spread of the new technology.

Our empirical object of study is prefabrication, a technology that in post-war Europe represented a new and promising way of rapidly constructing new and good apartment blocks at a low cost. Prefabrication refers to the factory production of concrete building blocks that are transported to the construction site where they are assembled into buildings. In the early 1950s, Denmark and France became world-wide pioneers in the adoption of this new technology, notably because of significant state support. Yet, in the late 1950s, the French state abandoned its support for prefabrication, resulting in a decline of its prevalence, while the Danish state continued to support it with the result that Denmark still remains a world leader in the use of prefabrication nowadays. Our comparative study traces how the theorization of prefabrication evolved in these two countries from 1945 to 1965 and how the evolving theorization affected the spread of prefabrication in Denmark and France.

Our comparative study relies on an inductive analysis of primary sources that convey how actors from both industry and state perceived prefabrication relative to competing construction technologies. We examine how their theorization of prefabrication manifested in law and why the adopted laws began to diverge in the two countries in the late 1950s.

Our analysis revealed that discursive battles among groups of construction actors gave rise to somewhat different theorizations of prefabrication in Denmark and France. These theorizations lend themselves differently to the formulation of standards. We further found that the adoption of standards, once they were embedded in law, indirectly privileged prefabrication relative to competing technologies. This indirect privilege strongly affected the diffusion of prefabrication, a finding that we validated carefully against competing explanations. The findings from this study lead us to propose general implications for the diffusion of new technologies, including suggestions for how actors can contribute strategically to the diffusion process by means of theorization.

The rest of the paper is divided into four sections. The first section introduces the postwar construction industry in Denmark and France and the new technology of prefabrication. We subsequently present our method, which is followed by a presentation of key findings. In the fourth and final section, we sharpen the theoretical contribution of our study and specify how actors may shape the diffusion of new technologies.

THE CONSTRUCTION INDUSTRY

Construction is an extraordinarily complex activity in which many professional groups interact with one another. One template is that architects draw the blueprint for a building in response to the needs of a private developer or a public authority. Contractors then coordinate the manual workers, such as masons, carpenters, painters, electricians and other trained craftsmen while engineers employed either by contractors or by consultancies select the appropriate building materials and technical processes.

The construction industry encompasses a large field of activities that range from the construction of new housing and public infrastructures to the renovation and destruction of them. Our analytical focus is new collective housing, more precisely the building of concrete apartment blocks in the post-war period. This subsection of the construction industry expanded very rapidly in the 1950s and 1960s Europe in response to post-war reconstruction, population growth, and increasing urbanization. This sudden increase in the construction of collective dwellings created a unique experimental field for the emergence of new thoughts in construction.

Modernism and Functionalism in Architecture

The French and the Danish construction industry were both guided by the institutional logic of modernism/ functionalism in the mid 20th century. The core principle of modernism/

functionalism is that form should follow function advocating a minimalist style of architecture that avoids purely decorative elements. Le Corbusier pioneered this movement in French architecture in the 1920s. A classical example is *Villa Savoye* that he completed in the late 1920s (see Figure 1). The diffusion of the modernist/functionalist principles reached Scandinavian architects at a conference in Stockholm in 1930 (Danish Ministry of Foreign Affairs, 2003). Within a few years, Arne Jacobsen, a young Danish architect, applied these ideas to build the residential complex of *Bellavista*, which later became internationally recognized (see Figure 1).

Insert Figure 1

During the 1930s and 1940s, modernist/ functionalist architecture gained wide recognition in both France and Denmark. Few construction projects were initiated during this period, however, because of economic conditions during the depression and the Second World War. The major breakthrough came after WWII when the economy improved and many new construction projects were initiated. Modernism/ functionalism gained dominance in the Danish and French construction industry in this period (see Figure 2).

Insert Figure 2

In the late 1960s, critique of modernist/functionalist architecture started to mount in both countries, eventually to become replaced by postmodernism. The shift to postmodernism meant that particularism and contextualism replaced the universalism and rationalism of the functionalist-modernist logic. Institutional logic of functionalism/ modernism had thus a similar life cycle in France and Denmark, reflecting a general trend in the western countries at the time. The logic emerged and became popular at about the same time, and it manifested in similar architecture, in the two countries.

Technological systems and concrete

The rational principles of functionalism/ modernism inspired not only architects but also engineers. The postwar period was a bustling period of experiments in the European construction industry. The construction process was organized in a more rational and efficient manner that corresponded to the ideas of scientific management. New construction technologies emerged and new building materials became popular.

Concrete became an exciting new alternative to bricks and stones in the construction of apartment blocks. Figure 3 shows a sharp increase of the use of concrete in the construction industry from 1945 to 1973. Concrete is a liquid substance made of gravel, sand, water and cement. All techniques for building with concrete involve some variation of casting. Casting refers to the pouring of concrete into forms that are made of wood, metal or plastic.

Insert Figure 3

New construction materials gave rise to new construction techniques. One technique was to cast concrete on the actual building site, using a concrete substance that was either mixed in a factory (ready-mix) or on-site. An expression of this technique is cast-in-place concrete walls (CIPCW), which refers to the pouring of concrete between frames on the construction site (shuttered concrete). Prefabrication represents another construction technique, one that was inspired by recent successes in the automobile industry where industrialization had rendered building processes significantly more rational and efficient. Prefabrication, the essence of industrialization, consists in pouring concrete into standardized, reusable forms in a factory and curing the concrete elements in a controlled environment. The output is concrete building blocks such as walls, floors and staircases. These prefabricated elements are then transported to the construction site, where they are lifted into place and assembled into buildings.

A graphic illustration of the use of prefabricated concrete in Denmark and France appears in Figure 4. This figure shows how large a percentage of all concrete sold on the national market in a given year was prefabricated. A five percent prefabrication rate implies that 95 percent of concrete was sold in raw form for building with cast-in-place techniques. The figure reveals a remarkable divergence around 1960, and it is this divergence that represents our dependent variable. This divergence is particularly interesting because of the long-term institutional effects that manifest in the 1970s: About 20 years after the onset of rapid diffusion, prefabrication had gained 40-45 percent of the Danish market for concrete, one of the highest in Europe, and only 15-20 percent of the French market, which is slightly below the European average. This long-term pattern accentuates the importance of the divergence that manifested so strikingly around 1960.

Insert Figure 4

METHODS

Comparative case study design

The study is conducted as an inductive double case study. This inductive research design is well suited to explore patterns in complex phenomena where a relative absence of theory makes it difficult to conduct targeted, large scale studies (Ragin 1987; Yin 2003). We set out to induce patterns by comparing two cases, a success case and a failure case. In this study, success refers to a wide diffusion of the new technology, while failure refers to its abandonment after an initial bout of diffusion. These two outcomes are precursors to what institutional theory refers to as respectively institutionalization and fad-and-fashion (see e.g., Greenwood et al., 2002). To our knowledge, previous studies on this topic have not compared success cases with failure cases. In fact, failure cases are rarely reported in the literature,

perhaps because they are harder to detect in retrospect than are success cases (Aldrich & Fiol, 1994). Yet, it is the contrast with failure cases that make success cases theoretically interesting.

The status of the two cases as respectively a success case (Denmark) and a failure case (France) is apparent from European statistics on the national consumption of concrete per year (see Figure 4). The two countries are particularly interesting to compare because they were among the first and most enthusiastic adopters of prefabrication in the early 1950s when the new technology began to diffuse worldwide. The State actively supported prefabrication in both countries in the early 1950s, hence giving momentum to the early diffusion of prefabrication. What is interesting about France as a failure case, relative to other potential failure cases, is that prefabrication lost grounds that it had already gained as a first mover in this country. Other failure cases never reached a prevalence of prefabrication that compared to that of success cases.

Data Collection and Data Sources

Relying on *theoretical sampling* from Grounded Theory, we selected data sources that corresponded to our evolving insights into the phenomenon (Strauss and Corbin 1967). Our collection and analysis of primary data continued until we reached a point of saturation where new primary sources did not add significant new insights. A sign of saturation occurred as alignment was established between the diffusion of prefabrication and the laws passed by the State in the two countries. This alignment linked diffusion to legal institutions and sociopolitical legitimacy, and pointed us in the direction of exploring the discursive battle that preceeded the adoption, or non-adoption, of laws that contributed directly to the diffusion of prefabrication.

The collected data stem from a number of sources, both primary and secondary sources. The secondary sources include national statistics and historical accounts of the development of the construction industry told in books and interviews. In total, we conducted seven interviews with individuals knowledgable about the Danish construction industry in the post-war period, several of them senior or retired members of the Danish construction industry. Similarly, we interviewed five individuals knowledgable about the French construction industry, including a scholar in urban history and architecture with a specialty in postwar prefabrication.

Our primary data, on which we base the core of our study, consist in documents produced during the post-war period and stored in archives and libraries. As for the State, the primary data comprise all laws and decrees pertaining to public financing of the construction industry, including regulation for subsidies, loans, and public commissions, and technical requirements for the construction of new apartment buildings. We also collected government policies, speeches, and reports on prefabrication that were produced during this period and that preceeded the adoption of laws. These documents represent the role of the state in the making of laws and politicies that influenced the diffusion of prefabrication.

Another set of primary data pertains to the role of professionals in the formulation of policy and law. We collected articles about prefabrication that were written by architects and engineers and published in trade journals and anthologies. We also collected expert reports from committees composed of construction professionals, primarily engineers and secondarily architects. These committees were charged with delivering policy input on housing and construction to either the Danish Ministry of Housing or the French Ministry of Reconstruction and Urbanization in the mid-1950s. In selecting among the primary data on the role of professionals, we prioritized articles by the most influential and vocal actors, i.e. members of the committees who also individually authored articles in trade journals and

anthologies. In addition, we conducted an interview with a very senior member of the Danish construction industry, engineeer Johannes Munch-Petersen, who served as secretary for the professional committees that were organized by the Danish Ministry of Housing in the 1950s. We have not been able to identify other primary actors who are still alive today.

Analytical Procedures

The first analytical task consisted in identifying whether laws and decrees favoured prefabrication over cast-in-place techniques and other competing techniques, notably brick-building. From the total list of primary sources, we selected laws and decrees whose content pertained to construction techniques to be used in building new apartments. In these laws and decrees, we highlighted the most relevant passages and coded them according to their support for prefabrication relative to cast-in-place technique and other competing technologies, like brick building. We used the codes ‘yes directly’, ‘yes indirectly’, and ‘no’. The first code refers to legal passages that *require* the use of prefabrication, while the second code was used in passages that encouraged construction professionals to use prefabrication, such as requirements for an elaborate blueprint, a standard floor height, or a detailed work plan for the coming year.

The second task consisted in analyzing how the theorization of prefabrication evolved over time, prior to the critical point in the late 1950s when diffusion of prefabrication began to diverge between Denmark and France. We analyzed the evolution of this theorization in 1) adopted laws and decrees, 2) ministerial discourse (state actors), and 3) professional anthologies and chapter (architects and engineers). The analysis consisted in coding text passages for means and ends that made up the rationale for construction techniques. We carefully coded the ends that were pursued and the means that were linked to them in all passages concerning prefabrication. This coding made it possible to compare how theorization

differed by actor group and by country, and also how it evolved over time. For instance, we compared theorization along the lines of professional groups to identify what engineers and architects wrote about prefabrication in trade journals and book chapters. While architects talked more often about aesthetics, and engineers more often about planning and technical solidity, no significant difference could be detected in their support of prefabrication. We found both proponents and opponents of prefabrication in both professional groups. We also compared how professionals theorized prefabrication relative to how state actors did it, and how theorization of prefabrication changed from the 1940s to the 1950s to the 1960s. The careful comparison of theorization revealed some interesting patterns that seem to explain why legal support for prefabrication were abandoned in France while they were further reinforced in Denmark in the late 1955s.

Validity check

In response to emerging working hypotheses, we carried out a number of additional analyses in the course of this project. Many of these initial hypotheses were functionalist in nature and presented potentially salient explanations. Examples include weather conditions, transportation costs, demand and supply issues, workforce availability and demographic patterns. We systematically tested the empirical support for each of these factors, using archival data from government archives, national statistics, professional organizations, libraries, and online resource centers. No substantial empirical support was found for any single one of them though they may certainly be part of a larger web of causalities. Appendix A lists some of the empirical findings that rule out some of the most plausible functionalist factors that could have explained the difference in diffusion of prefabrication in the late 1950s and early 1960s.

As part of this exploration, we also investigated whether prefabrication had produced better results in Denmark than in France during the first half of the 1950s. As it turned out, the results of experiments with prefabrication were, in fact, as inconclusive and neutral in Denmark as they were in France. Despite countless debates and some evaluations in the 1950s, no evidence showed that prefabrication lowered the costs relative to competing technologies, nor that it increased the pace of production. Yet, despite similar results, the situation evolved differently in Denmark and France. Appendix B lists some of the empirical findings that results from the systematic analysis of cost evaluation in both countries.

FINDINGS

Updated findings to be presented at the seminar.

DISCUSSION

In this section we discuss how we consider our study to contribute theoretically to the role of theorization in diffusion research, notably the contribution of strategic actors. These topics direct attention to the question of how actors can shape the extent to which new technologies diffuse. This comparative case study contributes to the stream of research on theorization as an important factor in the institutionalization of a new technology (Strang and Meyer 1993; Hasselbladh & Kallinikos 2000; Greenwood et al 2002). A particularly neglected aspect, the one that we have attempted to illuminate in this paper, is the question of how theorization affects the outcome of an institutionalization process. Our study showed that early theorization, while being an important force in the first stages of diffusion, was insufficient to explain the different institutional outcomes in Denmark and France. We had to look at the evolution of theorization, particularly its relationship with changing conceptions of modernity and its compatibility with sociopolitical support, to explain why the innovation became institutionalized in one setting but not in the other setting. We found theorization to

be a crucial factor at later stages of the institutionalization process: it either reinforced the momentum of early diffusion, producing an s-shaped curve that eventually leveled off into a full institutionalization of the new practice (Lawrence, Winn and Jennings 2001; Rogers 2003 [1962]) as we saw in Denmark, or it acted as a stick in the wheel that brought diffusion to a halt and provoked an inverted u-shaped curve of diffusion, i.e. a fad and fashion (Strang and Macy 2001), as we saw in France. The implication of this finding is that actors play an important role, whether strategic or not, in the diffusion of new technologies. We encourage future research on institutionalization processes to pursue this line of inquiry to illuminate how actors contribute to theorization. A worthwhile goal would be to further specify how the theorization of competing technologies evolves over time and with which institutional effects.

A related contribution that arises from our study relates to the political arena of institutionalization. A current debate within institutional theory revolves around the question of whether political action represents a fruitful or a futile avenue for understanding the dynamics of institutional change (Lawrence & Suddaby 2006). A growing body of works within neo-institutional theory suggests that individual actors and organizational actors do indeed engage in political action that effectively shapes diffusion processes (Lawrence and Suddaby 2006; Lounsbury 2001; Holm 1995; Rao 1998). Our study adds to this line of inquiry with a comparison between a failure case and a success case.

We found that centrally positioned actors, notably construction professionals on government committees for public policy on housing, engaged in political and discursive activity to further diffuse prefabrication in both countries. Our data also suggested that different professions, while supporting prefabrication, succeeded differently in pushing their own professional interests. The discursive battle influenced the theorization of prefabrication in Denmark and France in the late 1950s. Once the theorizations manifested in legal documents, they ultimately shaped the diffusion of the new technology.

FIGURE 1

Pioneering modernist/ functionalist architecture

Villa Savoye by Le Corbusier, France, 1929-1930.

Bellavista by Arne Jacobsen, Denmark, 1933-1934

FIGURE 2

Modernist/functionalist architecture in France and Denmark, 1950-1965

La Duchère, collective work, Lyon, France, 1958.

Høje Gladsaxe, by Hoff and Windinge, Denmark, 1964.

FIGURE 3
The Rise of concrete in Denmark and France, 1920-2001 (Source: CEMBUREAU)

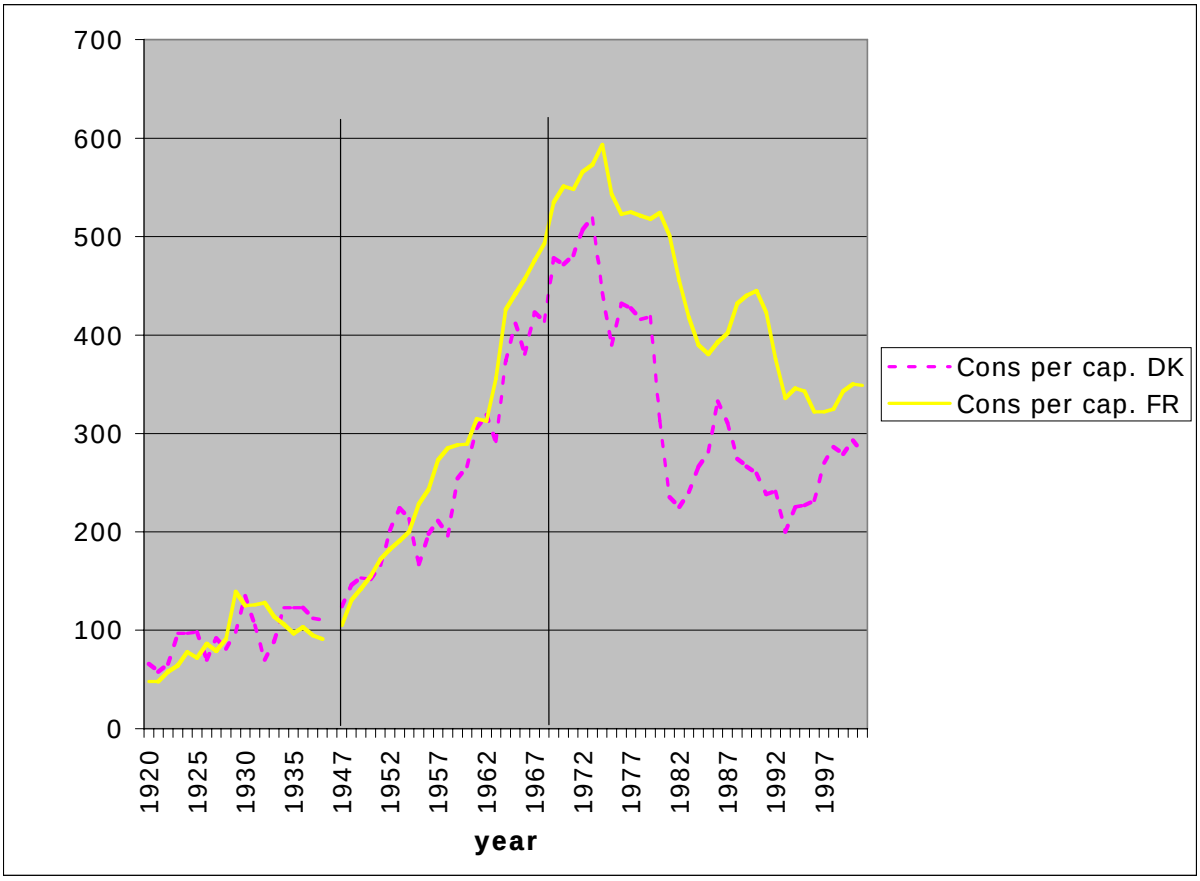
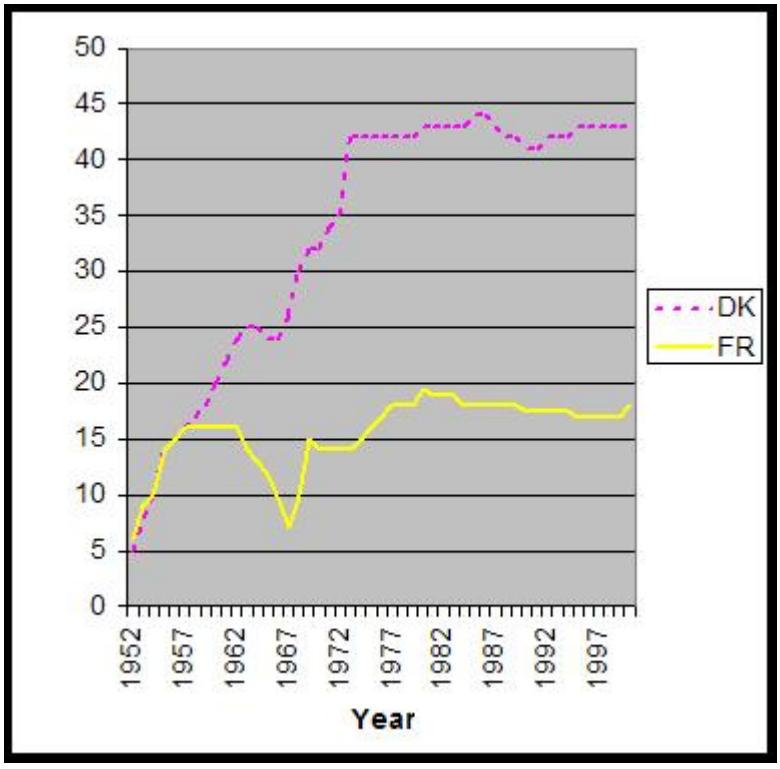


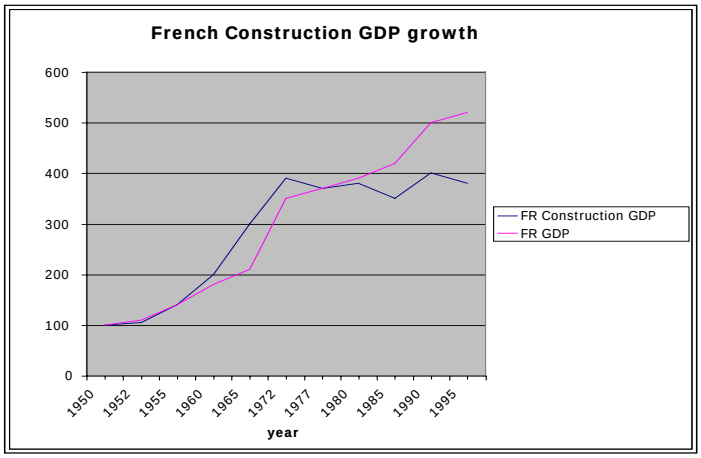
FIGURE 4
Frequency of using pre-fabricated elements relative to other concrete technologies in Denmark and France, 1952-2000 (Source: CEMBUREAU, UNICEM)

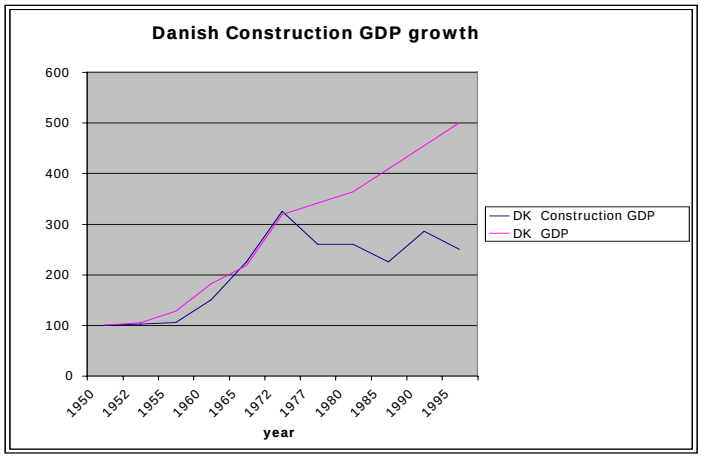


APPENDIX A
Test of objective functionalist variables

Functionalist explanatory variables	Counter evidence
Weather	- The comparison of meteorological data over a 50-year period in Paris and Copenhagen don't show any significant difference in the quantity of rainfall. There is still a difference in average temperatures. - Some countries in northern Europe haven't diffused prefabrication as much as Denmark. Precast concrete accounts for only 27% of total concrete used in Sweden (Source: CEMBUREAU, 2007) and the UK has roughly the same figure as France (btw 15% and 20%). - There is no evidence of regional differences in the use of prefabrication in France despite sharp weather differences. - Weather is unapparent in the discourse of professions in the studied period
Transportation costs	- Many technical reports indicate that 30 km is a good approximation of the maximum distance for cheap transportation of heavy materials. With such a small distance, difference in the size of the country has little influence on the phenomena. And differences in the effectiveness of the road transportation system between two industrialized countries have thus little influence. - In France, the dominant alternative material to precast concrete is ready-mix concrete that is also transported to the building sites. - Some large countries in Europe have high diffusion rate of precast concrete like Germany (30% of cement consumption in 2005), the UK (31%) or Sweden (27%) (Source: CEMBUREAU, 2007). - Urban density is higher in Denmark (Source: OECD, 2005). Nevertheless France has much bigger cities than Denmark. Paris with 10 millions of inhabitants should have been at the center of prefabrication diffusion.
Lack of workforce	- Many primary documents report that in both countries, labor supply was a qualitative and quantitative problem all over the period. - Qualified masons were missing to supply the huge demand for dwellings - France and Denmark have a large rural exodus in the following years after WWII bringing non qualified people in the construction industry (source: Danish and French statistics) - Immigration to France was eased from 1945 but remained low until the end of the 50's. Then it speeded up due to concomitants events, not least the Rome Treaty and decolonization (agreement with Spain in 61, with Portugal in 63, end of the Algerian war in 1962…). But two evidences contradict the immigration argument. M. Campinos-Dubernet, one eminent French expert on post war construction workforce demonstrates that the massive hiring of immigrants in this industry on began around 1962 that is to say after prefabrication had declined. (Campinos-Dubernet, 1984: 208). She also relates that immigrants had no special competences in alternative technologies to prefabrication.
Difference in demand	- Both countries had to meet a very high demand btw. 1945 and 1968 due to reconstruction after WWII, rural exodus, and the baby boom. France has moreover to face the very bad shape of its real estate due to a former law that froze rental increases between the two wars and thus discourage private investments in

	rehabilitation. From 1960, France has also to cope with a high immigration rate. - Concerning the construction of new collective dwelling in particular, both countries raised dramatically their production in the 50's and 60's and reached a peak around 1972. - The graphs below show very similar pattern in the evolution of construction GDP in both countries.





APPENDIX B

1) Perceived Costs advantages of prefabrication

1946-1951

FRANCE

"Work in a factory or a workshop is more economic than work on a construction site. The output is superior; it is possible to make products of higher quality and homogeneity with an unskilled workforce". (Anonymous entrepreneur, 1946: 32)

"The architect should organize the fabrication of construction elements so that also here, by means of rational prefabrication, he saves on labor costs and obtain a better output from workers who benefit from more comfortable working conditions, increased well-being, and healthiness that is far superior to the common standards on a construction site." (Hummel, Governmental architect, 1946: 31)

DENMARK

"As a second way to bring down construction costs, the Minister of Housing brought forward rationalization and industrialization of construction. It is my personal opinion, said the Minister, that rationalization and industrialization will lead to a revolution in construction. The new methods will eventually come to make construction cheaper." (Minister of Housing cited in Andreasen, architect, 1951: 210).

"The advisor asked for standard types so that projection costs could be reduced somewhat" (Olaf Sahl, architect, 1951: 207)

1958-1965

FRANCE

"At the current time, these two criteria: revenue and labor cost do not allow for a distinction between the evolved traditional techniques and the new techniques of prefabrication in a factory or on the construction site. In fact, the biggest progress in productivity that the industry has attained so far is essentially a result of studies on operations and organization of the construction site." (MRU (governmental research unit) Report, 1958: 8).

"Prefabrication, in the first construction projects, has not been able to deliver equal quality at a lower price than traditional techniques. Accordingly, the industrial cannot offer an attractive price estimate in response to the hesitation, almost hostility, of architects, traditional entrepreneurs, and even clients. The arbitrariness that characterizes the calculation of this price factor is so that, in our opinion, it is absolutely dangerous, even hazardous and vain, to compare prefabricated systems with the improved traditional" (Simon, engineer, 1962: 88).

DENMARK

"By increasing the rational construction and minimizing labor, it will undoubtedly become possible to lower the cost of constructing new dwellings. The available experiences, e.g., the most recently initiated project with prefabricated construction, confirm this perception. One should not, however, exaggerate the expectations to the results that prefabrication can attain in the short term. Expenses related to the construction process are only a part of the overall costs of acquiring a new building." (Ministry of Housing, 1964: 6).

"The construction [of *Bellahøj*, 1953-1956] was an experiment. There was, however, at no point in time, anything light-hearted or uncontrolled about this experiment, and the high price – which in this case simply refers to higher than usual, not unreasonable or shockingly high – came about primarily because of the particular character and form of the buildings." (Kjeldsen, 1961: 7)

2) Official reports on cost advantages of prefabrication

FRANCE

The French state organized several contests to promote prefabrication in the construction industries in the 1950s. Well-known contests led by CSTB (Centre Scientifique et Technique du Bâtiment) are: Orléans, (1946, 200 dwellings), Villeneuve-Saint-George (1949, 200 dwellings), Strasbourg (1951, 800 dwellings), Les 4000 (1952, 4000 dwellings).
The results of these experiments were closely monitored and several technical reports were published to account for the comparative advantages of prefabricated elements (Cahiers du CSTB, N°116-130, 1951-1953).
All of which show inconclusive or disappointing results.

DENMARK

In Denmark, data were compiled on prefabrication experiments in the 1950s and the results were finally published in 1962 (Appendix E, Nielsen 1962). The results show no advantage in price or cost between the use of traditional brick technology and modern concrete prefabrication technology, no matter how the data was split (city versus countryside; high rises versus low rises; early 1950s versus mid 1950s). The results of these experiments were published at a time when policies and laws had already been adopted, which made for a low impact in practice.

"The comparison that SBI [the research unit of the Ministry of Housing] has conducted between brick and non-brick construction did not give any result in terms of one category being clearly superior to the other. That was not expected either – had this been the conclusion then many of the endless debates in recent years would have come to an end as solid proof would be presented by either of the two parties". (Nielsen, architect, 1962: 28)

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