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Measuring Organizational Routine change in Work teams:
Towards a theoretical framework for studying organizational routine change

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Abstract
In this paper we present a theory based framework for studying organizational routine change. The type and level of interdependency in work teams, created by the interaction between work environment and individual, provides the basis for organizational routines and organizational routine change in the framework. Further, to map the outcomes of organizational routine change, we reflect on a case study in a Bakery done by Hoeve. Finally, we explore the possibility to transfer the approach proposed by Hoeve to the framework.

1. Introduction
The concept of organizational routines has showed promising results for providing a deeper understanding of organizational change (e.g. Becker, Lazaric, Nelson & Winter, 2005; Hoeve & Nieuwenhuis, 2006; Nooteboom, 2004). Nelson and Winter (1982) first introduced the concept of routines in relation to organizational change. Routines describe organizational behaviour, and change of this behaviour leads to organizational change (Nelson & Winter, 1982). In other words, they aggregate the individual behaviour of the employee to collective behaviour of the organization. In addition to the work of Nelson and Winter (1982) several studies on routines have been carried out (e.g. Becker, 2004; Feldman & Pentland, 2003). However, despite a growing body of research which contributes to the understanding of the concept of organizational routines, consensus about the meaning of this concept is still missing. Scholars define the concept of organizational routines in different ways. Because of these differences not much empirical progress in the research of routines seems to be made. Moreover, Becker (2005) noticed that most scholars define organizational routines implicit, rather than explicit. This might explain why most scholars have used qualitative research methods for measuring organizational routines (Becker, 2005). Without reliable and valid ways to measure organizational routines within organizations, it is difficult to determine in an objective way how organizational routines change, and why a certain level of change was
achieved. In this paper we present a theory based framework for studying organizational routine change in work teams.

In the following section we first outline our initial conceptual framework to study the process of routinization. A next step in section 3 is to develop the framework further by indicating relevant variables. In section 4 we describe a case study in a bakery done by Hoeve (in progress) aimed at developing an approach to map the outcomes of routine change. Finally, we explore the possibility to transfer the qualitative approach proposed by Hoeve to the framework.

2. Construction of a framework to study organizational routines quantitative

2.1 Identify the process of routinization

After a period of more than twenty years of conceptualization, scholars still define organizational routines in different ways (Pentland & Feldman, 2005; Hodgson, 2004; Nooteboom, 2004; Salvato, 2005). Hodgson (2004) for example treats organizational routines as “collective dispositions”, Nelson and Winter (1982) treat routines as repeated behaviour. According to Hodgson (2004), it is not enough to approach routines as repeated behaviour because also the causes of repeated behaviour have to be taken into account. Pentland and Feldman (2005) argue that the part that enables repeated behaviour can be very context dependent. They emphasize that the understanding of organizational routines may not be the same from person to person, from event to event or over time. Although every situation might be different and this might explain why most scholars define organizational routines in a different way, what the definitions do have in common is that organizational routine are defined on collective level. Therefore, it seems that organizational routines have to deal with a kind of interdependency, which means that one’s achievement is influenced by others. Furthermore, Becker, Salvator and Zirpoli (2005) emphasize that interdependence is an important concept to understand organizational routines.

In this paper, we define interdependency as an important characteristic of organizational routines and we chose teams as level of analysis to study the collective level. Research on teams provides the opportunity to bring the individual employee and organization together. Moreover, Lewin (1948)\(^1\) relates interdependency with team functioning. According to Lewin

\(^1\) Literature on team and group research will be used in this study; the term team in this study is interchangeably with group.
(1948), interdependence is essential to understand team processes and it is the reason that teams are formed. Several forms of interdependency consist within work team (e.g. Guzzo, 1992; Thompson, 1967; van der Vegte, Emans & van de Vliert, 1998; Wageman, 1995). The most well-known is task interdependence. Task interdependence means that each team members’ achievement influences others achievements and that the achievement of other team members are necessary to succeed.

According to Lewin (1948), interdependency is the reason that teams are formed. We assume that interdependency is also the basis on which organizational routines are formed, interdependency enables the development of organizational routines. And furthermore, the type and level of interdependency is influenced by both the individual and the organization and its interplay. Through the interaction between individual and organization a pattern of interdependency is formed. We assume that the pattern of interdependency as perceived and performed can lead to organizational routines. By perceived and performed, we mean that interdependency includes a perception of interdependency which contributes to the performance of interdependency. Further, this pattern of interdependency can become standardized at the collective level; over time employees know how they depend on others for example the inputs or outcomes of others.

By emphasizing the standardization of ‘knowing how to perform’ we pay attention to the knowledge part of organizational routines. Polanyi (1966) made a distinction between two types of knowledge: explicit and tacit knowledge. Explicit knowledge is transmittable in formal systematic language. And tacit knowledge is rooted in action, commitment and involvement in a specific context. Becker (2004) emphasize in his review of the work on organizational routines that many empirical investigations support the idea that organizational routines store knowledge, including tacit knowledge. Nelson and Winter (1982) argue that routines are an important form of storage of the organization’s specific operational knowledge and create organizational memory.

In summary, we assume that the interaction between individual and organization will lead to a pattern of interdependency and this will lead to knowledge about how to perform a collective task. We can regard this process as the ostensive (Pentland & Feldman, 2005) or cognitive part of organizational routines which leads to the performance of organizational routines. By performing organizational routines, employees build expectations for new performances of
organizational routines. By performance, employees receive feedback about the outcomes (Levitt and March, 1988). So, organizational routines build on the past (Becker, 2004). Below, figure 1 illustrates the continuous process of routinization.

![Figure 1: Framework of this study: Process of Routinization](image)

In this model, the process of routinization results from the interaction between work environment and the individual employee and this process results in organizational routines. To describe routinization as a process we draw a line between the outcomes and interaction between work environment and individual employee. Now that we have introduced a framework for studying organizational routines, a next step is to develop the framework further by explaining the concepts work environment, individual characteristics and the outcomes into concrete factors, for these concepts we have made the most progress.

3. Selection of factors

3.1 Identify factors which influence the process of routinization

In section 2, we introduced a framework to study the process of routinization. The aim of this section is to indicate relevant factors for the concepts work environment and individual, to develop the framework further.
Work environment

We concluded in section 2 that interdependency is an important concept to understand organizational routines. Therefore, we started by defining sources of interdependency in work teams. Wageman (1995) identifies four sources: (1) task inputs, such as the distribution of skills and resources and the technology that define the work (for example individuals on an assembly line vs. teams building the building whole products), (2) the processes by which members execute the work (for example people who make sales calls alone vs. people who sell as teams), (3) the way that goals are defined and achieved (for example measures of collective versus individual performance), and (4) the way that performance is rewarded (for example rewards contingent on group vs. individual performance) (p.146). Based on these four sources of interdependency we have tried to indicate factors to develop our framework further. We also consider the nature of work (task inputs: 1) and the way the work is organised (2) as important factors of the work environment which influences type and level of interdependency.

Another factor of the work environment is the way goals are defined, achieved and rewarded (3 and 4). Brickson (2000) describes in her study on collective identity that for example the reward structure can lead to interdependence as for example cooperation in a group. As Brickson (2000) illustrates in her study if rewards are on group level, employees will more likely view themselves as interpersonally connected.

Individual characteristics

If employees really execute their work in an interdependent way is also determined by their perception of the task. Employees’ task perception may be of even more importance to type and level of interdependency than the way the work is actually organised, defined, achieved and rewarded. Hackman and Oldman (1975) confirm this conclusion, in their famous job characteristics model in which they explain the relation between task characteristics and satisfaction form the opportunities that the task gives for intrinsic work motivation, they argue that worker’s perception of his tasks is the most important determining factor for his behaviour and attitudes. Therefore, on individual level we regard employees’ task perception as an important factor. Furthermore, we consider personal and educational background variables for example gender, age and level of education as important factors of the individual.
3.2 Change of organizational routines

So far, we have tried to indicate some relevant variables of the work environment and the individual. We emphasized that because of the interaction between the work environment and the individual employee routinization can take place. By finally the performance of organizational routines, employees build value and expectations for new performance, this can lead to organizational routine change. Feldman (2000) argues that organizational routines are not simply followed or reproduced, employees have a choice whether to do so, or whether to improve the routine. Therefore, the process of routinization can be regarded as a continuous learning process (Pentland & Feldman, 2005). On the other hand, a planned innovation from the top of the organization or environment through planned interventions can also take place.

The planned innovation can be seen as a starting point for organizational routine change, which can change the interaction between the work environment and individual employee and as a result type and level of interdependency can change. We assume that new forms of interdependency can lead to the articulation of existing knowledge about how to perform a task, and because of the articulation of knowledge, new knowledge can be created which lead to new or changed organizational routines in work teams. Figure 2 illustrates the change process.
3.3 The outcomes of organizational routine change

After introducing a framework to study the process of routinization and change, we operationalised this framework by indicating some relevant factors of the work environment and the individual. However, to test our theoretical framework in an empirical situation, it is necessary to explore the meaning of the outcome in this model. For this we reflect on a case study of Hoeve and we used her description of organizational routine change to develop the framework further.

4. Describing the results of an in-depth case study

4.1 The concept of organizational routines in qualitative research
Hoeve modelled in her Ph.D. study (in progress) innovation as a learning process at different levels of aggregation: organizational, team and individual level. An important finding in her study is that the concept of organizational routines is essential to understand innovation processes at different levels within the organization. Hoeve (in progress) concludes the struggle going on for twenty years researchers how to apply this concept in empirical research (Becker, 2005), has produced two possible approaches to describe organizational routine change; the ostensive-performative-artifacts approach (OPA-approach) developed by Pentland and Feldman (2005) and the script approach developed by Nooteboom (1996, 2000).

**The ostensive-performative-artifacts approach of Pentland and Feldman**

Pentland and Feldman (2005) operationalize organizational routines by analyzing its internal structure. They conceptualize organizational routines in a performative part (specific action), an ostensive part (abstract pattern), and the related artifacts. The performative part refers to specific performances of a routine for example who is doing what at a specific time in a specific place. The ostensive part of routines refers to the abstract pattern that guides and creates specific performance (Pentland & Feldman, 2005). Furthermore, they argue that artifacts can be viewed as physical manifestations of the organizational routines for example formal rules or standard operating procedures. Pentland and Feldman (2005) explain in their work that rules and standard operating procedures can be considered as indicators for the ostensive part (abstract pattern) that guides and creates specific performance (performative part). However, they notice that artifacts do not necessarily determine the pattern of action; there are more factors that determine the ostensive part of a routine.

**The branches, nodes and architecture approach of Nooteboom**

Nooteboom (1996; 2000; 2004) used the script concept developed by Shank and Abelson (1977) to model routines. The notion of scripts models routines as a specific pattern of behaviour in terms of branches, nodes and architecture. The branches represent a set of interchangeable set of action (for example paying in a shop routine can exist of the actions of handing over cash money, or paying by credit-card). The nodes represent a ‘reflective’ moment in which the effect of a preceding branche is judged and the appropriate subsequent action (suitable alternative in the next node) is selected. The architecture of a routine represents the underlying logic of the routine. This logic becomes manifest in the specific sequence of action, the role division, the chosen coordination mechanism and the degree of freedom build in the routine.
Comparing the two approaches it seems that the ostensive-performative-artifacts approach gives a thorough understanding of the phenomenon of organizational routine; it focuses on what it is. On the other hand, Nooteboom’s (2004) branches-nodes-architecture approach focuses more on understanding the change, and is less interested in the phenomenon of the routine itself, it remains unclear in this approach how to determine what exactly has changed because the approach does not spend much effort in understanding what the routine is.

Yet, to understand what has changed one has to know what is, or was. Therefore, Hoeve proposes an approach of researching routine change, combining the OPA and BNA approaches. In Hoeve’s approach routines are measured at different moments in time. At each point of measurement routines are studied following the OPA-approach, which focuses on a thorough description of what a routine is.

In fact, routines cannot be measured but only reconstructed on basis of a number of resources. This resources can be structured according to the OPA-approach.

1. Performatives = actual work activities + sequence (primary method observation)
2. Ostensive aspects = rules for action and the underlying norms & values (primary method: combination of interviews and observation of group interaction);
3. Artefacts = machinery, physical space, written protocols, work instructions (primary method: observation and document analysis)

Hoeve added a fourth aspects of routines

4. Degree of freedom = room for personal interpretation of the routine. Hoeve defined defined two important indicators for the degree of freedom of routines, that is:
   - The physical layout (the way the technology structures the work process): The stronger the physical layout structures the work process the lower the degrees of freedom allowed in the routines. (primary method: mapping of the physical work environment)
   - The institutional layout (refers to the extent a social entity puts pressure on the community to stick to a well-defined procedure) (primary method: documentary and interviews)

To analyse the change Hoeve used the BNA-approach, as it allows to classify the change that has taken place. Nooteboom distinguished three forms of change, i.e. optimization, substitution and innovation. Optimization refers to a change in the branches. Substitution refers to a change in the nodes and innovation to a change in the architecture. These are however not exclusive categories and therefore the routine change is depicted to a point in the
continuum. The routine change is depicted in a continuum between the opposites no change and radical change.

4.2 Approaches in qualitative research

Hoeve used a combination of research instruments was used to gather the data, i.e. observations, interviews, and documentary. Data were collected at different moments in order to get a grip on changes taking place. The differences between the routine constructed at t=0 and the routine reconstructed at t=1 is used as measurement for routine change. The data gathered are transcribed and coded. The coding scheme follows the levels as distinguished by Pentland and Feldman (2005): the ostensive-performative- artifacts approach. The coded fragments are summarized in tables displaying the three categories at both t=0 and t=1 (cf. Miles & Huberman, 1994). This allows us to compare the three categories at both moments and note the differences in time. These differences in turn were analysed in accordance to the elements of routine change developed by Nooteboom, i.e. change at branch level, node level or architectural level.

4.3 The case

In this paper we give account of the industrial bakery case of Hoeve (for a complete overview see the Ph.D. study of Hoeve) based on existing approaches of Pentland and Feldman (2005) and Nooteboom (2004) to select relevant variables for studying organizational routine change quantitative. Before presenting the results we first give a description of the organisational setting.

*General description of the industrial bakery*  
W is an industrial bakery that produces is about 50,000 loafs of bread baked, packed and transported to the supermarkets. The bakery employs about 140 people, working in one of the following departments: the bakery floor, logistics, expedition, stockroom, technical support and office. About 60 people are working in the actual bread production process, i.e. the bakery and logistics. Their work is organised in three shifts (day, evening and night shift).

In this study Hoeve followed two shifts operating the bread line in both the bakery and logistic department. Each shift exists of two teams: a team of bakers responsible for the actual bread backing process and a team of packers responsible for slicing the bread, bagging and making it ready for distribution. As the automated lines cover both the baking and packing process, each team is operating a part of the bread lines. Both teams share the responsibility
for the production process. In principle, it is always the same combination of bakers and packers that make up a shift.

In the early 2000s the director anticipated the production for niche markets would grow as consumers demand more variety and are willing to spend a little more on luxury products. Supermarkets’ demands follow consumer demands, so orders diversify, even on a daily basis. At that time it became apparent that the automated line is efficient for bulk production, but not for producing a lot of different varieties. Changing the line for another type of bread costs much delay and cleaning, and it is difficult to adjust the rise cabinets and ovens to specific rising and baking requirements (such as humidity and temperature) for each variety which would increase the quality. To be able to produce more cost-efficiently and enhance the quality, a new robotized line was developed.

In January 2004 the new line was installed at the shop floor in the bakery workshop. The first 6 months turned out to be a disaster as the new line had many operational problems. After 6 months a new machinery designer was contracted who adjusted the computer support system. On of the most important improvements he made was designing a new user interface that allowed the workers to ‘follow’ the baking process on screen. The newly designed user interface was ready and installed in September 2004. This adjustment made it possible for the workers to detect the impact of their actions on the technology, leading to a reciprocal process in which men and machine could adjust to each other. This adjustment process took about 4 months. So in January 2005 the robotized bread line was taken in full operation. At that point also the packers were

Once the robotized line in the bakery workshop was up and running, a new packaging line was installed in the logistics department. This line allows the packers to increase the speed of bagging and packing the rolls, and finetune their activities to the bakery department.

During the last two years the niche market specialities appeared more booming than in the most optimistic forecasts. Also the demand for Christmas and Eastern loaves increased spectacularly. Even with the increased efficiency of the robotized line, the bakery had difficulties meeting these booming demands. It was decided to replace the specialities line. However, as the introduction of the robotized line diminished the innovation budget, there was not much money available for this line. Therefore they picked up a bargain at the second hand market. Although this is old technology, it is a cheap solution for this urgent problem. In January 2006 the existing specialities line at the loaves workshop was replaced by a new one.
This new specialities line is similar to bulk line and requires less handwork for transporting the loaves from dough machine and rise cabinet and from rise cabinet to oven. With this line they are able to produce the specialities more efficiently.

4.4 Findings
In this section we present the findings about the routine change in the bakery. After, the change is presented from different angles in accordance with different aspects of routines that are identified in the literature, i.e. performative, ostensive part, and related artifacts (Pentland & Feldman, 2005) and finally the branches, nodes and architecture (Nooteboom, 2004).

Findings according to the ostensive-performative-artifacts approach

The change in the performative part
At performative level Hoeve observed little changes. The main task is control of the lines: this means walking along the automated lines and keeping an eye on the control signals in the robotized line. An important characteristic of the bakery routine is that not all steps of process are automated. Some steps still require handwork, such as adding ingredients –raisins and paste- for yeast bread. The trick is to combine such handwork with control tasks. Although the division between handwork and machine operations has changed as both in the robotized line and the specialities line more activities are automated, good performance is still based on developing effective patterns to control the automated lines, whereby a good balance between control tasks and handwork largely makes up the efficiency. Although what people do has not changed, who does what has changed. As two work stations diminished in the loaves bakery, the bakers who staffed these stations were assigned tasks at the packing department. These men were challenged to perform totally new tasks. At performative level one could say the workers in the bakery perform more or less the same job. There have been some slight adaptations, but their working day does not look that different than one year before. Yet, although the nature of the job at this level has not changed some are performing a job that is new to him. Still this is considered a slight adaptation. At the shop floor people state their work has not changed that much.

The change in the ostensive part
The introduction of the new line requires a complete turnover in the way of working. As the baking process is centralized even more, the employees need to oversee all the steps in the process in an abstract (virtual: see the importance of computer steered production) way. Employees have to recognise what is wrong
in the process, by not seeing things happening on the computer screens. This requires deepened insight and enhanced ICT skills. Another large difference between the old and the new lines, is the uncoupling of different operations: a disturbance in one of the modules does not immediately effects the process in other modules, so technical assistance can do its job without production delay. This takes another view of employees: you have to think more and more in process terms, to know how long modules can operate, and how many time there is for repairing without blocking the whole line.
The change in artifacts

The most noticeable aspect of the introduction of the new technology has been the change of artifacts. The introduction of the technology has had a striking effect on the layout of the workshops. This robotized line is shorter, modularised, more flexible and able to produce bread of higher quality. As the line is shorter it takes less space than the old ones. For example: cooling the loaves takes about 10 m², whereas in the old lines about 1.5 km cooling line was meandering throughout the whole plant. Robots connect the separate modules in the line that is for dough making, rising, baking and cooling down. The robots are put into service for transporting half products from one module to another. By spatial improvements and arrangements one operator is able to oversee the whole line, which is further enhanced by computer screen surveillance. Therefore this line is operated by one man only. The layout of the packers workshop has also changed quite dramatically. The new rolls packing line is situated at a platform. An important consequence is that this has created more space as well literally as figuratively, i.e. for the workers the workshop has become more neatly-arranged and therefore more easy to control. The change in layout of the loaves workshop has also changed because of the replacement of the specialities line. This is best explained by comparing the situational maps before and after the replacement (see figure 3a and 3b).

figure 3a Layout of the loaves workshop before replacement
In both figures the grey line represents the line for the bulk production, and the white line represents the production of specialities. The first striking difference is that in original layout there were 5 workstations, where in the new layout there are only three workstations. The main reason is that in the new line more is automated, especially in terms of transport, and thus less handwork is required. A second important difference is that in the new situation the workshop is more crowded with machinery. In contrast to the new situation at the packing workshop, here the situation has become less neatly arranged. However, this situation will change on the short term as the set up of this new line has inspired the technicians to change the set up of the bulk line in such a way that it needs less space. Although the layout of the workshops has changed quite dramatically, the machinery did not change that much, i.e. from an operational perspective. The operational handbooks have hardly changed after the introduction of the new technology. There is, however, one exception and that is the robotized rolls bread for which a new user interface in the computer has been designed. For the workers this was a totally new artefact they had to learn to work with it. In the following figures this new artefact is displayed at both t=0 and t=1:
Employees have to recognise what is wrong in the process, by not seeing things happening on the computer screens. This requires the ability of abstract thinking.
At \( t=1 \) operators make more use of computer screen (dare to rely on it). Another large difference between the old and the new lines, is the uncoupling of different operations: a disturbance in one of the modules does not immediately effects the process in other modules, so technical assistance can do its job without production delay. This takes another view of employees: you have to think more and more in process terms, to know how long modules can operate, and how many time there is for repairing without blocking the whole line. This becomes apparent in the information box about the situation in packing department.

*Findings according to the branches, nodes and architecture approach*

**The change in branches** The routine of the workers at the bakery is build upon a sequence of activities operating the lines for loaves and rolls of bread. The technology (the line) dictates the sequence of branches; that is first kneading the dough, followed by the rising, then the baking and finally the cooling down. Each branch has specific indicators for control; for example humidity and temperature indicators in the rising area, but also the point where wasters are removed from the line (too much waster is an indication that something is wrong with the settings of the oven). In case these indicators deviate the worker has to decide how to solve a problem, i.e. initiating a problem-solving routine. Within the new technology the sequence and contents of the branches have not changed. From a branches perspective the content and sequence of activities are generally unchanged.

**The change in nodes** With the introduction of the new technology some new nodes have been added to the routine structure. As workers have to think more and more in process terms the longer the sequence of branches that is part of their routine. Bakers have to consider the consequences of their actions for the packing process and the other way around.

**The change in architecture** An important change in the architecture is a shift in the constitution of the team. Although the teams were relative open communities in the sense that there was always boundary crossing between the bakery teams and the packing teams, the two teams worked in their own specific domain, and created their specific culture. The bakery teams considered the bread baking process as their domain: they felt responsible for baking quality bread. Further the bakers had a sense of craftsmanship as baking bread is seen as skilled work. The packing teams had less pride in doing their job. They felt responsible for the “simple job” of slicing, bagging and packing the bread. This is considered low skilled work.
The unity is not so much built on craftsmanship but on collegiality. The distinction between the two teams as different communities is apparent in the difference in work clothing. The bakers are wearing white uniforms and the packers wear red shirts.

With the introduction of the robotized line loaves production became different from rolls production. The latter is computer-controlled and allows and requires more finetuning of baking and packing activities. This has enhanced the communication between the bakery and packing department in this line. This development resulted in a critical reflection on the organisational structure at different levels. The result of this reflection is that the organisation should no longer be organised in accordance with the different production activities, i.e. baking and packing, but in accordance with the different production lines, i.e. loaves and rolls (see figure 5).

![Diagram of organisational structure](image)

Figure 5

A striking example of this change is that a new meeting structure has been set up in which work meetings are organised with all workers on the loaves line and all workers on the rolls line. At time of this study the change to the new organisational structure was still in progress. For example, even though white uniforms and red shirts are working in closer cooperation, the difference in uniforms still exists.

4.5 Conclusions

At first sight on the performative level (Pentland & Feldman, 2005) the routines in the bakery seemed not to have changed. At the shop floor people state their work has not changed that much; their working day does not look that different than one year before. Yet they do their job from a different perspective and in close cooperation with other people. The bakers have
to inform themselves what is happening in packing department and vice versa and more communication between bakery and packing is required. But at the ostensive level (Pentland & Feldman, 2005) some major turnovers have taken place, partly becoming visible in the change of artifacts.

As noted before Nooteboom distinguished three forms of change, i.e. optimization, substitution and innovation. Optimization refers to a change in the branches. Substitution refers to a change in the nodes and innovation to a change in the architecture. The routine change is in the bakery can be classified as a change in the architecture and therefore as a radical change of the routines.

From methodological point of view the study confirms that routines are not isolated phenomena. Further, the ostensive-performative-artifacts approach gives in this study a thorough understanding of the phenomenon of organizational routine at a certain point of time as it focuses on what it is. On the other hand, Nooteboom’s (2004) branches-nodes-architecture approach focuses more on understanding the change, which helps us to thoroughly assess the nature of the change.

5. Linking the qualitative research results to a quantitative approach
The results of Hoeve’s qualitative case study give a detailed overview of the change of organizational routines in an industrial bakery. The study shows how important it is to focus on every aspect of a routine: ostensive, performative and related artifacts. The OPA-approach allows us to draw conclusions on the nature of routine change.

Furthermore, the OPA-approach seems very helpful to structure the kind of innovation. From Hoeve her case study, the innovation was a new technology, a new line in the industrial bakery. In Hoeve her case study the innovation was introduced on the artifacts-part. As she describes: the most noticeable aspect of the introduction of the new technology has been the change of artifacts. The introduction of the new technology has had a striking effect on the layout of the workshops.... To look at all kind of innovations it is necessary to define categories of innovation, because the type of innovation can influence the change process. The ostensive-performative-artifacts approach seems fruitful to divide innovation in terms of innovation at the performative part, ostensive or artifacts part, in order to clarify and approach the kind of innovation and interventions.
Further, Hoeve her case study indicated another factor of the work environment for the framework (figure 2): degree of freedom or in other words the room for personal interpretation of the routine. If members really execute their work in an interdependent way is also determined by the freedom employees have to avoid settings in which they must depend on others. Hoeve describes in her study that although the protocol can give indications about what are considered appropriate actions, in for example a consultancy organization employees have a lot of freedom in the way they actually perform this protocol. She argues that the degrees of freedom derive from individual characteristics and characteristics of the work environment, and its interaction. We use the term degrees of freedom to refer to the degree employees have to avoid settings in which they must depend on others.

Finally, we consider the three aspects of Nooteboom: branches, nodes and architecture, as relevant to describe and validate the outcomes of organizational routine change in work teams. By studying the branches, nodes and architecture it is possible to say something about the level of change that is achieved.

6. Discussion
The purpose of this study was to develop a framework to study organizational routine change in work teams. Although we started by introducing a framework to study more quantitative organizational routine change, we have run across the problem of operationalizing the outcomes of organizational routines. We recognize that organizational routines and the change of organizational routines have to be understood in their context. To study organizational routine change it seems necessary to combine the framework we introduced with qualitative case studies; to understand what has changed and which level of change is achieved. Therefore, Hoeve proposed a qualitative approach of researching organizational routine change, combining the OPA and BNA approaches.

We suggest that effective research into organizational routine change requires combined research methods and also longitudinal research programs of study, so that the organizational routine change can be captured over time. Only through such research design we can draw valid conclusions about organizational routine change. A good starting point can be a case study to provide data that can give insight into the context of organizational routines and the routines itself, followed by a quantitative research, which gives information about which
factors influence the process of routinization. By combining the two methods, we can obtain a deep understanding of organizational routine change.

Although this paper certainly does not introduce a complete framework to study organizational routine change, this paper does provide some insight into organizational routine change from both a quantitative perspective and qualitative perspective. More research is needed to develop a deeper understanding of combining qualitative and quantitative research to study organizational routine change.

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