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Work organisation and competence development in Swedish firms

Based on the Swedish Meadow Survey 2010

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Abstract
The overall objective in this paper is to contribute to the discussion about growth in the economy. This can be done in many ways. Here it is done by exploring measurements created by researchers with focus on work organisation and competence development. The results and predictions of incidences of work organisation and competence development across the Swedish business sector are presented. Data from the new Swedish Meadow Survey is used that collects information from the employer. Background theory and data are also described and used in a tentative and exploratory way. By doing so, the paper also can spread knowledge of the EU Meadow project that provides the guideline to the Swedish survey.

Summary and concluding remarks
The overall objective
This study and paper is a part of the Statistic Sweden project called Organisation, Growth and Work. The overall objective in this paper, and also the Statistics Sweden project, is to contribute to the discussion about growth in the economy. This can be done in many ways. In this paper and project it is done by exploring measurements created by researchers with a focus on work organisation and competence development in work. Hopefully this paper will also spread knowledge of the EU project Measuring the Dynamics of Organisations and Work, Meadow, which provides an important guideline to the Swedish survey from Statistics Sweden.

This paper aims to support the other studies in the Statistics Sweden project with background theory and descriptions of the
measurements used. It also aims to analyse the predictions of incidences of work organisation and competence development across industries in Swedish business sector.

**Underlying theories**

The EU project is comprised of three main reports, where the main report is a proposal of collection and interpretation of data presented in the Meadow Guideline. Two meta-studies have also been published in the project: the Grid Report, a summary of questions in 21 earlier surveys that aims to pick out the best questions to the guideline, and the Meadow Multi-Level Theoretical Framework, presenting underlying theories behind the examined 21 surveys. The overall conclusion of the background reports is that it increases validity and reliability considerably in the Swedish survey that is using these guidelines. Nevertheless, it is of interest to give some more specific comments on the presented theory.

The presentation of theory in Meadow is divided into three levels: system level, organisation level, and individual level. My first remark is that it seems to be an understanding that the system level includes theories about research and the educational system, and that it also concerns innovation in products and markets etc. which includes both systems and strategies within an organisation. But it does not seem to be equally obvious that these perspectives on systems are intertwined with organisational innovations such as work organisation and competence development, even though it is mentioned that they can be parallel.

When it comes to theoretical aspects concerning the organisational level, the focus is on practices within the firm and on the employees in the firm. The focus is not on interaction between organisations or interaction between employees in different organisations. One of the important aspects that are presented is that employees are seen as a valuable resource for the business strategy and employees are looked upon as proactive and learning. On the other hand, the theoretical perspectives on individuals are focusing on how actions in the firm impact on employees, especially on the so called negative impact on the employees’ working conditions and health. It also touches questions about labour market.

One important conclusion concerning the background reports is that the outcomes of the these broad theoretical meta-studies may contribute to theoretical insights, but the link between theory and data needs to be constructed ex post rather than be taken as
something that has been structuring the original design of the guideline. This is also highlighted in the Meadow guideline.

Therefore, this first paper wisely uses these theories as well as the data tentatively. The measurements do not take a stand in any of the specific concept; they simply indicate incidences of several of the aspects, and broad indicators are created and used.

**Four composite indicators**

Four composite indicators are used as proxies of the employer’s point of view of the firm’s organisation and development. To summarise, the first indicator is a proxy for the employer’s perspectives of *individual learning* in the firm that includes the employees’ formal and informal learning at work. The indicator *structural learning* provides information if the firm is building structural capital through organised work with quality and innovations as well as strategies about customer satisfaction in focus. The indicator of *decentralisation* gives information about who is responsible for planning daily work and quality control. It also provides some information about horizontal integration in teams, which in itself can indicate the complexity of the organisation. *Numerical flexibility* provides information about the firm’s possibility to change the size of the workforce with short notice. It also gives some information about workforce flexibility within the firm in terms of task rotation and part time work. This indicator might also indicate the use of an external workforce for knowledge transformation, at least in combination with other work features.

**Relationships between the indicators**

The correlation analyses and the regression model provide information of predictions of incidences of the four composite indicators. The correlation gives an overview and studies the relationship between one feature at the time and the indicators. The regression model fine tunes the information and takes into consideration a more complex model of the firm and the work force.

If the correlations are high it can be interpreted as if the indicators and sub-questions provide the same kind of information. It can also be of further interest to analyse multiplicable effects if they are correlated. If they are negatively correlated it can mean that they exclude each other.

The correlations between all indicators are positive, except for the relation between decentralised work organisation and numerical flexibility, as more or less assumed. The level of significance is high.
in the positive correlations, which means that the higher the incidence of one indicator the higher the incidence of the other indicators. This might be an indication of a multipliable effect when using more than one indicator. The highest correlation is between the two learning indicators, and it is 31 percent which is not too high. When it comes to the negative correlation between decentralised work organisation and numerical flexibility the significance level is lower. A negative correlation means that the higher the incidence of one indicator the lower the incidence of the other indicator, and vice versa. Numerical flexibility is still positively correlated with the two learning indicators. The overall interpretation of the parameter estimates are that they are not so highly correlated that the indicators provide the same information.

**Work force features predict incidences**

A linear regression model is used to estimate the incidence of each of these four indicators, with the help of non dependent variables that measure features of the firm: size and industry and foreign ownership. The features of the firm’s work force are also measured: age, formal education and the degree of women and men in the firm. The non dependent variables are assumed to predict a higher or lower incidence of the four composite indicators, one composite indicator at the time, in separated equations. The non dependent features are included in the estimation simultaneously, but the result of one feature at the time can be interpreted and analysed if it provides information that can predict incidences of the indicator, given that all the other included features are held constant.

The result show higher incidences in larger firms and lower in smaller firms, compared to middle sized firms. This is true for all indicators but decentralisation. Another independent feature is the work force sexes. The average proportion of women in these industries is about 30 percent, which gives an average of 70 percent of men. According to the result of the analyses, sexes can predict the incidence. A higher percentage of women predicts higher incidence of three of the indicators, strongest for numerical flexibility. The estimations are highly significant for numerical flexibility, rather high for decentralisation, and significant but to a low level for structural learning. This means that the proportion of sexes of employees in the firm can help to predict the incidence of these three indicators, but not individual learning.

Types of industries cannot really explain the differences between the incidences of any of the indicators, and the incidences do not differ

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between if the firm is foreign and Swedish controlled. An important reason for why the indicators do not differ dramatically according to ownership, is that foreign direct investments in Sweden are dominated by mergers and acquisitions etc and not so called greenfield investments. Other reasons are that the industrial relations seem to be strong and stable and the knowledge level is fairly high across industries in Sweden.

Policy conclusion
The policy conclusion is of interest since these kinds of practices are of great importance for the development of the firm and of importance for the people working in these firms as well as for the labour market and potential new employees. Above it is stated that the practices are underrepresented in small firms. Moreover, some indicators are significantly underrepresented if the employees have a low educational level. Earlier analyses in the 1990s of the same kind of practices showed a significant relationship between individual learning and decentralisation as well as higher productivity and better working conditions for the employees. Some preliminary results based on this new data also indicate the same results (see footnotes 59 and 56). Since earlier policy programmes promoting these practices have proved to be efficient both when it comes to increase of these kinds of practices and their impact on the firms productivity, there is a reason for developing programmes that are boosting learning and decentralisation (see footnote 69).

Swedish Meadow survey constitutes a good starting point for analyses
Finally, it is worth mentioning in this summary that this paper also describes the Swedish Meadow Survey and quality, alongside other parallel papers in the project, see footnote 42. One important aspect is the selection frame that is based on two EU regulated surveys: The Swedish CIS survey about innovations and the ICT survey. Together with the Meadow Survey they comprise a great potential to make analyses of intertwined perspectives of dynamic changes on a system level and work organisation and competence development in firms and its impact on employees. Several of the presented background theories concerning innovations can be found the CIS Survey, and some issues can be found in the ICT Survey. Data from these surveys have been used in parallel papers to this one, and the relationship between innovation and work organisations as well as competence development are analysed, see footnote 56. Relations between ICT and work organisations and competence development
are also analysed, see footnote 57. Other parallel papers concern analyses of the difference between the sexes and employees' working conditions according to work practices, see footnotes 58 and 59. Together the three Swedish surveys cover in principle all themes of questions in the Meadow Guidelines, and since their selection frame is based on business numbers, the survey data can be matched with several other register data at a low cost with really high quality. The organisation of the Swedish Meadow increases validity (quality of the questions) and reliability (the consistency of the measurement) considerably. Therefore forthcoming papers can even include further analyses of the relationship between the firm and its environment, and economic performance, as well as the employees' position on the labour market given for example their formal education. The overall conclusion is that the first Swedish Meadow Survey, its organisation with other surveys and register data, constitutes a good starting point for further analyses.

**Background**

The background of this paper is the need for complementary ways to describe driving forces for growth. Classical economical growth models primarily describe changes in growth rates on aggregated levels and even though it is good that they stand out for aggregated mathematical input and output models, they have to be complemented. Today, even economists call these models “the black box” because they lack a description of what is taking place in the firm. The principle idea behind these traditional aggregated methodological assumptions is the desire to sum up the result of the entire economy, since all activities count. A complementary argument is that analyses on disaggregated levels based on growth in businesses, industries or enterprises can give the wrong impression, due to resource allocation and different values of output between economic sectors, businesses, industries and firms.

New endogenous growth theory emphasises that activities in the firms are important to understand value creation and economic growth. Therefore, growth economists argue that the models are especially in need of development when it comes to explaining endogenous activities, and they need to include theories about the
Economists who are looking to do so argue that new data is needed to develop theories about driving forces. But still very few economists are interested in theories of work organisation and learning. One explanation for this is probably related to the traditions in the different theoretical disciplines. Theories of work organisation and learning are often based on qualitative in-depth studies of a single workplace or a single firm. Sometimes some few firms are included, but never or very seldom a larger number of firms. These kinds of deeper qualitative analyses are not mentioned to be aggregated to the business level, or mentioned to be used in an input and output model, or other equations explaining the production function of the economy.

At the same time, targets for policies today are to create new jobs by investing in people and by increasing innovations in firms in the business sector. These policies that prioritise in meeting an increasing demand of lifelong learning, research and development in the knowledge-based society need background information. Moreover, the rapid diffusion of ICT and global markets has increased the knowledge intensity. Alongside traditional emphasis on research and development and investments in third-level science and technology education within the European Union, knowledge in a broader social framework has been recognised. This includes skills development on all levels of the firm. Knowledge-based policies, such as the European Strategy for Growth and Jobs as well as the revised Lisbon Strategy for ‘flexicurity’, depend critically on indicators monitoring incidences and diffusion of these broader aspects of knowledge and skills.

Therefore, it is in order to argue that there is a growing consensus that knowledge has become of great importance for wealth creation and that innovation is a key driver of economic growth.

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These questions are acknowledged in the European Union project Meadow, an acronym for Measuring the Dynamics of Organisations and Work\textsuperscript{26}. The result from the project is a proposal of EU guidelines in the collection and interpretation of new data about work organisations, management and work practices as well as human resource development.

With help of these guidelines created by researchers with focus on work organisation and competence development, new data can be collected that might better fulfil the needs of endogenous growth theory to study activities in the firms and its relationship with value creation and economic growth.

Objective

The overall objective is to contribute to growth and prosperity, by participating in the joint discussion among disciplines about endogenous activities in the economy. This can be done in many ways. As mentioned above, theories of work organisation and learning are often based on qualitative in-depth studies of a single workplace or a single firm, seldom a larger number of firms. Economists in general emphasise that studies of economic growth must be done on an aggregated level, on national or other system levels. Researchers involved in endogenous growth theory support the idea of aggregated growth perspectives, at the same time they argue that it is important to look into activities within the business sector and within the firm. The different disciplines can meet in studies based on firms. Hopefully they meet in this study.

This paper use measurements and data that are created by researchers in disciplines that focus on work organisation and competence development at work, often with focus on so called cases studies. Here these measurements are aimed to be used in aggregated analyses. Further, this paper aim to support the Statistic Sweden project Organisation, Growth and Work, with background

theory from the EU project Meadow, and it especially describes the EU project Meadows theory paper. Hopefully it can contribute in making the EU project more known and spread. This paper also describes the Swedish survey that is collecting data of work organisation and competence development at work, based on the guideline in the EU Meadow project. It also describes used measurements and to a certain extent it explores data and these used measurements. Finally the paper analyses the prediction of the used measurements' incidence and diffusion across the business sector.

Method

Overall frame
The overall frame for this study is the EU project Meadow 2007-2010 and its proposal of how to collect data of skills in firms. The guideline is based on two major background reports; The Grid report and The Theoretical Framework. Both background reports are large meta-studies, the first of empirical surveys and the second of theory related to this surveys. Part of the EU projects background is two earlier Swedish surveys and studies that analyses work organisation and competence development and their impact on people and firms in Sweden during the 1990s. They were organised by the Swedish National Board for Industrial and Technical Development, Nutek, see also footnote 48 and 49.

New data describing work organisation and competence development have been collected in Sweden mainly based on the guideline in the EU Meadow project. The collection of data has been done by Statistic Sweden in the project called Organisation, Growth and Work Environment. The selection frame for the Swedish collection is based on two other surveys. The restrictions and possibilities that this constitutes are described in the paper.

Analyses based on the new Swedish data will be published by Statistics Sweden. These are partly inspired by the two Swedish surveys from Nutek that were included in the EU project. The earlier Swedish survey data was used to analyse the relationship between work organisations and competence development in firms, its economical impact on the firms and its social impact on employees.
New survey data matched with individual and firm register data

The data used to measure work organisation and competence development in the Swedish business sector is from a new Swedish survey called the Swedish Meadow Survey 2010. Statistics Sweden has collected data from firms in the Swedish business sector during the winter 2009/2010. Two other surveys constitute the selection frame for the Swedish Meadow Survey 2010, the survey’s themes, and questions as well as other frame and used measurements are presented and discussed further on in this paper.

To describe the diffusion of incidence of work organisation and competence development in the Swedish business sector Meadow data are matched with register data that, in addition to economic data, classifies the firm’s size, type of industry and foreign control of firms in Sweden. The source of register data is briefly presented below.

Statistics Sweden’s longitudinal integration database for health insurance and labour market studies, with the acronym LISA, complements survey data in this study. The register holds primary annual records from 1990 for all individuals aged 16 and older who were registered in Sweden as of 31 December of each year. The individuals are connected to family, firms, places of employment etc.27.

The Swedish Agency for Growth Policy Analysis (Growth Analysis) is the official provider of statistics on the internationalisation of the Swedish business sector including foreign controlled firms in Sweden, as well as some other statistics on firms.28 This agency and Statistics Sweden are working together to provide statistics on foreign controlled firms in Sweden. In this paper firm data from the

27 Statistics Sweden, 2009. *Longitudinell Integrationsdatabas för Sjukförsäkrings- och Arbetsmarknadstudier (LISA) 1990-2007. Arbetsmarknads- och utbildningsstatistik, 2009:1*. The individual section includes: Age, Genus, Education, Employment, Unemployment, Income, Professional, Entrepreneurial activities, Illness, Parental leave, Rehabilitation, Retirement, Private pensions, etc. The firm section includes: Firms, Work places, Type of industry, Sector, Location, Number of employees and Salaries per year, Basic economic data. LISA does not include data in the finance and insurance industry (Nace 64-66) since these data is differently collected. In the Statistics Sweden Book 2011 data for all industries will be included.

28 The database for foreign controlled firms in Sweden includes organisational number country, country groups, business classification, size, employees, if the firm is active.
Swedish Meadow survey are matched with data of firms' controlled by foreign ownership.

The firm is the observation unit
The data from Meadow are matched with register data with help of information from the Swedish Business Register. In the register the firms have both a business number and an organisational number. The business number is a statistical definition of a firm unit. The majority of all business units are defined as a sole legal unit and have an organisational number (it can also be a person's identity number, depending on the type of business). In statistics, the business unit is the smallest economic entity with employees that produces goods or services. According to the registers' administrators the absolute majority of all firms in the register have a so-called one to one relationship between the legal and business unit numbers. Larger firms often consist of more than one legal unit and they often belong to a group of firms. These firms can be organised in the register so that related legal units belong to one common business unit, which can include both active and non active legal units. They are also called complex business units. The idea is that all business units that are related have a common identity, for example if they belong to a group of firms. Mainly the register includes all units that perform actively economically in both private and public sector.

Before the 1990s the statistics of the performance of the business sector was very much focusing on manufacturing activities, because of the tradition of good statistics in these industries on the work place level. This level was in most cases the same as an economic entity with a specific geographical address. Measurements of service activities were poorer in Sweden and there were no measurements of economic activities on the work place level. This was partly because this level did not exist as an economic entity in service business and because many service activities are not taking place at


30 Limited liability firms, or other types of enterprises, or types of economic organisations, or sole proprietorship etc.

one specific address in a measurable geographic place, as activities in manufacturing. Since then the measurement of service activities has developed considerably, both in terms that they are measured and in terms of how they are measured. Sweden can today be seen as part of the frontier in Europe when it comes to developing measurements in service industries in the economy.

Today it is possible to measure economic activities in both manufacturing and services on the same level, using information of business number and organisational number. Therefore business activities from both manufacturing and services are included in this study. The measurements are on a level that has common features, for instance that they are legal units and economic entities, so the basic quality in the analyses can be seen as high. Further the definitions of this unit for all business activities are based on common European regulations, see also footnote 29.

Another reason for measuring at firm level is that investments in management practices and work organisations will be related to innovations and use of information technology, which have to be studied at a level where these decisions and economic decisions are held together according to these measurements guidelines, see footnote 36. In general this level is the legal unit that is the same as the economic entity, called firm in the business sector.

**Statistical analyses**

Descriptive statistics are used to present the incidences and diffusion of the four composite indicators in the business sector. The diffusion is described according to sizes of the firm, different industries and if the firms are foreign controlled.

The estimation of each firm’s incidences are standardised for the firm’s own industry’s proportion of value added in the business sector, except for firms in finance and insurance industry (Nace 64-66) since these data are differently collected, see footnote 27. One way to study how well the included firms are representing their industries is to calculate their value added, and how well they represent the value added in their own industry or group of industries. The way the firms differ from how they should represent their group of industries can be described in terms of their weight.

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The ratio of value added is calculated as the sum of all included firms in relation to the entire value added in the industry or group of industries that the firm belongs to. If each industry was equally well represented the ratio would be the same in all industries. Some industries are over represented and others are underrepresented. The idea is also to use the weight in the different analyses, including the presentation of incidences and diffusion of work organisation and competence development across the business sector in Sweden.

The most common measuring of the degree of correlation is used, the Pearson correlation coefficient. It is widely used in the sciences as a measure of the strength of linear dependence between two variables. The motive is to study the relationship between the indicators and the relation between all included sub questions within each of the four composite indicators. If they are too much correlated they might be providing the same kind of information, if they are not highly related to each other they can be contributing with specific information. A third correlation analysis is done between the indicators and some features of the firm and the firm’s workforce.

Finally, a linear regression model is used in further analysis of the prediction of incidences of the four used indicators. The questions answered are if certain features of the firm or features of the employees working in these firms can explain a higher or lower incidence of the four composite indicators. Included features of the firm are size, business unit and if it is foreign controlled or not. The features of the work force are age, sexes and formal educational level. The model estimates for one feature at the time and in the same time standardises for all included features.

**Swedish Meadow Survey 2010**

The first Swedish collection based on the Meadow guideline was performed during the winter of 2009/2010\(^\text{33}\). Information was collected by telephone interviews from the employers in the Swedish business sector. The questions are based on the Meadow Guideline, see footnote \(^\text{26}\) and the former Nutek surveys, footnotes \(^\text{49}\) and \(^\text{50}\).

Selection frame
The selection frame for Swedish Meadow Survey consists of 1,395 firms, divided into two rounds of collection. The first one consisted of all firms with 20 employees or more and the second consisted of 395 firms with 15 employees or more. The known over coverage is 21 firms that should not have been in the selection, since they are acquired, insolvent, or not active.

Executive directors in the selected firms were invited to participate in the Swedish Meadow Survey, in a telephone survey. If the executive director could not participate he or she had to appoint another respondent. The field report from the Swedish collection states that it was more problematic to replace the executive director as a respondent in the largest enterprises than in others, see footnote 33. Some of these executive directors decided not to participate, which was possible since the survey is not mandatory or otherwise regulated. One reason for the difficulty to find a replacement in larger firms could have been that it is more common that the larger firms are so-called complex business units, which includes more than one legal unit. On the other hand the total frequency of these complex firms in the present selection is small, only 13 firms, implying a rate of less than one percent (0.9). Half of them did not respond, 7 firms, and half did respond.

Piggy-backing two other surveys
The Swedish Meadow Survey that provides data of work organisation and competence development is piggy-backing two other surveys that are collecting data from firms in Sweden. Piggy-backing means that these surveys constitute the frame for the selection of firms in the Swedish Meadow Survey.

The first survey the Swedish Innovation Survey to firms, based on the European Community Innovation Survey, CIS. It is a

35 Nylund A. Calculation of complex business units in the selection, responded compared with non responded firms.
measurement of scientific and technological activities that is conducted every second year. The second survey is the Swedish Information and Communication Technologies Survey, ICT, which collects yearly data from households and enterprises. These two other surveys are EU-regulated and mandatory.

The technique to use two other surveys as the selection frame makes it possible to match data, and to reduce the Meadow Survey. The data set in the other surveys includes business and organisational number that make it possible to match all data in the three surveys and to match with other registers that organise data after these numbers. It is plausible to argue that the technique to match with other data increases both validity and reliability of these data since the surveys that are collecting these other data have been used several years and because the information is specifically collected from the person who knows most of the specific matter.

Neither the CIS nor the ICT Survey includes all industries in the business sector; therefore all industries are not included in the Swedish Meadow. Table 1 presents the included industries and the amount of employees that are included in the Swedish Meadow Survey.

Table 1
Included and excluded industries in the Swedish Meadow Survey

<table>
<thead>
<tr>
<th>Industries in business sector, market producers and producers for own final use 38</th>
<th>Nace classification</th>
<th>Percent Employees*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry, fishing</td>
<td>1-:</td>
<td>2,3</td>
</tr>
<tr>
<td>Mining and quarrying</td>
<td>5-:</td>
<td>0,3</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>10-3:</td>
<td>20,7</td>
</tr>
<tr>
<td>Electricity, gas, water supply, waste collection</td>
<td>35-3:</td>
<td>1,2</td>
</tr>
<tr>
<td>Construction</td>
<td>41-4:</td>
<td>9</td>
</tr>
<tr>
<td>Wholesale trade, except motor vehicles</td>
<td>4:</td>
<td>6,4</td>
</tr>
<tr>
<td>Wholesale, retail trade, repair motor vehicles</td>
<td>45, 4:</td>
<td>10,8</td>
</tr>
<tr>
<td>Transportation and storage</td>
<td>49-5:</td>
<td>7,4</td>
</tr>
<tr>
<td>Accommodation and food service</td>
<td>55-5:</td>
<td>4,0</td>
</tr>
<tr>
<td>Information and communication</td>
<td>58-6:</td>
<td>5,5</td>
</tr>
<tr>
<td>Finance and insurance</td>
<td>64-6:</td>
<td>3,0</td>
</tr>
<tr>
<td>Real estate, except advertising, other professional activities, veterinary</td>
<td>68-7:</td>
<td>10</td>
</tr>
<tr>
<td>Administrative and support service</td>
<td>77-8:</td>
<td>6,5</td>
</tr>
<tr>
<td>Education</td>
<td>8:</td>
<td>2,5</td>
</tr>
<tr>
<td>Human health</td>
<td>86-8:</td>
<td>4,7</td>
</tr>
<tr>
<td>Arts</td>
<td>90-9:</td>
<td>0,8</td>
</tr>
<tr>
<td>Other service</td>
<td>94-9:</td>
<td>2,0</td>
</tr>
</tbody>
</table>

Note: *The percentage of employees per industry in business sector included in the selection frame, calculated as the average number of employees per industry or group of industry divided with the average number of all employees in business sector, November 2008. The industries are defined according to Swedish Standard Industrial Classification, Nace 2007, European Classification of Economic Activities, NACE, Rev 2. Industries in business sector is defined according to the overall definition of business sector in National accounts GDP and FDB se also footnote 29, and matched with data in the LISA-database, se footnote 38. The marked business industries (in pink) are included in the Meadow selection frame.

Table 1 above presents the specific industries that are included or excluded according to the Swedish Standard Industrial Classification in combination with the definition of activities that are included in the business sector, primarily based on the overall

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38 Firms and other organisations in the business sector are defined by National accounts (GDP) and the European system of accounting (ESA) and on definitions in The Swedish Business Register (FDB). These are matched with information in the LISA-database of each organisations sector code (SektorKod). All organisations on the business market are included: 11 = Statlig förvaltning; 12 = Statliga affärsverk; 13 = Primärkommunal förvaltning; 14 = Landsting; 15 = Övriga offentliga institutioner; 21 = Aktiebolag, ej offentligt ägda; 22 = Övriga företag, ej offentligt ägda; 23 = Statligt ägda företag och organisationer; 24 = Kommunalt ägda företag och organisationer.
Yearbook on Productivity 2010

Work organisation

definitions of these activities in the National accounts GDP. The table shows that several service industries are excluded from the selection frame, mainly because they are excluded from the CIS Survey, and some of them are also excluded from the ICT Survey. The industries that are included represent about 55 percent of all employees working in the business sector, i.e. the market producers and producers for own final use in Sweden 2008.

There are assumptions concerning innovations and technologies in the different industries. Industries that are more likely assumed to use advanced technologies are included (see footnote 37). Firms in industries that are within manufacturing are more likely to be using advanced technologies, due to their products and production techniques. This is not assumed among service industries. Earlier studies in Sweden during the 1990s showed that the incidence of work organisation and competence development in the industries that are excluded here can be, but not necessarily would be, lower than in the included industries.

To fully describe working life in Sweden, all industries in the entire business sector and the public sector should be included in the future. If the expansion of the Meadow Survey has to go step by step, the next step should at least include all business industries. The Meadow Survey, its stakeholders and users, would gain from this.

Response rate for different size and industry groups
The 1,395 firms that constitute the selection frame for the Swedish Meadow are all included in the calculation of the response rate. Usually the over coverage is not included, but here it is because the rate is compared with the response rate of the CIS and ICT Survey where the over coverage is not withdrawn. This lowers the response rate by one percent in Meadow, but only marginally in the other two surveys.
Table 2
Response rate in CIS, ICT and Meadow

<table>
<thead>
<tr>
<th></th>
<th>CIS</th>
<th>ICT</th>
<th>Meadow</th>
<th>Production of:</th>
<th>services</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-49 employees</td>
<td>83</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-49 employees</td>
<td>67</td>
<td>68</td>
<td>67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-249 employees</td>
<td>66</td>
<td>63</td>
<td>58</td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>250+ employees</td>
<td>63</td>
<td>61</td>
<td>65</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Tot</td>
<td>63</td>
<td>64</td>
<td>63</td>
<td>(64)(^{39})</td>
<td>65</td>
</tr>
</tbody>
</table>

Note: Business classification according to Swedish Standard Industrial Classification, is based on European Classification of Economic Activities, NACE, Rev 2. Here they are aggregated in production of goods or service according to European System of Accounting, ESA. The over coverage is about 2-3 firms in CIS and ICT respectively, in Meadow it is 21 firms. The source of the overall response rate for the CIS Survey (see footnote 36), and for sizes, Sandra Dovärn, Statistics Sweden Department for Economic Statistics (Investments, R&D, ICT). The overall response rate and sizes for ICT-Survey (see footnote 37). The overall response rate for the Swedish Meadow Survey (see footnote 34). The calculations of response rates for sizes have been done by Rönnlund R, MSc student/MSc candidate, trainee at Statistics Sweden summer 2010.

As shown in table 2 in the last row, the overall response rate for the Swedish Meadow Surveys is 63 percent. The two EU-regulated and mandatory surveys CIS and ICT are higher and about equally high, 85 and 84 percent respectively. The response rate for Meadow is roughly 20 percent lower. This is a good result considering that Meadow is piggy-backing two surveys that are EU-regulated and mandatory, while Meadow is not. The Meadow Survey has been launched for the first time and it was performed after the two other surveys; Meadow was the third survey in a row submitted to the same firms. The other surveys’ higher rates are probably also the result of several reminders to reach high rates. It is possible to conclude that some of the firms are rather content that they completed the two earlier surveys. Since Meadow is collected for the first time it is also possible that it still needs some adjustments to work even better in the future.

Table 2 also shows that the response rate in the Meadow Survey is rather similar in the different group of firms according to the two types of production and sizes, except for the large firms in services. For both the other surveys, action has been taken to obtain a high

\(^{39}\) If the over coverage is withdrawn in Meadow the response rate is one percent higher, 64 percent.
rate for large firms\textsuperscript{40}. The information from the collection of the Meadow Survey has presented that it was more problematic to replace the executive director if needed as a respondent in the survey in the largest firms (see footnote 33). This can help to explain the lower response rate for larger service firms in the Meadow Survey.

The response rate for different industries is not presented in a table but it is calculated. The response rate across industries fluctuates but can still be considered as rather similar. The rate is calculated at the industry group level since the selection frame is group level and it constitutes the relative chance for each industry to participate in the survey. The response rate for each group of industries is about 60 percent or above in Meadow. Compared to the two mandatory surveys the response rates fluctuate the same way. In other words, the industry group in Meadow that has the highest response rate is the same group of industries that has the highest rate in both CIS and ICT. In this case the particularly group of industries are in production of good and more precisely in manufacturing\textsuperscript{41}. This also indicates that the lower response rate for large firms in Meadow is spread across the business sector, even though it is stated that the response rate for large service firms are lower than in production of goods.

\textbf{Result from the non-response analysis}

A non response analysis of the Swedish Meadow Survey has been conducted with help of economic register data and some of the data from CIS and ICT. Differences between the responding and non responding firms are obtained by calculating the means of the different variables. For 1 197 firms register data were available, divided into firms that responded and firms that did not respond the Swedish Meadow Survey. The result shows no significant difference between the responding and non responding firms, see parallel paper.\textsuperscript{42}

\textsuperscript{40} According to the staff at Statistics Sweden, the Department for Economic Statistics (Investments, R&D, ICT).

\textsuperscript{41} It contains the industries: Paper (Nace 17), Petroleum (Nace 19), Chemical products (Nace 20), Mineral products (Nace 23), Basic metals (Nace 34).

The ICT survey excludes some business industries but it is mainly the CIS survey that excludes several industries. Because of this the non-response analysis does not cover all differences across industries in the Swedish business sector.

Concluding remarks on the organisation of the survey
The technique to use the CIS and ICT survey as the selection frame makes it possible to match data between three surveys, including the Swedish Meadow survey and to reduce the questions in the Meadow Survey. The three surveys cover in principle all themes of questions in the Meadow Guidelines and can include several other register data with high quality, validity and reliability, at a low cost. Even though the response rate is about 20 percent lower than in the two other surveys that it is piggy-backing, it is reasonably high. The reason it is lower is that it has been launched for the first time and it is not EU-regulated and mandatory, and it was performed after the two other surveys. The non-response analysis conducted with help of economic register data and some of the data from CIS and ICT shows no significant difference between the responding and non-responding firms. The only known drawback with piggy-backing the two other surveys is that since they exclude several industries, the working life in Sweden will not be fully described, so analysis based on this survey cannot say anything about the excluded industries. All industries in the entire business sector and the public sector should be included in the future, at least stepwise, first of all business industries.

Frame of reference
The theoretical background to the measurement used is the EU Meadow project is described in three reports, two meta-studies: The Grid Report and The Multi-Level Theoretical Framework. The overall result is the Meadow Guideline. Here, in this paper I also specifically refer to the two Swedish Nutek surveys during the 1990s, which are included in the background studies in the EU Meadow project. The two Nutek reports are: Towards Flexible Organisations (Nutek project Flex-1); and Enterprises in Transition, Learning Strategies for Increased Competitiveness (Nutek project Flex-2); and Flexibility Matters - Flexible Enterprises in the Nordic Countries (Nutek project Nordflex).
The Meadow Guideline, to capture skills develops in the firm

The key question in the Meadow Guideline\(^\text{\textsuperscript{43}}\) is described as a growing consensus that knowledge in form of skills develops on all levels of the firm has become of increasing importance. Therefore one can conclude that the overall object in the guideline is to catch skills development in the firm.

The EU project was organised so that it studied questions and good results from earlier surveys that aimed to pick out the best questions to the guideline. Surveys included were two from USA, one from Canada, one from the European Union, and the rest from different member states in Europe including two from Sweden. The 21 surveys are summarised in the Grid Report\(^\text{\textsuperscript{44}}\). The aim of this meta-study was to map existing quantitative data sources of National and European statistical system on employer and employee level and to present the state of the art in surveys on organisational change. The conclusion in the report is that many of the same questions and indicators were found in different surveys, even though the designers of the surveys build upon quite different theoretical traditions.

The guideline and the two questionnaires are the main concrete result of the Meadow background work. Further, the examination of the 21 surveys did indentify underlying theoretical perspectives. These are presented in a parallel report to the Grid Report and presented further on in this paper, Meadow Multi-Level Theoretical Framework, see also footnote 45.

The Meadow Guideline themes that is used

The result of all background studies in the EU Meadow project is concluded in the Meadow Guideline, that the Swedish Meadow Survey is mainly based on. The Swedish survey includes all themes in the proposed guideline, but the technique in the collection of


some of the Swedish data is to use the CIS and ICT surveys and register data, as described above. The Swedish Meadow Survey covers in principle all themes of questions in the Meadow Guidelines and several other register data with high quality. Since all the Swedish Meadow data also can be matched with individual and firm register data, some questions in the Meadow guideline have been excluded in the actual new collection of data 2010. This includes more or less all data about innovations and ICT and background data about the firm and the employees, as well as economic output data of the firm. The Swedish survey 2010 is presented with its themes, in table 3.

**Table 3**

*Swedish Meadow Questionnaire 2010, included themes*

<table>
<thead>
<tr>
<th>Introduction about the firm and the respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Workforce characteristics</td>
</tr>
<tr>
<td>B. Organisational structure and change</td>
</tr>
<tr>
<td>1) Work practices</td>
</tr>
<tr>
<td>2) Management practices</td>
</tr>
<tr>
<td>3) Outsourcing and Collaboration</td>
</tr>
<tr>
<td>C. Human resources</td>
</tr>
<tr>
<td>D. Objectives and context of the firm.</td>
</tr>
</tbody>
</table>

The questionnaire includes several themes. Section A. Workforce characteristics, gives information about number of employees, type of working contracts, and features of the staff structure etc.

Section B, is divided into three parts: the first unit 1, Work practices; and part 2, Management practices, provide mainly information about firms work organisation and practices as well as the firm’s structural learning. Information from the last part 3, Outsourcing and Collaboration, is not yet used. The plan is to use this information together with CIS and ICT data in a forthcoming paper studying the firm’s link to its environment.

Information from Section C gives information about employees’ individual learning.

Section D is not used even though some data are collected, since other individual and firm data are available and of good quality. The used measurements are presented further on in the paper.
Underlying theoretical perspectives in Meadow

Meadow Multi-Level Theoretical Framework\(^6\) is a meta-study of underlying theories behind the examined 21 surveys, and a parallel report to the Grid Report.

The Meadow theory report lists an important result that there are two major difficulties with the method to establish the multilevel theoretical framework. The first is that there is ‘a lack of well-developed cognitive foundations which limits theoretical cumulativeness’ in the knowledge management literature. The second is that the analysis of organisational change draws upon a multitude of disciplines: economics, management sciences, industrial relations, labour studies, ergonomics and work psychology. Several others such as cognitive science, education and learning theory could have been listed as well. The overall conclusion is that the outcomes of the broad theoretical meta-study may still contribute to theoretical insights, but the link between theory and data needs to be constructed ex post rather than be taken as something that has been structuring the original design of the survey.

The underlying theoretical perspectives are summarised here, basically in the same way as they are presented in the report. The theories are divided into three levels: socioeconomic system level, organisational level and the individual level. The presentation is rather straightforward, and it includes some references to basic research. It is almost inevitable that the summary is coloured by my insights in the theory as an economist.

The socioeconomic system level

The system level includes theories concerning overall processes such as the society’s organisation of higher education and research, technology shifts and markets. But it also includes theories about product and process innovations in a firm. The Meadow framework is focusing on overall systems but to some extent also includes some theories of how organisations interact in these systems. It is stated in Meadow that indicators of organisational change are often parallel to indicators of product, process and market innovation etc.

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Theories of innovation, especially if they are based on endogenously driven processes of change, are included in theories concerning socioeconomic system level. These concern the overall economic system level and systems within and between firms (Schumpeter 1934, 1959, 1989). Innovations are seen as changes of products, processes, markets, inputs, and organisational innovations. An underlying conclusion is that all of these aspects are parallel or I would even argue that they often can be seen as intertwined. It is argued that innovation systems also include selection of firms, birth and deaths, entrepreneurship and small firms and larger often oligopolistic firms, but these aspects is not equally explored in the framework.

A rather traditional perspective on innovation on the system level is the change in major techno-economic paradigms, emerging in cycles of about 50 years (Perez 1983, Freeman and Perez 1988, Freeman 1991). These technological changes are often related to production technology and industrial manufacturing organisations with a long delay in impact on productivity and growth.

Other perspectives are evolutionary-oriented theories (Perez 2004) that include inertia or gradual evolutionary changes or the interaction between organisations and their environment. Compared to Schumpeter these perspectives are not linear processes. Instead they focus on co-evolution between technology and organisation, between drivers and impacts (Lundwall 2007). The assumption of interaction and feedback are seen as crucial for innovation performance of the firm (Rothwell 1977, Pavitt 1984). Strong connection and interaction among divisions as well as with customers and suppliers are successful characteristics for innovations.

The last decade’s complementary innovation system within national systems has come more in focus. There are regional and sectoral systems as well as technological and competence-building systems. Theories about the learning economy are related to these complementary innovation system approaches. They address both public learning systems and learning activities within work, including work organisation and systems for learning at work. These theories also intertwine policies of lifelong learning and concepts such as “flexicurity” and numerical flexibility. Industrial relations and labour market organisations as well as systems of labour insurance are addressed. New public management and human service organisations are also discussed. Several aspects
have been brought into attention but not equally explored as changes of products and technology.

**Organisational level**
The most important conclusion in the Meadow theoretical framework concerning organisational level is about the upcoming of HRM theory, human resource management (Fombrun et al 1984, Bee et al. 1984). Earlier perspectives on employees and management have been narrower, and employees were more or less only looked upon as production costs, and management of employees has mostly been seen as control of production. However, employees today are increasingly looked upon as the most important resource in the firm. The role of management is broader, and includes allocation of all important resources, including employees, to achieve the business goal.

When it comes to theories about changes on the organisational level, the focus is on management of knowledge and continuous learning in combination with planning of personnel and the business strategy. Some models emphasise the strategic and rational approach to management resources, while others emphasise the utilisation and development of the employees, based on consensus and commitment among employer and employees. The aim is to seek a competitive advantage. (Storey 1992, 1995).

One strategy is alignment between business strategies and human resources strategy. Another strategy is to build loyalty, while a third is to emphasise all personal capabilities and not only formal skill boundaries.

The organisational design is critical in the HRM theory and it constitutes a frame that promotes and develops the employees. Therefore changes towards decentralisation are seen as crucial. Team-based jobs, self governing for planning and control and quality improvement are basic features (Huselid et al 1996). Job rotation and cross functional networks are also seen as promoting continuous learning.

HRM is also merged with theories about Industrial Relations in Employment Relation Theories. The challenges are: 1) meeting the up-skilling and rapid change in new information and communication technology, 2) shift from traditional industrial relations towards HRM in local firm bargaining, 3) rapid development of temporary work contracts, self employment, part-time work, 4) outsourcing and downsizing (Gallie 1998).
One of the first concepts to meet these new demands were the theories of the Flexible Firm (Atkinson 1985). When the concept was first introduced over twenty years ago, it divided work and the workforce into core and peripheral. The core considered horizontal flexibility strategies in the firm, Atkinson called it functional flexibility. For example, he included job rotation as a functional flexibility. Strategies to meet short time fluctuations on the market were called numerical flexibility. The two perspectives on flexibility were assumed to interact with different segments in the labour market. The labour market was seen as dual. Qualified tasks and highly educated people were related to the core, and the rest more or less related to peripheral tasks. Financial flexibility was added and associated with wage flexibility, and at that time related to numerical flexibility.

The term work system is, in parallel with concepts of learning organisations, interrelated to specific work practices. Work organisations mainly refer to division of tasks and employees, while the execution of these tasks is referred to as work practices (MacDuffie 1995). There are synergy effects on performance when they are adopted together (Delery 1997). A concept that takes this interrelated perspective further is “High Performance Work System”. It also includes high involvement of employees, sometimes other organisations. It is yet to prove its impact on performance (Pil & MacDuffie 1996).

Organisations that need to meet multi-complex environments can gain by being process-oriented. Each part of the organisation, or sub parts, meets the demand of new technologies, customers, products, markets etc. with its own precondition. The different units of the organisation are organised after its own specific circumstances. Feed-back and feed-forward, often horizontal regulations, are instruments for control. Different teams/units discuss directly with each other. The management’s role is to create, promote and monitor self-management teams.

Lean production is not a concept so far from the process-oriented. The first definition was “precisely specify value by specific product, identify the value stream for each product, make value flow without interruptions, let the customer pull value from the producer, and pursue perfection” (Womack and Jones 2003). The practical use is described as cost reduction, empowerment, value chain orientation, customer focus and product innovation. The model is often referred
to as the Toyota-model. Various forms of the model have been implemented and followed up with varying results.

Teamwork, which seems to be a straightforward practice, is not described as a uniform concept, and follow ups of the benefit of various forms of teams show various results. They have one feature in common: all forms of teams have increased (Huys 2007). Much of the focus is on the structure of the teamwork: tasks, the degree of autonomy, the interdependency in the team. Maturity and diversity of the team members can be added (Delarue and Savelsbergh 2005).

Many economists have a resource-based view of the firm when it comes to their organisation. The firm is seen as successful if it possesses a superior set of resources or is able to explore its resources more efficiently than its competitors (Billerbeck 2003, Burr 2004). The perspective aims to explain heterogeneity in firm’s economic performance (Helfat/Peteraf 2003, Gersch et al. 2005). The firm’s resources include physical and tangible resources as well as intangible and dynamic capabilities (Teece et al 1997, Barney 1991). Dynamic capabilities are seen as the firm’s capability to learn routines and routines for learning (Eisenhard and Martin 2000).

Knowledge management is defined as an intentional and systematic process of acquiring, sharing and using knowledge to enhance learning and performance in organisations (OECD 2003). Knowledge management deals with knowledge transfer between different types of knowledge: explicit, not explicit, tangible, intangible, tacit, and individuals/organisations (Nonaka and Takuechi 1995). Managing diversity is one way to describe it, gender is an important field in this research and other aspects of formal and informal processes in the organisation (Härenstam and Bejerot 2007).

Culture has had a prominent position in management theory, like formal cultures and management strategies versus subcultures in a firm (Schein 1988) but it is argued that it has diminished in recent decades. Many researchers have been involved in quality approaches of the work organisation. A starting point can be the discussion of quality in the Japanese production during the 1950s (Deming 1986) including the Total Quality Management TQM-model, described by many researchers and summarised as the integration of all functions and processes within an organisation to achieve continuous improvement of the quality of goods and services (Ross 1994).
Organisational innovation is specifically described in the Meadow theoretical framework as dependent on several different approaches. I summarise a few of them. The first approach is to see organisational innovations as a basically intentional process of breaking down regular patterns of behaviour to create new patterns that become institutional (Lewin 1951). A modern approach is described as when members of the organisation are constantly changing (Kant et al 1992). The perspective is seen as incremental, which means that the organisation can look stable on the surface but is built on instability.

There is of course opposition to the second approach that puts forth the same basic criticism when it comes to a broad definition of innovations concerning products and markets etc. The opposition defines organisational innovations as the development and implementation of new organisational structures and processes that offer customers more flexibility and efficiency (Goffin and Szweczyewski 2002, Armbruster et al 2006). This approach aims to approve business performance. Another business perspective on this is the definition that organisational innovations are the discrepancies between what the organisation could do and what it actually does, i.e. the performance gap. Maybe a complementary approach is that this cannot take place without individual and organisational learning (Gjerding 1996).

The role of management in organisational innovations is focusing on ambiguity. One perspective is described as speeding up processes and, as equally important, at some point slowing down changes on a redirected path. Another is described as a dialectal process, based on a dialogue between two or more parts of the organisation. The different parts may hold differing views, yet wish to pursue truth by seeking agreement with one another, where the innovation is involving combination of different goals and methods simultaneously. If all are involved in changes, the innovation is very complex. But if only some are involved, the innovation can be easier but there can be ramifications for the coherence of the organisation. Coherence is an approach in itself. Finally, approaches of innovation processes is also focusing on how speeding up and slowing down take place. Are they linear or occurring simultaneously? The hypothesis says they do when including feedback.
Individual level
Theories on the individual level specifically include impacts of work organisation and competence development on individuals. It seems to include both the individual’s own view of these aspects and a system perspective on the employees, in contrast to the employers view on the organisation as such. The employer’s perspective of the organisation and its employees is as I see it covered in the section above. Still, the individual level is not obviously focusing on the individuals perspectives on different matters. Even though the EU project has proposed a linked survey between employer and employees, one would assume that the individual level would be matching the employee survey to a great extent. The current project in Statistics Sweden is only collecting information from employers about the employees. But complementary register information about the employees can be used. In the future Statistics Sweden proposes that forthcoming surveys are linked between employers and employees. Anyhow, theories concerning individuals are presented in the Meadow framework.

The concept of competence development is used as a way to describe almost all activities crucial for the society, organisation and the individual. In the framework of Meadow it is narrowed down to three important perspectives. One is the generic competence, the ability of the reader to understand the implied system of codes, i.e. for example a language. The other perspective is situated competence, i.e. the context for example in a school or in a job situation. The third is collective competence, closely related to job situation, organisational culture and work practices.

The change from lifelong employment to a flexible labour market and different working conditions and the importance of continuous learning are much in focus in this part of the framework and reflected on. The changes in the labour market in recent decades are described as profound both in terms of work load, stress and new work practices, the new and broad use of information technologies etc. (Paoli and Mérlié 2001). Discussions about stress and health issues are in focus.

It is argued that there are systematic links between the forms of work organisation adopted and the quality of jobs including working conditions and health and safety (Valery, Lorenz, Cartron, Csizmadia, Illéssy, Gollac, Makó 2008). At the same time it is argued that it is the combination of high demands and low control that is detrimental to health (Härenstam, Bejerot 2007).
Another point is that organisational change as such is identified as hazardous to health (Bordia et al 2004, Kaminski 2001, Kivimäki et al 2001). Research on temporary contracts, job insecurity and nonstandard job arrangements are seen as still limited. Some studies show a negative effect on the employee’s health (Benach 2004, Benavides et al 2005, Virtanen et al 2002) while others find the opposite relationship with health (Bardasi and Francesconi 2004, Virtanen et al 2003). The conclusion is that the results are due to the circumstances people accept nonstandard work, i.e. if there is a lack of opportunities. Other results show that people with poorer health conditions from the beginning often have nonstandard job arrangements.

These perspectives are important in the discussion of how to organise the working life and labour market so that it includes all people that have at least some capability to work. Motivation theories, reward and compensation systems theories, including bargaining theories and labour (industrial) relations, are also discussed.

Two Swedish surveys in the 1990s

Two Swedish surveys have contributed with questions and an economic background to the Meadow Guidelines; they have been conducted by Swedish National Board for Industrial and Technical Development, Nutek. The main report of these surveys shortly describe how they look upon the economy, its conditions and presumption as a background to their specific measurements of work organisation and competence development. The background knowledge of the economy has also influenced the measurements in the overall Statistics Sweden project, this and parallel papers. To better understand the measurements used in this paper, the background and result of the two surveys will be shortly presented.

To start with, it is worth mentioning that both of the two earlier Swedish surveys took place after the deep economical crisis in the Swedish economy in the early 1990s. The first survey was conducted a couple of years after the crisis, in 1995, and almost at the same time as the manufacturing industry had bounced back to

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*Hans-Olof Hagén, project manager of the present Statistics Sweden-project, was the project manager of the first Nutek survey 1995-1996, Annette Nylund participated as co-project leader.*

Statistics Sweden
the earlier performance level. The second survey was conducted some years later, 1998, and at this time almost the entire Swedish economy was more or less back in balance. It was before the next crisis in the Swedish economy that took part in the first couple of years in the new millennium, i.e. when the IT-bubble burst in Sweden.

Both Nutek surveys describe the decades in the Swedish economy before the 1990s as characterised by low productivity despite a constant high pressure from the outside world. From the mid-1990s the Swedish economy made positive progress in comparison with other OECD countries, and growth in Sweden was appreciably higher.

Based on the first Nutek survey several reports were published by Nutek. In the first one, where the main results were published in 1996, the economy is described as changing from large oil-tankers to a fleet of smaller and faster boats, moving in the same course, according to new technology and market demands. The economy during the industrial era, after the two world wars and before the oil crisis in 1973, was characterised by a rapidly expanding growth. In that era predictions about the future were rather easy and the steady growth fed larger firms, which often had long term planning departments and long term plans. But the smooth broad growth changed to a rockier pathway. In this new more unstable environment, flexibility and continuous learning became a must.

Therefore the first Nutek survey specifically included measurements of both numerical and functional flexibility. Functional flexibility mostly concerned work organisations, and who in the hierarchy of the organisation carried out different kinds of tasks. Another important aspect was the employees' competence development at work. An index including these two aspects was created, i.e. information on the degree of decentralised task and if the everyday/normal work contain elements of organised skills development. The top quartile of those work places that were

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67 Hans-Olof Hagén was the project manager and Annette Nylund the co-project manager in the second Nutek survey 1997-1999, which also included some new publications based on the first survey. When Hans-Olof Hagén left Nutek Annette Nylund became the project manager for the last year of the project 1999-2001.

highest ranked was selected and compared to the rest of the work places.

Other preconditions also played a part in the construction of measurements, such as the argument that some industries did have difficulties attracting and keeping young employees. At the same time employment agencies that hired out temporary employees to firms and other work places started to grow. Short time contract workers seemed to increase. Therefore different kinds of measurements of numerical flexibility were included.

The second Nutek survey conducted in 1998 was a follow up on the first survey, but even so it elaborated on the measurements a bit further. For instance, in the main publication (2000\textsuperscript{49}, 2001\textsuperscript{50}) there is a greater awareness of the distinction between the individual’s competence development at work and the firm’s ambition to create structural capital. The distinctions are following some principles of human resource management that include “selection and recruitment of personnel; design of work organisation, job description and remuneration systems, job evaluation, and various forms of personnel training/development.”\textsuperscript{51} The way to collect information about these issues is more or less the same in the two surveys, but the creation of indexes based on the information differs. In the main report, based on the second survey, the index that measures a decentralised work organisation is also taking into account how many of the tasks that are relevant for each firm, and the scale was based on the relevant number of tasks. An index was made based on this information that goes from 0 to 100 percent. The first survey did not consider that all tasks are not relevant for all firms. The second change in the measurement of decentralised work organisation is that the index of decentralisation is not combined with other measurements, it stands out by itself. In the first main report it was combined with information about daily learning.

Daily learning at work is still an important measurement in the second Nutek survey, but in the main report it is based on an index

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that is combined with other measurements of individual learning and not with information if the tasks are decentralised. The question about if everyday/normal work contain elements of organised skills development is combined with two other questions. One question about if the work place has development plans for the employees and another question about the proportion of employees that participated in training/courses that were wholly or partly paid by the employer the specific year. The index of these three questions results in a scale that goes from 0 to 3, depending on how many of the activities the work place uses, from none up to a top of three.

There are other differences between the two surveys and their main reports that are worth mentioning, even if they are not elaborated further in this paper. One is the argument that measurements of external factors such as the market and changes in the market, cooperation and interaction with other firms and other parties have to be included. This is because these activities are assumed to be of great importance for competence development and their importance is assumed to have increased. The measurement of these aspects is more elaborated in the second Nutek survey and a bit further analysed than in the first report. Another difference between them is that the first survey included measurements of information technology, IT, that were focussed on production technology. These aspects were partly included in the second survey and elaborated. But the second survey also included new measurements of information communication technology, ICT. These two aspects, cooperation with other parties and ICT, are further elaborated in parallel and forthcoming paper.

The data from Flex-1 was combined with developed perspectives of how to measure human resource management in Flex-2 and a third study was performed. It also contains data from Finland, Norway and Denmark, see Flexibility Matters.

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A not yet mentioned parallel paper is studying the included work places in the Flex-2 survey over a period of ten years. The objective is to study if there are any long term effects of used work organisation and competence development on productivity.\textsuperscript{54}

**Concluding remarks on reference**
The overall conclusion concerning the EU Meadow project and its background reports is that they considerably increase the validity and reliability of the EU Meadow guideline. Since the Swedish survey is based on the guideline it also increases the quality in the Swedish survey.

The underlying theories are presented in a background report on the EU Meadow website, see footnote 26. I have read the report with great interest. As mentioned the report provides an important quality aspect to the guideline, and it is one of the more recent overviews of theories in the area. Hopefully, and as far as I understand there is a chance that this background report will be further developed and published by some of the project members in the EU Meadow project\textsuperscript{55}.

Some reflection that might be useful in the further development of the report is that the division of theories, perspectives, in three levels might gain by a being differentiated from actors, and other kinds of institutional parts of the system. Interaction between the levels and different actors and institutions, according to theories might also be of interest to include.

For example, theories supporting studies of business organisations, i.e. firms, are probably in some sense more straightforward since the firm in a more intuitive way is separated from systems and individuals than for example public or households’ own organisations. Of course almost everything is connected in some sense, but public organisations are more often integrated important parts of the system, and are often representing the government policy, at the same time as they are organisations as such. Many people work in them and it is important that their work organisation


\footnote{According to professor Peter Nielsen, Aalborg Universitet, team leader for the Danish research group in Meadow.}
is efficient. A public organisation that is not acting on the market but in the public sector is more obviously a part of both the system levels and the organisational level, at the same time. It is possible to ‘sense’ these aspects in the EU report and they can be further developed. According to theories on the individual level, the interpretation is that they are based on system perspectives on individuals or group of individuals. Several of the theories on individuals that are included are based on theories about systems and organisations institutions connected to systems.

According to the Meadows theoretical background and its three levels of theories, the presentation of the three levels are not distinctively seen as intertwined with each other, even though it is mentioned that organisational innovations and systems are described as parallel. The focus is neither on interaction between different organisations nor employees in different organisations. Focus is rather much on organisations as such and employees in the organisations. Further the employees are seen as proactive and learning, at the same time the theoretical perspectives on the individual level are focusing on more negative impacts on employees.

Still, it is tempting to test some of the more advanced theoretical assumptions about organisational innovation with the help of the new data at once. For instance, the theories about organisational innovations based on breaking down and building up new patterns, but this kind of analysis will probably demand data from several years of collection. Another intriguing hypothesis to test is the performance gap and the resource-based view of the organisations. But as I see it, knowledge building will probably gain from a stepwise approach towards both theory and data. Therefore, this first paper wisely uses theories as well as the data exploratively and tentatively. The measurements do not take a stand in any of the concepts, they simply measure the incidences of several of them. Therefore broad indicators are created and used in this and the other parallel papers in the project. The indicators are presented further on. Still, forthcoming analyses include building more complex models and studying its relationship with the firm’s environment. There will also be possibilities to relate the model to the firm’s economic performance and the employee’s position on the labour market.

As mentioned above, the common frame between the three Swedish surveys, CIS, ICT and Meadow creates greater possibilities to make
analyses of intertwined perspectives between system level aspects, organisations and individuals. Several of the presented and traditional themes concerning innovations can be found in the CIS Survey, and some aspects can be found in the ICT Survey. These have been used in parallel papers to this one. The relationship between innovation and work organisations as well as competence development are analysed, and relations between ICT and work organisations and competence development. Other parallel papers are analyses of differences between sexes and differences in working conditions. Forthcoming papers include further analyses of the relationship between the firm and its environment, and economic performance, as well as the employees’ position on the labour market.

Four composite indicators
Theoretically it is possible to present all the data in the Swedish Meadow Survey but it is not so analytically meaningful. In the Statistics Sweden project measurements of work organisation and competence development are classified into four groups of indexes, here called four composite indicators. These four indicators are also used in parallel papers in the project. Authors of the different papers have contributed to the construction of and knowledge about the composite indicators in different ways. Even so, the construction of the indicators is mainly the result of decision by the management of the Statistics Sweden project. My intention here is to describe them and to use them as tentative measurements of work organisation and competence development. In other words, I use them in an explorative way. In my forthcoming papers I will use theory and availably data in a more profound way, both by study patterns of practices and specific models like the ideas about the firm’s competence portfolio and its links to the firm’s environment.

58 Ahlstrand C, 1010. Work organisation and differences between sexes.
Why these indicators?
The choice of indicators is based on the fact that firms are acting in environments that change more and more every year. This means that firms’ ability to adopt has become a necessity for their survival in the long run and their economic performance in the short run. Earlier I described that the growth path have become rocky, which was the case during the 1990s, and it has also been profound the last couple of years during the financial crisis that culminated in 2008. The repeatedly coming crises during the years has showed the firms the importance to be able to reduce cost very fast, even labour cost with short notice. Therefore indicators of numerical flexibility are still included among the composite indicators in the present survey and analyse. They were also included in the Nutek studies during the 1990s. This kind of indicator is not necessarily assumed to be positively correlated with productivity, since the use can fluctuate with the labour market and the rise and fall of the economy. The features are still of importance to study. Some background information shows that the Swedish labour market has a relatively high proportion of fixed-term contracts: about 16 percent of all employed. Only five other countries in Europe have higher proportions. Sweden also has the second highest proportion of part time workers: almost 27 percent of all employed and about 5 percent self-employed. Measured over a period of about ten years the proportion has changed marginally.⁶⁰

Flexibility in terms of rotation between different tasks within the firm was partly in focus in the earlier studies, and is included among the present indicators. It can be seen as an indicator of numerical flexibility since it alters the total hours worked from one task to another in a department and sometimes between different departments in the firm. It can also be seen as an indicator of functional flexibility since it indicates that the employees have competence to work with several tasks within the firm.

The need for flexibility also forces the firm to develop new ways to meet customers’ demands on short notice. Decentralised work organisations in combination with customer focus can create more and broader possibilities to pick up early signals, taking advantage of new opportunities and act to different threats. This way the firm

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must understand that the employees have become a more vital resource in the planning of the work. The management is therefore broadened and includes allocation of all important resources, including employees, to achieve the business goal. Indicators measuring some features of knowledge management, work organisation and practices, and self-management teams, also in combination with product quality and customer focus are therefore included in the composite indicators. The two earlier Nutek studies showed significantly positive correlations between decentralised work organisations and productivity. Since the same kind of information is collected in the Swedish Meadow Survey it will be possible to create a similar indicator and to also compare the incidences.

Learning aspects in the firm are included in the measurements, both individuals’ learning and if the firm is building on structural capital. The assumption is that learning also contributes to the flexibility of the employees and the firm, since learning helps the adaption of a rapidly changing environment. This gives the firm better chances to survive and increase productivity and profitability, and hopefully it helps the employees to keep their job. Since there is a greater awareness of the distinction between the individual’s learning and the firm’s ambition to create structural capital, measurements of learning are divided into two indicators. Learning in the daily work is one approach that in the earlier Nutek studies showed to be significantly correlated with productivity and profit. Building structural capital in the firm was not specifically analysed in the earlier studies but has been argued to be of great importance for growth and productivity. There seems to be some good information in the Meadow to build indicators of both individual and structural learning.

In summary, the objective is to use all relevant information in the Swedish Meadow Survey to study work organisation and competence development in the Swedish business sector. There is also an ambition to follow up the two earlier Nutek studies concerning these aspects in the Swedish economy. Four composite indicators based on these features are constructed to capture the firm’s use of human resource management strategies. Both the employers’ and the employees’ perspectives are important, when it comes to the firm’s need of alignment of business strategies and customer focus with the employee’s capabilities and continuously learning. Indirectly it is stated that responsibilities and authority go
hand in hand, to create better work conditions and to meet customers. Views of the employees are not measured in this first Swedish Meadow Survey, but these firm features can be related to register data of the employee’s background and position on the labour market.

The construction of the indicators
The four composite indicators include information from the Swedish Meadow Survey that is based on the Meadow guideline, which in turn also includes questions from the Nutek surveys. The Swedish Meadow Survey also includes one question from the Nutek survey that is not included in Meadow guideline, more on this further in the paper.

First some technical features. The questions in the survey are constructed and organised in different ways. Sometime the answer can be a simple YES or NO, while other questions have several options in their answers or almost infinite options since they are numerical. Therefore the amount of optional answers in every question has been standardised so the construction of the question will not affect the importance of one question compared with another question.

Further, all questions in each indicator sum up to 1, which means that each firm can have a value of each index between 0 and 1. If a firm has the highest value in all four indicators the value will be 4. All questions have been given a specific weight according to assumptions described below in the presentation of each indicator. Most of the questions have the same weight which means that they are seen as equally important. If they have a higher or lower weight they are assumed to be of less importance compared to the other questions in the index. The robustness of these specific weights has been tested to see if the same firm will be highest ranked in the index if the weights are altered, in its own business industry group. The test shows that the result is robust. This is also one reason for to create broad indicators, they often are more stable. For a presentation of the test and its result see the parallel paper, footnote 42.

All questions that are included in the four indexes are presented below. In case a question is depending on another question, all needed information has been included in the presentation of the question.
**Individual learning**

The sub-questions presented in table 4 define the indicator *Individual learning*. All questions except for one have the same weight in the indicator. The specific question that has a higher weight is "96. *Is competence development part of the normal every-day work, Yes or No?*" This question is assumed to be of more importance than the other questions, and the assumption is based on earlier results. This specific question has been used at least twice in analyses studying firm and employees performance, and is therefore known to be of importance. In the first Nutek study this question was the only used measurement of individual learning, in the second it was part of an index including three questions. The question was included in a Swedish cognitive test, with a good result, before it was used in the second Nutek survey 1998. Those firms and work places that answered that the daily work includes competence development have been found to have a significantly higher productivity rate than others. Therefore the question of daily learning has been given 2/3 of all the value of the indicator, in this new measurement of industries across business sector in Sweden 2010. In the table the weights are indicated in parentheses. At the same time the importance of this weight shall not be exaggerated, since the result is that the indicators are rather robust, as mentioned above.

Several questions were deleted in the final proposal of the EU Meadow Guideline for different reasons. The above mentioned question is not included in the final guideline because the cognitive test of the questions in the EU Meadow project found it to be to problematic to understand. This is the only question that is used in the Swedish Meadow Survey that was tested but not included in the final proposal of the EU Meadow Guideline.
Table 4
Individual learning

96. Is competence development part of the normal every-day work, Yes or No? (2/3)

102. What proportion of employees has received on-the-job training in the past 12 months? (1/12)

94. Approximately what proportion of your employees has a performance appraisal or evaluation interview at least once a year? (1/12)

99. What proportion of employees has been given paid time-off from their work to undertake training in the past 12 months? (1/12)

100. What proportion of employees has been given non-paid time-off from their work to undertake training in the past 12 months? (1/12)

The index about individual learning is rather straightforward. It includes both formal and informal learning activities. The question about if the daily work can capture formal and informal learning, including tacit knowledge, can be described as not explicit learning and not explicit knowledge. It can also indicate perspectives like continuous learning at work, because it is daily. The index also includes information on whether the employees participate in other training and learning activities at the work place or elsewhere. This kind of training can be strategic investments in the future of the individuals, both in the firm and elsewhere. If employees participate in these kinds of learning activities it might also say something about the climate of learning in the firm. The index does not generally give specific information about whether the firm is trying to build competence that can be seen as structural, except for the question about performance appraisal or evaluation interview. This kind of evaluation meeting can give both parties information and can be used to build structural capital. Because it also can be an indication of structural learning it is also included in the index of structural learning. The question is marked in grey to indicate that it is included in two indicators.

To summarise, the indicator of individual learning indicates the understanding of the importance of continuous learning at work, both formal and informal learning, including tacit knowledge. The hypothesis is that the indicator is correlated with almost all the other indicators, and that it indicates a good climate for learning in the firm.
Structural learning
The sub-questions below in table 5 define the indicator called structural learning. Each question has been given a specific weight according to its assumption of importance compared to the other questions in the index. All questions in the index have the same weight, and are therefore assumed to be equally important. The reason is that there is no information in advance that one of this questions are of more or less importance, therefore they have the same weight.

Table 5. Structural learning

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>44.</td>
<td>What proportion of employees at this firm currently participates in groups that regularly meet to think about improvements that could be made within the workplace?</td>
<td>(1/7)</td>
</tr>
<tr>
<td>94.</td>
<td>Approximately what proportion of your employees has a performance appraisal or evaluation interview at least once a year?</td>
<td>(1/7)</td>
</tr>
<tr>
<td>53.</td>
<td>Does this firm monitor the quality of its production processes or service delivery? Yes or No.</td>
<td></td>
</tr>
<tr>
<td>57.</td>
<td>Do employees in this firm regularly up-date databases that document good work practices or lessons learned? Yes or No.</td>
<td>(1/7)</td>
</tr>
<tr>
<td>59.</td>
<td>Does this firm monitor external ideas or technological developments for new or improved products, processes or services? Yes or No.</td>
<td>(1/7)</td>
</tr>
<tr>
<td>61.</td>
<td>Does this firm monitor customer satisfaction though questionnaires, focus groups, analysis of complaints, or other methods? Yes or No.</td>
<td>(1/7)</td>
</tr>
<tr>
<td>104.</td>
<td>How often do meetings between line managers or supervisors and all the workers for whom they are responsible take place?</td>
<td>(1/7)</td>
</tr>
<tr>
<td>a) Every day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) At least once a week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) At least once a month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Less than once a month</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All the questions about structural learning indicate if the firm is building knowledge, and several of them can be seen as indicators of investments in structural capital. It is also rather obvious that the indicator gives information about if the firm is working with quality and innovations concepts, and also if these are systematically organised. This latter aspect is seen as critical when it comes to long term quality issues. Some questions in the index also give structured information about products, processes and the customers. If this information is combined with information about if the work is decentralised and organised in teams, it can be used as an indicator.
of an awareness and structural approach to meet customer demand. Using new information technologies to build structural capital is seen as important; this information can specifically be found in the questions about databases and is also indicated in the question about monitoring external ideas or technological developments.

The question about meetings between line managers/supervisors and employees is in line with the question about performance appraisal or evaluation interviews. The latter one of these two is, as mentioned above, an indicator of both individual and structural learning. The dialogues captured in the two questions can be instruments to build structural capital as well as instruments to improve individual’s skills. The question that is used in two indexes is marked in grey to indicate its use in two indicators.

In summary, the indicator structural learning provides information if the firm is building structural capital thru systematic work with quality and innovations, and strategies about customer satisfaction.

**Numerical flexibility**

The questions in table 6 define the indicator called *numerical flexibility*. Two questions have been weighted so that the value of the answer is less important compared to the other questions, they only have weights of 1/6 each. Rotation of tasks within the firm is one of these questions, the other is about part-time work, and both questions can be seen as flexibility within the firm even if they are not assumed to be closely related to each other. This means that the other questions concerning fixed and short term contracts are valued higher in the indicator. These later aspects are not necessarily assumed to be positively correlated with the other sub-questions in the indicator or with the other indicators.
Table 6
Numerical flexibility

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>51.</td>
<td>Are any of the employees at this firm trained to rotate tasks with other workers? The training could have taken place outside or within your firm. Yes or No. (1/6)</td>
</tr>
<tr>
<td>11.</td>
<td>What proportion of the employees at this firm has a temporary contract? This includes all employment contracts with an end date or for a defined period of time, even when the contract is for several years. (1/3)</td>
</tr>
<tr>
<td>14.</td>
<td>Please think of the total number of people working at this firm, including employees on your payroll and people contracted through an employment agency. What proportion of this total consists of people from an employment agency? (1/3)</td>
</tr>
<tr>
<td>12.</td>
<td>What proportion of the employees at this firm is part-time? 'Part-time' includes all working-time arrangements below the usual full time hours that apply at your firm. (1/6)</td>
</tr>
</tbody>
</table>

As can be interpreted and more or less obvious when reading the questions concerning numerical flexibility, they contain of two or three perspectives. The question about task rotation is an indication of flexibility within the firm. The other perspective is the traditional aspect about fixed and short term contracts, each captured in separate questions. A third perspective is the question about part-time work, since it is a way to change the total number of working hours within the firm but without new short term contracts. Because the survey is collecting information only in the business sector, and not in all industries, this latter concept is not as obvious as it is in the public sector and some service industries where part-time work is frequently used this way. Therefore it is a better chance that it can be an indicator of the employees’ personal preferences or the preference decided in the family, and not by the firm. In that case, part-time employees can use more of their time after their own preferences or after the needs in their family. All three perspectives can include core as well as peripheral work and work force.

The index does not explicitly include information about what is called knowledge transformation and needs of continuous new knowledge from outside the firm. The use of consultants, often other than private employment agencies, is used as such indicators. It is assumed that knowledge in the absolute frontline often is available with help of these consultants or through the firm’s cooperation with other organisations. At the same time the private employment agencies in Sweden have a high proportion of university educated
employees; some figures from a few years ago show that the proportion of university educated in these private employment agencies was even higher than on average in the industry group that they belong to “Office administrative, office support and other business support activities (Nace 82)”. This figure is an indication that it cannot be excluded that there is an element of knowledge transformation in using private employment agencies.

To summarise, numerical flexibility provides information about work flexibility within the firm in terms of task rotation, and information about possible flexibility in terms of changes in the total amount of workforce with short notice. It might also indicate the use of an external workforce for knowledge transformation.

Decentralisation
The questions in table 7 define the fourth indicator, called decentralisation. The only question that has another weight than the others in the index, and that is assumed less important, is question number 26. *How many organisational levels are there in the firm?* The numbers of hierarchical levels are known to be related to the number of employees in the firm, and can therefore also be an indication of the firm’s size. But there are also other arguments, see below.

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61 In Swedish the apostrophised industry often is called “Företagsnära tjänster”. Se also HTF Utan de privata tjänstebranscherna stannar Sverige1 Privata tjänstebranschers bidrag till tillväxt och jobb.
Table 7
Decentralisation

26. How many organisational levels are there in your firm, including the highest level (for example, senior management) and the lowest level (for example, production staff)? Number: ......(1/9)

32. Who normally decides on the planning and execution of the daily work tasks of your non-managerial employees? (2/9)
   a. The employee undertaking the tasks or both employees and managers or supervisors
   b. Managers or work supervisors, or others

34. Who is usually responsible for quality control of goods and services? (2/9)
   a. The employee undertaking the tasks
   b. Managers or work supervisors, specialist group or division within the firm or organisation, external groups – customers, external evaluation experts, etc.

40. What proportion of the employees at this firm currently works in teams, where the members jointly decide how work is done? (2/9)

48. What proportion of the non-managerial employees at this firm can currently choose when they begin or finish their daily work? (2/9)

The sub-questions in the indicator can be interpreted in multiple ways. One interpretation is that the perspective in the index mostly focuses on centralisation versus decentralisation. Several of the questions have an approach of hierarchical and vertical aspects. The question about organisational levels in the firm can be one of them. Two other questions that also can be included in this perspective include the one about the planning of the daily tasks and the one about the performance of quality control.

The question of proportion of employees that participate in self steering teams can also be seen as a question of decentralised responsibility, but it can also indicate a horizontal integration of work from different part of the organisation, and therefore it can also indicate the complexity of the organisation as well as a more process-oriented work organisation. Then again, the first question about the number of organisational levels can also say something about the complexity of the organisation. There is a greater need for several organisations levels if the organisation is more complex. The number of levels also indicates if the organisation is small or large; the larger the organisation is, the greater the need of several
organisational levels. Researchers concerning teams are divided when it comes to the importance of teams in terms of economic performance, but they seem to agree that use of teams is increasing and that they are important when it comes to promoting structural learning in the organisation.

Possibilities such as the one implied in the question about flexibility in hours worked per day is often implemented with arguments that it affords the employees possibilities to organise family life or participate in personal leisure activities. It also ends up beneficial to the employers since the individuals can “fine tune” work load with family life.

Finally, the indicator of decentralisation gives information about decentralisation and some information about horizontal integration and the complexity of the organisations and its environment.

**Concluding remarks on the indicators**

As mentioned above, the indicators used are tentative and explorative. To summarise, the indicator of *individual learning* include formal and informal learning as well as continuous learning at work. The indicator *structural learning* provides information if the firm is building structural capital through systematic work with quality and innovations, and includes strategies about customer satisfaction. The indicator of *decentralisation* gives information about decentralisation and some information about horizontal integration, as well as it indicates the complexity of the organisations and its environment. Finally, *numerical flexibility* mainly gives information about changes of the workforce with short notice, and some information about work flexibility within the firm in terms of task rotation. It might also indicate the use of external workforce for knowledge transformation. Finally but already mentioned, there will be more profound analyses of patterns of practices and analyses of the idea about the firm’s competence portfolio and links to the firm’s environment in forthcoming papers.

During the process of this paper the insight has grown stronger that indicators might but do not have to gain from being constructed differently according to the cause. They might be constructed in one way if they are suppose to be explorative and in another way if they are to characterise for example certain industries or if they aim to be used to study different organisation and practices impact on people and firms, controlling for industries etc. Sometimes the intention is to combine these different analyses.
Correlations between the indicators

It is of interest to look into the correlation between these indicators to analyse if there are measurable relationships between them. First the correlation between the four indicators are presented, and secondly the correlation between all sub-questions within each indicator.

I have used the most common measuring of the degree of correlation, the Pearson correlation coefficient. It is widely used in the sciences as a measure of the strength of linear dependence between two variables. The aim is to test a null hypothesis. A value of 1 implies a perfect relationship, with all data points lying on a line for which \( Y \) increases as \( X \) increases. A value of \(-1\) implies that all data points lie on a line for which \( Y \) decreases as \( X \) increases. A value of 0 implies that there is no linear correlation between the variables. The interpretation of a correlation coefficient depends on the context and purposes. Cohen (1988), has observed that all such criteria are in some ways arbitrary and should not be observed too strictly. In social science a correlation close to 0.5 or -0.5 might be very high since other complicating factors contribute.

Correlation between the four composite indicators

The correlations between the four indicators are presented in Table 8. The table shall be interpreted as follows: Each indicator is presented in the head of a column, which shall be compared with the result of the other indicators presented on each row in the column. For example, the first column shows the correlation between Decentralisation and the four indicators. The first calculation shows at perfect correlation between Decentralisation and Decentralisation (1) this is of course obvious, since it is a correlation with itself. For each correlation the level of significance is presented. The lower the significance level, the stronger the evidence required, since this value is the probability of that the null hypothesis is true. For many applications, a level of 5 percent is chosen, and 1 percent is even better: that means that there is only one chance in a thousand this could have happened by coincidence. The highly significantly correlated indicators are marked with in blue print and light pink background, the negative in red.

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62 The correlation coefficient is defined as the covariance of the two variables divided by the product of their standard deviations.
Table 8
Correlation analysis between the four composite indicators

<table>
<thead>
<tr>
<th></th>
<th>DEC</th>
<th>NUM</th>
<th>STRUC</th>
<th>IND</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEC</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NUM</td>
<td>-0.06</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STRUC</td>
<td>0.24</td>
<td>0.17</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>IND</td>
<td>0.21</td>
<td>0.11</td>
<td>0.31</td>
<td>1</td>
</tr>
</tbody>
</table>

Correlation Analysis Generated by SAS
*** High significance, the correlation is significant at the 0.01 level, i.e. it is under 1 percent chance that the result is a coincidence
** Rather high significance, the correlation is significant at the 0.05 level, under 5 percent is a coincidence
* Low significance, the correlation is significant at the 0.10 level, under 10 percent is a coincidence

Table 8 shows that between three of the indicators there are positive correlations: decentralisation, and structural and individual learning. Structural and individual learning are assumed to support each other. Individual learning can easier be developed to structural capital if there also is systematic work with quality and innovations in teams. Tacit knowledge that is assumed to be captured in the indicator of individual learning in work is of great importance in building structural capital. Both individual and structural learning are assumed to be even better supported if work is decentralised. Here, the positive correlation between the three indicators can be assumed to indicate that if the firm combines the different features it can achieve even higher value as a multiple effect, for example measured as productivity.

There is one negative correlation between numerical flexibility and decentralisation, but the correlation coefficient is low, as well as the level of significance that is almost 9 percent, which is the chance that it could have happened by coincidence. The interpretation implies that when numerical flexibility decreases, decentralisation increases, and vice versa. A decentralised work organisation characterised with individual and structural learning can be assumed to meet different kinds of demands and fluctuations. Since the work itself is organised in a more flexible way, the need for numerical flexibility in terms of extra work force on fixed contracts and from private

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63 Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations.
employment agencies might decrease. On the other hand numerical flexibility is positively correlated with all other indicators.

The correlations are not so high between the indicators that they can be interpreted as providing the same information. If the coefficients are too high, it is an indication that the indicators provide the same information.

**Between sub-question in each indicator**

Below are the correlations between all sub-question within each of the four indicators presented in tables 9 to 12. Each of the tables shall be interpreted the same way as the correlation above, which means that each sub-question is presented in the head of a column and shall be compared with the result of the other indicators presented on the rows of the column. The Pearson correlation coefficient is used to measure the strength of linear dependence between two variables to estimate a null hypothesis. For each correlation the level of significance is presented.

The interpretation of the result of estimations of these sub-questions can be even more difficult. For example a positive correlation between two sub-questions can mean that they partly provide the same information; therefore it can be a good thing if the questions do not correlate too highly, or it can be a good thing that they do not correlate at all. If so, they can be assumed to provide unique information. A negative correlation can mean that they are replaceable to each other, but it might also mean that they are partly excluding each other or that they do not belong to the same family of indicators. In any case, interpretations are assumed to be improved if they can be put into context, and step by step in different studies indicators will be put into context. The interpretation therefore is on a high aggregated level.

In the correlation analyses of the four indicators above, all questions were given a specific weight according to assumptions described. Even though most of the questions did have the same weight and were seen equally important, these weights are not included in the correlation between the sub-questions. Still the amount of optional answers in every question has been standardised so the construction of the question will not affect the importance of one question compared with another question.

Table 9 shows that some of the sub-questions have a positive correlation with other sub-questions within the indicator. I will
comment on those that are highest positively correlated with a very high level of significance, and they are marked with blue print and a light pink background. The question that is included in more than one indicator is marked with a grey color.

**Table 9**
Correlation analysis between sub-questions in Individual learning

<table>
<thead>
<tr>
<th></th>
<th>96</th>
<th>102</th>
<th>100</th>
<th>94</th>
<th>99</th>
</tr>
</thead>
<tbody>
<tr>
<td>96. is comp. dev. part of daily work</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102. prop. employees on-the-job training</td>
<td>0,24 ***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100. prop. employees non-paid time-off for training</td>
<td>0,10 **</td>
<td>0,07 *</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>94. yearly evaluation of employee performance?</td>
<td>0,14 ***</td>
<td>0,09 **</td>
<td>0,07 **</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>99. prop. employees paid time-off for training</td>
<td>0,16 ***</td>
<td>0,19 ***</td>
<td>0,13 ***</td>
<td>0,12 ***</td>
<td>1</td>
</tr>
</tbody>
</table>

Correlation Analysis Generated by SAS

*** High significance, the correlation is significant at the 0,01 level, i.e. it is under 1 percent chance that the result is a coincidence

** Rather high significance, the correlation is significant at the 0,05 level, under 5 percent is a coincidence

* Low significance, the correlation is significant at the 0,10 level, under 10 percent is a coincidence

The two questions that have the highest correlation are both about competence development in work. One is about if there is development in the daily work, question 96 and the other one is about the proportion of employees having on-the-job-training, question 102. They can be assumed to partly contribute with the same information, but not totally since the estimation of the correlation is only about a quarter of the possible value (24 percent). The two questions about learning at work complement each other. Further, they seem to be correlated to a higher proportion of employees that can take part in training with paid time-off. The correlation is rather low, even though highly significant. These results are more or less expected.

The other two sub-questions are also positively correlated and the value of the correlation is low. These two later aspects can intuitively be seen as supporting the other questions, for example: assume that the employee participates in a training course that is basic and needed in the job, the training take place on paid time, and step two in the course is not needed at the current work. If the
manager is positive the employee can take part in the next step but not on paid working time, therefore a correlation between paid and non paid training. If the non paid training is planned in advance the employee also have support of Swedish legislation\textsuperscript{64} to take part in the training even if it will take place during working hours. But the employee can not expect to have paid time off from work for this training. This question is positively correlated with all other questions, with high significance, but in several cases with a rather low coefficient.

The second indicator that is analysed is structural learning, table 10. The main result from the estimation of correlation indicates that one sub-question is positively correlated with all other sub-questions in the indicator. It also indicates that one of the sub-questions is not significantly related more than one of the other questions. The question included in more than one indicator is marked with a grey color.

\textbf{Table 10}
\textbf{Correlation analysis between sub-questions in Structural learning}

<table>
<thead>
<tr>
<th>Question</th>
<th>104</th>
<th>44</th>
<th>53</th>
<th>57</th>
<th>59</th>
<th>61</th>
<th>94</th>
</tr>
</thead>
<tbody>
<tr>
<td>104. frequency of meetings between managers, workers?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44. prop. employees participates in improvements groups?</td>
<td>0,17***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53. monitor quality of processes or service</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57. employees up-date databases of good work practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>59. monitor external ideas or technological developments?</td>
<td>-0.02</td>
<td>0.04</td>
<td>0.03</td>
<td>0.09**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>61. monitor customer satisfaction</td>
<td>0.03</td>
<td>0.09**</td>
<td>0.32***</td>
<td>0.19***</td>
<td>0.06*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>94. yearly evaluation of employee performance</td>
<td>0.03</td>
<td>0.16***</td>
<td>0.13***</td>
<td>0.19***</td>
<td>0.07**</td>
<td>0.27***</td>
<td>1</td>
</tr>
</tbody>
</table>

Correlation Analysis Generated by SAS

*** High significance, the correlation is significant at the 0.01 level, i.e. it is under 1 percent chance that the result is a coincidence

** Rather high significance, the correlation is significant at the 0.05 level, under 5 percent is a coincidence

* Low significance, the correlation is significant at the 0.10 level, under 10 percent is a coincidence

\textsuperscript{64} Lag om studieledighet 9.3.1979/273.
The question that is positively correlated to all other questions in the indicator is about if the employees update databases of good working practices, 57, it is correlated with high significance, with all but one question, 59, where the significance is a little lower. Updating databases can be seen as a core task in building structural capital. The later question is about monitoring external ideas or technological development and is not correlated with any of the other sub-questions. The highest correlation is between the two questions concerning monitoring quality and monitoring customer satisfaction. Intuitively it can be assumed that they to some extent provide the same kind of information, but not totally. The interpretation of the correlation is that up to a third of all value they provide the same kind of information, but mostly they still complement each other.

There is also a rather high correlation between monitoring customer satisfaction and evaluation of the employee’s performance. It can be assumed that firms that follow customer satisfaction to a greater extent include most of the employees in these tasks, and therefore it is logical that the firm also organises evaluations of the employees’ performance, possibly concerning performance related to customer satisfaction, and even quality matters. The result that these kinds of evaluations are not related to a higher frequency of meetings between managers and workers. This would be interesting to investigate further.

Some other results are also of interest to further investigate, even the result that there is no linear relationship.

The third indicator analysed is decentralisation. Even for this indicator, the main result from the estimation indicates that one sub-question is positively correlated with all other questions in the indicator, see table 11.
It seems to that the question about if the employees do their own planning and decide about the execution of their daily work tasks it is correlated to the possibility of having flexibility in when to start and end the daily work. Decentralised planning also seems to be positively correlated to other aspects of decentralised responsibilities, here quality control is measured. It also seems to be correlated with team work where the work is jointly decides how to be done. The correlations are highly significant.

There is a negative correlation between decentralisation and a larger numbers of organisational levels in the firm. This means that if there are several organisational levels the work is less decentralised, and vice versa, if there are fewer organisational levels the work is to a greater extent decentralised. Several organisational levels indicate a larger firm but also a more complex production. It might be assumed that there is a greater need to have an overview of work if the organisation is large and with many levels and more complex. The need to centralise the planning and have an overview is greater. This might explain the negative correlation. But to be able to really make stable conclusions, work practices in small respectively large firms need to be further investigated. I leave deeper analyses of different models to forthcoming papers.
Finally, the fourth indicator analysed is numerical flexibility. The indicator contains different features but it aims to provide information about flexibility in terms of possibilities to changes in the workforce with short notice, in terms of numbers of employees or hours worked, see table 12. The result shows that some of these features are positively correlated on a high significant level while others are not.

Table 12
Correlation analysis between sub-questions in Numerical flexibility

<table>
<thead>
<tr>
<th></th>
<th>51</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>51. are employees trained to rotate tasks?</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>12. prop. employees with part-time?</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>11. prop. employees has temporary contract?</td>
<td>0.07 **</td>
<td></td>
</tr>
</tbody>
</table>
| 14. prop. from private employment agency? | -0.01 | 0.05 # 0.25 *** | 1

Correlation Analysis Generated by SAS
*** High significance, the correlation is significant at the 0.01 level, i.e. it is under 1 percent chance that the result is a coincidence
** Rather high significance, the correlation is significant at the 0.05 level, under 5 percent is a coincidence
* Low significance, the correlation is significant at the 0.10 level, under 10 percent is a coincidence

Table 12 shows that the most direct ways to change the numbers of work force, measured in question 11 and 14, are the highest correlated with a high significant level in the indicator. The indicator also includes information about if the workforce is organised so that it is flexible within the firm in terms of task rotation. This practice is not correlated with the other aspects in the indicator. The third aspect in the indicator is part-time work, the estimation shows that it is not particularly correlated with the other features. In forthcoming papers there will be possibilities to elaborate further on different flexibility aspects.

Concluding remarks on the correlation
The four composite indicators are made to include as much different information as possible about work organisation and competence development. The object in this first explorative analysis of data is to study the relationship between the four composite indicators. The different correlations concerning the sub-questions in each indicator have given some insights about how much they provide the same kind of information. Since the correlation estimates are not too high
this is not the case. The analyses also indicate how to go further into
deeper analyses of relationships and patterns of practices in the
firm, possibly using factor analyses. There can be some interesting
patterns between the included sub-questions. In forthcoming
analyses, measurements depending on underlying patterns might be
one of the outcome, together with a discussion about how different
features are related to the underlying theory, presented in the
Meadow background reports. Different features that are included in
the present four indicators will be further analysed as well as other
features such as competence building outside the firms that seems to
be of importance to highlight. The main conclusion from this
analysis is that three of the indicators can be used in an index but
the one measuring numerical flexibility is better used as a sole
indicator by itself.

Incidence across industries in Sweden

Many researchers still have the picture of incidence and diffusion of
decentralised work organisations and competence development
across the Swedish business industries from earlier studies in the
1990s. The result of studies at that time showed that the incidences
differed according to type of industry and their intensity of human
capital and size. Will this overall picture of incidence change with
this new data for 2010? A new perspective is included compared
with the analyses during the 1990s, and that is if the firms are
foreign controlled or Swedish controlled.

The described four composite indicators are used to describe the
incidence and diffusion of work organisation and competence
development across the Swedish business sector. They are; Individual learning that is assumed to indicate formal and informal
learning, as well as continuous learning. Structural learning gives
information about if the firm is building structural capital with the
customer in focus, and if the firm work systematically with quality
and innovations. The indicator of decentralisation provides
information about decentralisation of responsibilities; some
information about team-work that also can indicate the complexity
of the organisations. Finally, numerical flexibility gives information
about the possibility to change the number of employees with short
notice and work flexibly within the firm, in terms of task rotation. It
might also indicate use of an external workforce for knowledge
transformation.
All presentation of data for 2010 is made with the help of descriptive statistics of the four composite indicators. The firms are weighed after their own industry's proportion of value added in the business sector. For each table the incidences and diffusion will also be compared with the earlier results in the two Swedish surveys from the 1990s. First of all, descriptive statistics provide some information of how the indicators are diffused. The first column in table 13 provides the number of firms per indicator. The second column is the mean value of the indicator in the business sector. As explained earlier each firm has a value of each index between 0 and 1. If a firm has the highest value in all indexes the value will be 4. Each indicator should be interpreted solely and not compared with the other indicators, since the construction of them does not allow this. The column presenting standard deviation (Std Dev) provides information of the general deviation from the mean value, i.e. plus (+) or minus (-) 0,23 for decentralisation

**Table 13**

Descriptive statistics of the four indicators: number of observations, mean, standard deviation, summa, minimum and maximum

<table>
<thead>
<tr>
<th>Indicator</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decentralisation</td>
<td>795</td>
<td>0,43</td>
<td>0,23</td>
<td>346</td>
<td>0,01</td>
<td>0,92</td>
</tr>
<tr>
<td>Numeric_flexibility</td>
<td>802</td>
<td>0,30</td>
<td>0,13</td>
<td>243</td>
<td>0</td>
<td>0,83</td>
</tr>
<tr>
<td>Structural_learning</td>
<td>821</td>
<td>0,73</td>
<td>0,17</td>
<td>596</td>
<td>0,04</td>
<td>1</td>
</tr>
<tr>
<td>Individual_learning</td>
<td>767</td>
<td>0,64</td>
<td>0,33</td>
<td>493</td>
<td>0</td>
<td>0,96</td>
</tr>
</tbody>
</table>

The table 13 shows that in the Swedish Meadow survey there are firms that do not use numerical flexibility and individual learning practices, at least not the kind of practices that are measured in the survey. This is implied by the value 0 in the minimum column. There are firms with the highest value of structural learning as implied by the maximum value 1. Almost all firms answered all of the included questions, as can be seen in the number of observation for each composite indicator. The indicator with the highest number of observations also has the highest mean value, it is structural learning (0,73). It is these kinds of practices that have come in focus in endogenous theories about innovation and development. There will be more about these theories in forthcoming papers.
The incidence is higher in larger firms

Table 14 is to be interpreted as follows: For every index the mean value of all firms in the business sector is presented (last column) and the mean value of all firms that are small (15-49 employees) or medium (50-249) or large (250+) are also presented. In the bottom row the sum of the mean values of small, medium, large and the whole business sector is presented. The maximum value of the business sector can be 4.

Table 14
Incidences across firm sizes, mean values

<table>
<thead>
<tr>
<th></th>
<th>15-49</th>
<th>50-249</th>
<th>250+</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual learning</td>
<td>0.56</td>
<td>0.61</td>
<td>0.73</td>
<td>0.63</td>
</tr>
<tr>
<td>Structural learning</td>
<td>0.63</td>
<td>0.69</td>
<td>0.77</td>
<td>0.70</td>
</tr>
<tr>
<td>Numerical flexibility</td>
<td>0.26</td>
<td>0.35</td>
<td>0.38</td>
<td>0.33</td>
</tr>
<tr>
<td>Decentralisation</td>
<td>0.45</td>
<td>0.40</td>
<td>0.40</td>
<td>0.42</td>
</tr>
<tr>
<td>Sum</td>
<td>1.90</td>
<td>2.05</td>
<td>2.28</td>
<td>2.08</td>
</tr>
</tbody>
</table>

The firms are weighted after their industry's proportion of value added in the business sector.

Table 14 shows that there are differences between the sizes of the firms, but the mean values per indicator are not dramatically different. However, it is clear that larger firms have higher mean values in three out of four indexes. The argument for this can be that larger firms have more resources to invest in individual and structural learning, and also a greater need and possibility to organise the work with help of numerical flexibility, i.e. strategies such as task rotation and fixed contracts etc. If the question in the indicator of individual learning would not have been weighted upwards, it is possible that the difference would have been even greater between the sizes, since the up weighted feature is the one assumed least exact. All the other questions in the index can be defined as ‘open’ investment in training, and large firms are to be handling such investments easier. Several of the questions in the index of structural learning can also be seen as indications of investments in structural capital.

The indicator of decentralisation shows the opposite picture. The smallest firms have a higher mean value than all the others. This is interesting. One argument can be that the smaller firms do not always have a deliberate decentralisation strategy since there are fewer levels of management, in very small firms only the executive director and then the rest of the staff. In these firms someone in the
staff has to have the responsibility and make the day to day decisions. Another possibility is that the negative and significant correlations between the feature of organisational levels and the decentralisation of planning can explain the more modest frequency of the indicator among larger firms.

It is not easy to compare the current incidences of decentralised work organisation with data from the 1995 survey that are published, since the index differs a bit. In the 1995 survey the index is the top quartile of the work places that had the most decentralised work organisations in combination with daily learning. But it is also known that all of the top quartile had daily learning in the work so this will not differ according to the sizes. The top quartile is compared with all other work places. The incidence of the top quartile was about the same in all groups of work places that were smaller than the largest (500+). The frequency of top quartile work places in the largest group was about twice as high as in all other sizes. This means that all work places with small (50-99) and medium (100-199) and large (200-499) sizes but not the largest work places had about the same incidence. The data for 2010 in the largest group (250+) should be compared with the large ones and not the largest group of work places 1995. This is possible since we know from the collection report and the response rate (see footnote 33) that the number of the absolute largest firms is rather low in 2010. So when we are comparing the data this way the picture is about the same in 1995 as in 2010.

Differences across the business industries
Table 15. For every index the mean value of all firms in the business sector is presented (last column) and the mean value of all firms in different industry groups are also presented. In the bottom row the sum of the mean values of small, medium, large and the whole business sector is presented. The maximum value of the business sector can be 4.
Table 15
Incidences across industries, mean values

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing</th>
<th>Capital intensive</th>
<th>Service</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Labour intensive</td>
<td>Knowledge intensive</td>
<td>Trade &amp; transport</td>
<td>Knowledge intensive</td>
</tr>
<tr>
<td>Individual learning</td>
<td>0.59</td>
<td>0.70</td>
<td>0.60</td>
<td>0.52</td>
</tr>
<tr>
<td>Structural learning</td>
<td>0.66</td>
<td>0.74</td>
<td>0.74</td>
<td>0.69</td>
</tr>
<tr>
<td>Numerical flexibility</td>
<td>0.31</td>
<td>0.34</td>
<td>0.32</td>
<td>0.32</td>
</tr>
<tr>
<td>Decentralisation</td>
<td>0.39</td>
<td>0.48</td>
<td>0.43</td>
<td>0.35</td>
</tr>
<tr>
<td>Sum</td>
<td>1.95</td>
<td>2.26</td>
<td>2.09</td>
<td>1.88</td>
</tr>
</tbody>
</table>

The firms are weighted after their industry’s proportion of value added in the business sector, except for the finance industry here included in knowledge intensive service.

Table 15 shows that the mean value is higher in the knowledge intensive industries, for three out of four indexes.\(^{65}\) The mean value of numerical flexibility seems to be about the same in all type of industries. The incidences of decentralised work organisation and individual learning between the 1995 and 1997 and 2010 surveys, shows the same picture. See the comments to table 14, above, about the complexity to compare with the 1995 survey. The industries are aggregated from a two digital level to the five presented groups, see table 16 for type of industries on two digital levels.

\(^{65}\) Generally there is a substitute between low-skilled labour and tangible capital and complementarities between high-skilled labour and tangible capital. If true it means that learning will be positively correlated between knowledge intensive and capital intensive. See some recent papers: Autor D H, MIT and NBER, and Dorn D, CEMFI and IZA, 2010. The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labor Market. Also published 2009. DP No. 4290. And Belhocine N. WP/10/86, IMF working paper. The Embodiment of Intangible Investment Goods: a Q-Theory Approach.
Table 16
Swedish standard Industrial classification, Nace 2007

<table>
<thead>
<tr>
<th>Department</th>
<th>Two digital numbered industries, each industry is separated with semi comma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour intensive manufacturing</td>
<td>10-15 Manufacture of food products; Beverages; Tobacco products; Textiles; Wearing apparel; Leather and related products</td>
</tr>
<tr>
<td></td>
<td>18 Printing and reproduction of recorded media</td>
</tr>
<tr>
<td></td>
<td>22 Manufacture of rubber and plastic products</td>
</tr>
<tr>
<td></td>
<td>25 Manufacture of fabricated metal products, except machinery and equipment</td>
</tr>
<tr>
<td></td>
<td>31-33 Manufacture of furniture; Other manufacturing; Repair, installation of machinery. equipment</td>
</tr>
<tr>
<td>Human capital intensive</td>
<td>20-21 Manufacture of chemicals, chemical products; Basic pharmaceutical products</td>
</tr>
<tr>
<td>manufacturing</td>
<td>26-30 Manufacture of computer, electronic and optical products; Electrical equipment; Machinery and equipment n.e.c.; Motor vehicles, trailers and semitrailers; Other transport equipment</td>
</tr>
<tr>
<td>Capital intensive</td>
<td>16-17 Manufacture of wood, products of wood, cork, except furniture; manufacture of articles of straw and plaiting materials; Paper and paper products;</td>
</tr>
<tr>
<td></td>
<td>19 Manufacture of coke and refined petroleum products</td>
</tr>
<tr>
<td></td>
<td>23 Manufacture of other non-metallic mineral products; Basic metals</td>
</tr>
<tr>
<td></td>
<td>35-39 Electricity, gas, steam and air conditioning supply</td>
</tr>
<tr>
<td>Trade, transport, post</td>
<td>46 Wholesale trade, except of motor vehicles and motorcycles</td>
</tr>
<tr>
<td></td>
<td>49 Land transport and transport via pipelines</td>
</tr>
<tr>
<td></td>
<td>53 Postal and courier activities</td>
</tr>
<tr>
<td>Human capital intensive</td>
<td>58 Publishing activities</td>
</tr>
<tr>
<td>service</td>
<td>61 Telecommunications</td>
</tr>
<tr>
<td></td>
<td>62 Computer programming, consultancy and related activities</td>
</tr>
<tr>
<td></td>
<td>63 Information service activities</td>
</tr>
<tr>
<td></td>
<td>64-66 Financial service activities; Insurance, reinsurance and pension funding, except compulsory social security; Activities auxiliary to financial services and insurance activities</td>
</tr>
<tr>
<td></td>
<td>71 Architectural and engineering activities; technical testing and analysis</td>
</tr>
<tr>
<td></td>
<td>72 Scientific research and development</td>
</tr>
</tbody>
</table>


Swedish work practices in foreign controlled firms
The definition of foreign controlled firm is that more than 50 percent of the voting value of the shares in the firm is held by one or more shareholder abroad.66

The foreign controlled firms in Sweden have increased since the middle of the 1990s, rapidly during the second half of the 1990s, and slower in recent years with a rate between 5-10 percent per year. Norwegian shareholders own the largest number of firms in Sweden, about 15 percent of all foreign controlled firms. Denmark is

66 The definition is commonly decided in OECD and EU (Eurostat).

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in second place and United Kingdom in third. The increase of foreign ownership is dominated by mergers and acquisitions. With regard to the number of employees, the US is largest, with almost a hundred thousand employees in the Swedish business sector. Today foreign controlled firms employ about 23 percent of all employees in the Swedish business sector. Foreign ownership is concentrated to the three metropolitan city regions.

The foreign controlled firms are compared with national firms (last column), in table 14. The foreign ones are broken down by type of country: Asia, Europe, NAFTA, and the Nordic countries. The number of observations in Asia is low, and in the smallest size group it is zero. For every four indexes the mean value of small (15-49 employees) or medium (50-249) or large (250+) firms are presented in the Swedish business sector. The maximum value of each size group in the business sector can be 4.

Table 17
Incidences across ownership, mean values

<table>
<thead>
<tr>
<th></th>
<th>Asia</th>
<th>Europe</th>
<th>NAFTA</th>
<th>Nordic</th>
<th>Swedish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual learning</td>
<td>0,68</td>
<td>0,65</td>
<td>0,67</td>
<td>0,62</td>
<td>0,68</td>
</tr>
<tr>
<td>Structural learning</td>
<td>0,79</td>
<td>0,76</td>
<td>0,75</td>
<td>0,73</td>
<td>0,76</td>
</tr>
<tr>
<td>Numerical flexibility</td>
<td>0,56</td>
<td>0,44</td>
<td>0,40</td>
<td>0,46</td>
<td>0,43</td>
</tr>
<tr>
<td>Decentralisation</td>
<td>0,35</td>
<td>0,34</td>
<td>0,34</td>
<td>0,31</td>
<td>0,34</td>
</tr>
<tr>
<td>Sum</td>
<td>2,38</td>
<td>2,19</td>
<td>2,16</td>
<td>2,12</td>
<td>2,21</td>
</tr>
</tbody>
</table>

The firms are not weighted after their industry's proportion of value added in the business sector

Table 17 shows that in general the mean values are not dramatically different for any of the indicators according to foreign ownership of the business. The last column shows the mean value for the Swedish controlled firms. These values are almost identical compared with the first table, 14, which gives the mean value in every size group. It is not presented here but data divided into firm sizes shows that the mean values are fluctuating. For the smallest firms the mean values are higher than in the national firms, but on the other hand it is lower for the middle sized firms. The mean value for the group of large firms differs only marginally between the countries. So even with this fluctuation in mind the general picture still hold.


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One partial explanation as to why foreign controlled firms in Swedish business sector do not differ more among themselves and from national firms is that these kinds of foreign direct investments in Sweden are dominated by mergers and acquisitions not greenfield investments, see also footnote 67. In countries like Sweden where the knowledge level in terms of technology and human capital is high, greenfield investments are uncommon. If you buy an existing business, it is much more probable that you also keep much of the culture and old ways to work, compared with if you set up something completely new.

Concluding remarks on incidences across industries
The study of incidence and diffusion of work organisation and competence development in the Swedish business sector shows that there are no dramatic differences across the business industries and ownership. Some differences according to sizes, the larger firms have higher incidences in three out of four indexes, but not decentralisation. The incidences seem to be higher in the human capital intensive industries, This is not surprising since it is assumed to be a relation between human capital intensiveness and at least the two kinds of learning indicators. An important reason of why the incidences of the four indicators do not differ dramatically according to foreign compared with Swedish ownership, is that foreign direct investments in Sweden are dominated by mergers and acquisitions etc and not so called greenfield investments. Other reasons are that the industrial relations seem to be strong and stable across the industries in Sweden and we know that the knowledge level is fairly high across industries.

What can predict the incidence?
Will the above presented differences of the incidences of the four composite indicators across industries stand in more complex models together with other features of the firm and the firm’s work force? The aim is to answer the question with help of correlation analyses and regression models. Alongside the firm’s size and

---

68 Greenfield investments are investments in service business and in manufacturing or physical related structure in an area where no previous facilities exist. The name comes from building a facility literally on a "green" field, i.e. farmland or forest. They often occur when multinational corporations enter into developing countries to build new factories and/or stores. There was Greenfield investment in the Eastern European countries during the 1990s.

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industry, and foreign ownership, some features of the firm’s work force are included in the analyses, such as: age, education, and the proportion of men and women in the firm.

**Correlation between the indicators and firm and work force features**

First, estimations of the correlations between each indicator and the described features of the firm and its work force are done. The aim is to gain information about the relationship between each feature and indicator. The Pearson correlation coefficient to measure the strength of linear dependence is used. The results from the correlation analysis and the level of significance are presented in table 18. All positive correlations with high significance are marked in blue and all negative in red.

**Table 18**

Correlation matrix between the four indicators and other features

<table>
<thead>
<tr>
<th></th>
<th>IND</th>
<th>STRUC</th>
<th>NUM</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign</td>
<td>-0.03</td>
<td>-0.10 **</td>
<td>-0.13 ***</td>
<td>-0.01</td>
</tr>
<tr>
<td>Small firms</td>
<td>-0.23 ***</td>
<td>-0.22 ***</td>
<td>-0.35 ***</td>
<td>-0.00</td>
</tr>
<tr>
<td>Medium sized firms</td>
<td>0.08 **</td>
<td>0.06 *</td>
<td>0.07 **</td>
<td>0.02</td>
</tr>
<tr>
<td>Large firms</td>
<td>0.18 ***</td>
<td>0.19 ***</td>
<td>0.32 ***</td>
<td>-0.02</td>
</tr>
<tr>
<td>18 Industries, those with high sign.</td>
<td>1 pos ***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young &lt; 35</td>
<td>0.06</td>
<td>-0.02</td>
<td>0.07 **</td>
<td>0.06 *</td>
</tr>
<tr>
<td>Middle-aged &gt; 35 &lt; 50</td>
<td>-0.00</td>
<td>0.07 **</td>
<td>-0.12 ***</td>
<td>0.14 ***</td>
</tr>
<tr>
<td>Old &gt; 50</td>
<td>-0.05</td>
<td>-0.03</td>
<td>0.03</td>
<td>-0.17 ***</td>
</tr>
<tr>
<td>HighEdPerc university¹</td>
<td>0.15 ***</td>
<td>0.22 ***</td>
<td>0.03</td>
<td>0.26 ***</td>
</tr>
<tr>
<td>LowEd compulsory²</td>
<td>-0.16 ***</td>
<td>-0.21 ***</td>
<td>-0.02</td>
<td>-0.26 ***</td>
</tr>
<tr>
<td>MedEd Perc college³</td>
<td>-0.05</td>
<td>-0.09 **</td>
<td>-0.01</td>
<td>-0.11 ***</td>
</tr>
<tr>
<td>Women⁴</td>
<td>0.07 **</td>
<td>0.10 **</td>
<td>0.13 ***</td>
<td>0.15 ***</td>
</tr>
</tbody>
</table>

Correlation Analysis Generated by SAS

1) University = 23 year or longer; 2) Compulsory school = 9 years schooling; 3) College = gymnasium and shorter university educations and courses, <3 year; 4) Woman, is a numerical variable

*** High significance, the correlation is significant at the 0.01 level, i.e. it is under 1 percent chance that the result is a coincidence

** Rather high significance, the correlation is significant at the 0.05 level, under 5 percent is a coincidence

* Low significance, the correlation is significant at the 0.10 level, under 10 percent is a coincidence

Table 18 indicates that almost all features are correlated with at least three out of four indicators, but there are one or two exceptions. The firm feature that provides most information is the size of the firm,
according to the result of the correlation matrix. The firms are divided into three size groups of the same as in the presentation of incidences, see table 14. They are so called dummy variables, and each one is a feature that is correlated to the indicators. Large firms seem to be positively correlated and small firms negatively correlated with high incidence of three of the indicators, except for decentralisation. As mentioned previously, the sums of the incidences of the four indicators for each firm size are presented, and it differ between the largest and the smallest firms by almost 40 percent. The results in the correlation matrix strengthen the earlier findings that firm size matters.

Another firm feature is foreign ownership that is compared with Swedish ownership. The estimation indicates one significant but negative correlation with numerical flexibility. There is also an indication of a negative relationship between foreign ownership and structural learning, but the significance is not the highest. A negative correlation means that the incidence is lower if the ownership is foreign, compared to Swedish ownership, and vice versa, positive and higher if it is Swedish. Finally, the firm feature called type of industry is included. It simply measures the correlations between all 18 types of industries included in the calculation and each of the four indicators. Of all possible correlations between the included industries and the four indicators only 1 out of 72 are highly significant: it is the correlation between the industry group including Telecommunication (Nace 61) and Computing (Nace 62) and the indicator decentralisation. The weak relation between industries and the four indicators is the reason why the 18 groups of industries are not included one by one in the table.

Other included features are those of the work force. Two of these features provide the most information: they are sexes and education, according to the result in the correlation matrix. According to education that is a variable comprised by firms with different proportion of employees with high and low educations. Measured this way education is significantly correlated to three of the indicators, all but numerical flexibility. The firms with the highest proportion of university educated employees are positively correlated with three out of four indicators. Those with a higher proportion of employees with a low education are negatively correlated with three out of four indicators, and the third group is firms with a high proportion of college educated, and they are also
negatively correlated with two of the indicators of structural learning and decentralisation. The result can be interpreted rather intuitively: firms with a high proportion of high educated are more likely higher incidences of all indicators but numerical flexibility.

The sexes of the employees are a feature that seems to be correlated to all of the indicators: the higher the percentage of women at the firm, the higher the incidence of the indicators, but with a different significance.

When it comes to the age of the work force there are fewer significant correlations, but it does seems to be related to three out of four of the indicators, all but individual learning. The firms are divided into three groups constituted by the age of the employees: The first group is characterised by a high proportion of employees under the age of 35. For these firms the result is not so clear, because the correlation value is low and the significance is rather low, but positive with numerical flexibility and decentralisation. The firms characterised by a high proportion of middle aged are negatively correlated with numerical flexibility, and positively correlated with structural learning and decentralisation. The firms that have the highest proportion of employees, 50+, are correlated negatively with decentralisation. The result of age can be interpreted rather intuitively: firms with a high proportion of middle-aged are more likely have decentralised work organisations than firms with higher proportions of younger and older employees. The middle-aged employees are probably on top of their job career that includes decentralised responsibilities, such as planning and quality control etc.

The overall conclusion is that the matrix shows that there are correlations between almost all firm and work force features and the four indicators. Therefore a model that can take care of several of the non dependent variables simultaneously will be of interest to develop and use.

**Regression model to predict incidences**

The second calculation, based on a regression model, aims to study if the includes firm and work force features can predict the incidences of the four indicators. There is a relationship between this kind of calculation and correlations, with some significant differences. The linear regression model that is used includes all available information about the firm and the work force simultaneously. In other words, this model is measuring the
relationship between one dependent variable, the indicator with several non dependent variables, the firm and the work force features, simultaneously. The non dependent variables are assumed to predict a higher or lower incidence of the dependent variable. All non dependent variables are included in an equation for each of the four composite indicators, one at the time. The non dependent variables are the same features as in the correlation: size and industry and ownership as well as features of the firm's work force: age; and education; and sexes.

For example, the feature of ownership is the same as in the correlation matrix; it is still divided into two variables but handled differently in the regression model compared to the correlation. Foreign owned firms are compared with Swedish owned firms, and the difference is the value that aims to predict the incidence. Here the value of the Swedish owned firm is included in the model’s basic value, (I come back to this) and the values of foreign firms are presented in the table.

The firm size is still divided into three variables, as in the correlation. But in the regression model small and large firms are compared with medium sized firms, therefore the result of these two variables are presented in the table, and the third, the value of the medium sized firms, is included in the basic value.

With the same logic, firms with high proportion of young and old employees are compared with firms with higher proportions of middle-aged employees. Firms with higher proportion of employees with university and compulsory education respectively are compared to employees with college education. Finally the proportion of the sexes is included. This feature is constructed so that it measures and compares the result of every extra percent of women in the firm, and it is constructed as a numerical variable. Therefore it compares to each extra percent.

The value of each of the presented features in table 19 is compared with the sum of the basic value, intercepted, for each indicator. The basic value is calculated as the sum of the value of the following variables: the value predicted by the Swedish owned firms, plus the value it has as middle sized firm, and plus the value of middle aged employees, as well as the value of employees with college education, and finally the value of the lowest percentage of women in the work force is part of the basic value. So, the features that are presented in the table are compared with this basic value, either the
presented features bring extra value or withdraw value from the basic estimation.

Once more, the features value respectively is interpreted as prediction of higher or lower incidence of each indicator. For example, in the model for predicting incidence of individual learning, the result indicates no significant value for the non dependent variable of the firm's ownership: foreign or Swedish. The feature of firm size withdraws value: if the firms are small (-12) this estimation is highly significant, and the indicator is given extra value if the firms are large (0.09) but with a little lower significance.

The results from all the four regression models, together with the level of significance are presented in table 19. All contributions of extra value with high or rather high significance are presented in blue, and all features that withdraw values are in red.

**Table 19**

**Matrix of the result of four regression models: Individual learning; and Structural learning; and Decentralisation; and Numerical flexibility**

<table>
<thead>
<tr>
<th></th>
<th>IND</th>
<th>STRC</th>
<th>DEC</th>
<th>NUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign</td>
<td>0.04</td>
<td>-0.01</td>
<td>0.0003</td>
<td>-0.01</td>
</tr>
<tr>
<td>Small firms</td>
<td>-0.12***</td>
<td>-0.05***</td>
<td>0.01</td>
<td>-0.06***</td>
</tr>
<tr>
<td>Large firms</td>
<td>0.09**</td>
<td>0.05**</td>
<td>0.01</td>
<td>0.05***</td>
</tr>
<tr>
<td>18 Industries, those with high sign.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young_ &lt; 35</td>
<td>-0.08</td>
<td>-0.13**</td>
<td>-0.09</td>
<td>0.05</td>
</tr>
<tr>
<td>Old_ &gt; 50</td>
<td>-0.18</td>
<td>-0.1</td>
<td>-0.24**</td>
<td>-0.02</td>
</tr>
<tr>
<td>HighEdc university¹</td>
<td>0.05</td>
<td>0.15***</td>
<td>0.19***</td>
<td>0.01</td>
</tr>
<tr>
<td>LowEd compulsory²</td>
<td>-0.08</td>
<td>-0.06</td>
<td>-0.12</td>
<td>0.02</td>
</tr>
<tr>
<td>Women³</td>
<td>0.09</td>
<td>0.06*</td>
<td>0.15**</td>
<td>0.09***</td>
</tr>
</tbody>
</table>

Generated by SAS System Model: Linear_Regression_Model
1) University = ≥3 year or longer, 2) Compulsory school = 9 years schooling; 3) Woman, is a numerical variable
*** High significance, the correlation is significant at the 0.01 level, i.e. it is under 1 percent chance that the result is a coincidence
** Rather high significance, the correlation is significant at the 0.05 level, under 5 percent is a coincidence
* Low significance, the correlation is significant at the 0.10 level, under 10 percent is a coincidence

Table 19 is a matrix of the result of four regression models, one for each indicator. The overall conclusion is that there are less significant estimations compared with the result presented in the correlations matrix. This means that the earlier result of the
correlations explains more simple situations that are without the complexity of simultaneously impact of several features.

The results presented in table 19 of each regression i.e. each indicator is first commented on and secondly, the features, the non dependent variables, are commented across the regression models and indicators.

The conclusion of the result of each regression model provides information of if the included features, the non dependent variables, in the model suites the four models, the indicators, equally well. The conclusion is that they suit some indicators better than others. This is also clear in the test of how much of the variances in the dependent variable that can be explained by the non dependent variables. This test is commonly called R-Square ($R^2$). For the model of individual learning $R^2$ is rather low, 0.13. This means that the regression is nonlinear or the construction of the non dependent features is not suited to predict individual learning. Only one feature, the firm size, predicts incidences of individual learning. Structural learning is predicted by several features: size, education, age, sexes, and the result of the $R^2$ test is higher, 0.16. The regression model for decentralisation can be predicted by education, age, sexes, and the $R^2 = 0.14$. Numerical flexibility is predicted by size and sexes, and has the higher $R^2$ result of all of the models, 0.19.

It is also of interest to follow the importance of the different features, the non dependent variables, across the regression models. Only one features of the firm is still significant compared with the correlation matrix and predict a lower or higher incidence of the different indicators; it is firm size. Smaller firms predict significant lower incidence and larger firms predict higher incidence, compared with middle sized firms. This seems to be true for all indicators but decentralisation, according to this regression model. The other firm features like ownership and industry cannot predict the incidences of the indicators, according to the used regression model.

Several features of the work force predict the incidences of the indicators. A higher proportion of women predicts a higher incidence of three of the indicators but with different significance, and not for individual learning. Firms with a higher proportion of university educated employees predict the incidences for two of the indicators, structural learning and decentralisation. The age of the work force in the firms also predicts the incidence of structural learning and decentralisation. Firms with a higher proportion of
young employees and firms with higher proportions of older employees are compared with firms with a higher proportion of middle aged employees. The result is negative or not significant. The conclusion is that the middle aged predicts a higher incidence of structural learning and decentralisation.

**Concluding remarks on prediction of incidences**
The correlation analyses and the regression model provide information of predictions of incidences of the four composite indicators. The correlation gives an overview and study the relationship between one feature at the time and the indicators. The regression model fine tunes the information and takes into consideration a more complex model of the firm and the work force.

The main result from all four regression models is that firm size and higher proportion of women in the firm predicts incidences of the indicators. Smaller firms predict a lower incidence of three of the indicators and larger firms predict higher incidences of the same indicators, compared to middle sized firms. This is true for all indicators but decentralisation. A higher degree of women in the firm increases the incidences of three of the indicators, but not individual learning. Firms with a higher proportion of university educated and firms with a higher proportion of middle aged employees predict a higher incidence of two of the indicators, structural learning and decentralisation.

A policy conclusion from these estimations is that in small firms almost all of these practices, except individual learning, are underrepresented, compared to medium sized and large firms. Some results in parallel analyses to this paper show significant results between individual learning and decentralisation and higher productivity. And also, earlier analyses in the 1990s showed these results, so policy actions can be defended. Both the firms and society can gain from actions that boost learning and decentralisation in smaller firms. Some background figures can contribute to the importance of small firms concerning their efficiency and productivity. The smaller firms constitute 99 percent of all firms in Sweden, and they comprise 44 percent of all export firms and their proportion of turnover is 49 percent, according to the Swedish
Business Register. Earlier policy programs promoting these practices in small and medium sized firms have been proven to be efficient69.

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