The impact of human capital and human capital investments on company performance. Evidence from literature and European survey results

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The impact of human capital and human capital investments on company performance Evidence from literature and European survey results

Bo Hansson, Ulf Johanson, Karl-Heinz Leitner

Abstract

This study consists of a literature review and an analysis of an existing database on human resource management (HRM) (the Cranet survey). It focuses on research that connects human capital with the firm and asks whether education, skills/competence and training have any impact on company performance. The main results may be summarised as follows.

It appears that training provided by firms for employees is not characterised by being general or specific but by what is needed to stay ahead of competitors. There is a growing body of literature suggesting that firms are financing both types of training.

More recent research also suggests that investments in training generate substantial gains for firms even if employees can use this training in other firms. The evidence that employers profit from training investments comes from different countries including Britain, France, Ireland, the Netherlands, Sweden, and the US. Most of these studies indicate that training affects performance and not the other way around.

The effects of education and skills/competence on aspects such as productivity and innovations are generally found to be positive and significant, though the connection with profitability might be less expected. Firms can also extract profit from prior education as they do from general training investments. Supporting employee development through training policies and methods for analysing training needs is important to explain the provision of training and training outcomes. Similarly, innovative (and comprehensive) HRM practices tend to be associated with positive company performance.

Innovation and information technology (IT) both result in greater investment in training and also depend on education and skills in generating profits. Other findings suggest that training and comprehensive HRM practices are closely related to firms' innovative capacity.

The lack of studies connecting small and medium enterprises (SMEs), labour market conditions (systems), and social partners with company training policies and performance measures such as productivity or profitability, makes it difficult to draw conclusions on these aspects. This suggests an incentive to research such matters more thoroughly in the future.

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1. Introduction

Human capital is a major factor in generating future growth and prosperity. Human capital investments such as education and training are, therefore, a main concern for individuals, firms and governments. According to Becker (1993), human capital is the key determinant in explaining the rise and fall of nations as well as a main factor in determining individual income. The impact of human capital on enterprises is less clear. This is because the attributes of human capital and human capital investments are ascribed to the individual and not the firm. This study concerns research that connects human capital with the firm. The question is whether education, skills/competence and training have any impact on company performance. The focus is on continuous vocational training that takes place inside companies and is paid for, in part or whole, by the employer.

A considerable volume of employer sponsored or company training takes place each year. The European Union continuing vocational training survey 1994 suggests that more than half of all firms with 10 or more employees provided some training during 1993 and that about 1.6 % of labour costs are spent on training (European Commission, 1999). More recent figures from Sweden suggest that company training plays an increasingly important role in creating new knowledge and skills in society. Working time spent on company training in Sweden has increased considerably in recent years, from about 2.5 % in 1999 to roughly 3.5 % in 2001. A Norwegian study estimates the time spent on formal and informal training as high as 4-6 % of working time (Hagen et al., 2001).

Although these investments amount to considerable sums, until recently little has been known about the return for firms ([1]). The impact of education and training on company performance is an important issue not only because of the large amount invested each year in knowledge and skills, but also because it is pertinent to know who benefits from these investments. The latter question has a bearing on who should carry the costs of training investment, to what extent we have under-investment in training, whether there is a need for policies to improve the current situation in regard to company training, etc.

The aim of this study is to provide an overview of research that connects education, training or skills/competence with the impact of these activities on productivity, profitability or other variables of firm performance. Besides reviewing associated literature, the study also involves an analysis of an existing database (Cranet survey) with regard to education and training.

The remainder of the paper is organised as follows. The next chapter introduces the method used in gathering studies for this review and provides a short introduction to some statistical problems encountered in this line of research. Chapter 3 gives an overview of findings in different research disciplines. Chapter 4 takes a closer look at a European human resource management (HRM) survey (Cranet survey) in relation to employee development issues. Chapter 5 gives the combined findings of this paper and presents the major results in regard to the impact of training on company performance. Chapter 6 suggests some policy and future research implications based on the main findings of this study.

([1]) An estimate by SCB (Statistics Sweden) considers as much as 3.8 % of GDP was spent on company training in 2001 which is roughly SEK 80 billion or in the order of EUR 9 billion. The amount spent on company training is close to what is spent on compulsory and secondary school in Sweden 2001 (SEK 88 billion). Source: The National Agency for Education. The amount spent on formal training in the US was close to USD 59 billion in 1997 (Bartel, 2000).

2. Method and research problem

Literature on the impact of education, training, and skills/competence on firm performance has been reviewed from several different sources, including published material. We have scanned published literature mainly through channels such as ABI/Inform and other university library databases. In collecting the most recent research papers we have also surveyed different web based databases, the best known being the social science research network (SSRN). This is a major source of information with over 3 million downloaded working papers since the start. Another important source is the IDEAS (UQÀM – *Université du Québec à Montréal*) database with over 100 000 working papers and articles from 1 000 universities and research centres around the world. It includes papers from IZA (Institute for the study of labor), NBER (National bureau of economic research), CESifo (Center for economic studies and institute for economic research), and several other important institutions. Other sources of information include the Cedefop bibliography on impact research. We have also collected research papers directly from different universities and research centres. These efforts have been made to provide the latest working papers on the matter.

The focus of the survey lies on more recent studies and on European based research. While this is an area that clearly needs much additional research, we have included all papers that we have come across that connect education, skills, and training with measures of company performance. In addition to labour economics literature, we also include findings in areas such as HRM, high performance work systems (HPWS), innovation studies, accounting and finance based studies, SME based research, as well as other reviews and meta-analyses. The focus in the review has been on quantitative research from the economic perspective of training. For instance, we have not surveyed literature on psychological aspects of training nor with a more ad hoc approach to training issues. A prerequisite of inclusion is that the paper uses a statistical approach and is concerned with economic aspects of human capital and human capital investments. We have also made an effort to find research published in other languages, though most research papers included in this review are in English.

The review of the literature is divided into different sections. Labour economics forms a main segment since human capital and human capital investment has been a major research question for a considerable time. The contribution of HRM literature in regard to education and training is also given a section of its own. In this section, the literature on HPWS plays an important role because of the ability to connect HRM practices with company performance measures. We also decided to give national, cross-national, and SME based research their own sections. Since the focus is on empirical findings, theoretical considerations are (briefly) dealt with in connection with empirical findings or in relation to their respective research area.

A brief description of previous work in each research area is provided, followed by in-depth coverage of more recent papers with an analysis of methods used, data, and results. The tables that summarise each section include only the more recent papers and those that we regard as contributing substantially to the existing literature.

A short description of statistical problems typical of this type of impact research follows to provide an understanding of the problems dealt with in the review.

2.1. Inference and causality problems

Heterogeneity problem poses statistical difficulties in estimating the impact of training on any outcome variable. Differences between those who receive and those who do not receive training make it difficult to maintain that training alone causes the entire effect on a dependent variable. In labour economics, heterogeneity among workers is typically controlled for by including proxies for differences in human capital accumulation and other variables (age, tenure, education, occupation, etc.).

In addition to factors that we normally can control for in empirical work, we have a number of factors for which it is hard to attain estimates (unobservable factors). The main concern in statistical analysis is unobservable factors that are correlated with the regressors of the estimated equation. There are several remedies for this problem. One is to find some broad approximation for the unobservable factor, as in firm-level data which typically includes industry dummies to control for differences in productivity, profitability, market valuation, etc., between firms in different industries.

If the effect on the uncontrolled (unobserved) variable is considered fixed over time, it is normal to use changes in the variable, instead of the original, level data. This procedure needs data over time (panel data). An example of a fixed-effect problem that can be solved by using changes in the variables (first difference) is that of unobserved ability among individuals. For instance, if more capable individuals are more likely to receive training, the return on past training will be upward biased, measuring, in part, ability instead of human capital investments. As long as the effects of the unobserved variable (in this case ability) are stable over time (time invariant) taking the first-difference (the change in the variables) will mitigate the problem.

Another problem is that not all explanatory variables in an equation can be considered to have a one-way relationship with the dependent variable. Explanatory factors that also are determined by the dependent variable (the variable we try to explain) are called endogenous and pose a problem in estimating the returns on training. The following example, given in Dearden et al. (2000), details the problem with mutually dependent variables (endogenous variables) when trying to assess the impact of training on aggregated industry productivity.

'Transitory shocks could raise productivity and induce changes in training activity (and of course other inputs, labour and capital). For example, faced with a downturn in demand in its industry, a firm may reallocate idle labour to training activities (the pit stop theory). This would then mean that we underestimate the productivity effects of training because human capital accumulation will be high when demand and production is low. If firms train when production and demand is high then the opposite applies.' (p. 25).

The remedy here is usually to estimate the equation in a system that considers the two-way relationship between the dependent and explanatory variables. Typically this procedure includes a search for instrumental variable(s) that are correlated with the explanatory variable but not with the dependent variable. Another way to mitigate the problem is to include lagged variables of the endogenous variable, as the lagged variable can partly alleviate the problem of simultaneity.

Few studies have been able to explore the effect of mutual dependence between training and productivity or profitability. While this is a potential problem in most impact research, the results of Dearden et al. (2000) are particularly interesting, assessing the impact of training on productivity from different estimation procedures. In their study, the impact from increasing the proportion of workers trained by 5 % would result in a 31 % increase in productivity using only the raw correlation between training and productivity. 'We account for an overwhelming proportion of this correlation, however, by our control variables. The 31 % effect in model A (no controls) falls to 8.5 % in model B (some controls) and 2.6 % in model C (include controls for occupation). Dealing with endogeneity through general method of moments (GMM) (model D) increases the effect to 4.1 %.' The results in Dearden et al. (2000) suggest that a well-specified regression model with adequate controls works quite well even in the presence of simultaneity problems. Given the data set used in their study, the main issue in a well specified regression model is not whether there is an overestimation of the impact of training but to what extent the model underestimates the impact (due to the assumption that training is determined exogenously).

It is important that studies address the question of heterogeneity by including adequate control variables in statistical models. Using changes in variables instead of level data normally gives a better base for conclusion. Lagging the effect of the impact of training further strengthens the basis for cause and effect relationships. The results of Dearden et al. (2000) suggest that the problem of endogeneity in training might be of a lesser concern, at least in a well-specified regression model. In our review of literature we have made an attempt to address these issues by examining the regression models used and by examining the variables included in the estimates.

3. Overview of research and findings

3.1. Labour economics

There has been continuing debate in labour economics literature on the subject of whether firms can profit from training investments. Before Becker's (1962) theory on company training, most economists saw education and training as the investment decisions of individuals. From a company perspective, investments in human capital (on-the-job training) differ from investments in other assets because the employee has an option to leave the firm, engage in wage bargaining and, in other ways, influence the outcome of the investment decision. Becker (1962) advanced a theory on investment in human capital, explaining levels of investment and predicting who should pay for, and who will benefit from, the completed training.

Becker divided on-the-job training into general and specific. General training is useful not only to the firm providing the training but to other firms as well. Because of this, employers are less inclined to invest in this type of training. In a competitive labour market, general training would lead to a wage increase for the employee and would offset the profit for the firm providing the training. In other words, general training increases the market value of the employee, suggesting that the employee should pay for this type of training, for example, by receiving wages below his or her productivity. Specific training, on the other hand, does not benefit other firms and, subsequently, the trainee's market value is not affected. Because specific training does not influence wages, the employee is not willing to pay for it. The firm pays for specific, on-the-job training and increased productivity is accrued by the firm providing the training. The employer may share some of the increased productivity with the employee to prevent the trainee from leaving the firm before the specific training investment is recouped ([2]).

The main idea of Becker's theory is that the party that is most likely to benefit from the investment also pays for it. The basic reasoning that employers are unable to benefit from general human capital such as schooling, apprenticeship programmes, and company training that are also useful to other firms, might be mitigated by the function of different labour markets or the degree of competition for the skills in the market ([3]).

Theoretically, specific training poses no problem for firms as these investments are not transferable to other firms. However, most of the training provided by companies is to be considered general in nature. About 60-70 % of all company training is classified as general training (e.g. Barron et al., 1999; Loewenstein and Spletzer, 1999). The study by Loewenstein and Spletzer (1999) also indicates that the generality of training increases with more complex jobs, which suggests that most of the training completed in human capital-intensive firms is useful to other companies. While research indicates that most company training has a value to other employers, the question is who is actually paying for this type of training?

Because most training has a value to other employers, theory predicts that the individual should pay directly (by bearing the full costs) or indirectly by accepting a wage below his or her productivity. So even if firms pay for all explicit costs such as trainers, course fees, allowances, the individual still has the potential to pay through wages below productivity. Testing the theory directly requires not only data about wages but also, more importantly, information about productivity.

([2]) If one introduces turnover into the equation, this will result in joint investments in firm specific human capital. This is because the higher wage for employees receiving specific training leads to an excess supply of workers willing to be trained. To bring supply more in line with demand some of the costs for specific training are shifted onto the workers.

([3]) The division into general and specific training may be too rigid. Company training might better be viewed as training with differing degrees of generality (marketability), from benefiting only the current employer, to benefiting competitors, industries and companies in general. Company training that has varying potential to suit other employers is of interest when considering the ability of employers to benefit from general (marketable) training investments.

The absence of measurement of individual productivity guides labour economics studies to using data on wages to examine the question of payment for company training. Asking who pays for company training also implies an answer to the question of who will benefit from the training, i.e., if firms pay for general company training it also suggests that firms are able to capture the returns from such investment. By this reasoning, a first step in establishing whether training has any impact on performance is to establish whether firms fund such investments.

Empirical studies that focus on wage profiles appear to confirm the general human capital prediction (Neumark and Taubman, 1995; Reilly, 1995), as well as the specific human capital prediction (Topel, 1991). In addition to the division into general and specific human capital, Neal (1995) suggests that an industry-specific factor constitutes an important component of the human capital stock. Neal (1995) investigated displaced workers and found that wages partly reflect compensation for industry-specific skills.

Observations made on wage profiles seem to support predictions of human capital theory. The problem with inferences from wage profiles is that a number of other theories and explanations also predict an upward sloping wage curve. For instance, wage growth is produced in job-matching models because of imperfect information about the employee's productivity (Jovanovic, 1979). Self-selection models use back-loaded compensation to discourage 'movers' from applying for jobs (Salop J. and Salop S., 1976). Implicit contracting models explain the firm's future wage commitment (rigidity) as a consequence of an income insurance agreement between the employer and the employee (e.g. Azariadis and Stiglitz, 1983; Marcus, 1984). The forced savings explanation justifies an upward sloping wage curve by workers' preferences (Loewenstein and Sicherman, 1991).

Apart from the problem of alternative theories of wage growth, empirical studies that used a more direct test by utilising training data have failed to support the predictions of human capital theory. Indications that firms invest in general training are sometimes indirectly revealed in studies on the impact of training on wages. For instance Lengermann (1996) found that recipients of what appears to be general company training benefited from increased earnings during the training period. Veum (1995), after studying more recent data from the national longitudinal survey of youth (NLSY), came to the conclusion that firms pay for general training. Loewenstein and Spletzer (1998) conclude that employers pay for general training and contend that firms are able to obtain some return from general training investments ([4]). More recent studies (Lowenstein and Spletzer, 1999; Barron et al., 1999) argue convincingly that firms pay for general training and that firms are also able to benefit from these investments. Other studies that also suggest that employers pay for general training include Acemoglu and Pischke (1998; 1999a) on apprenticeship programmes and Autor (2001) on temporary help firms. Literature connecting training with wage effects indicates that firms pays for general training. This is an important finding because it suggests that firms benefit from all types of training investments (specific as well as general training).

Whether this is the case is the main question of this review of literature. A prerequisite for a direct test of Becker's theory is performance data such as productivity or profitability, though data connecting training with productivity or profitability is hard to come by. The absence of company data is striking and few studies have had access to performance data until very recently. These studies will be examined in greater detail below.

3.1.1. Recent advances on the effect of training for firms

In a review of the literature on effects of company training for employers, Bartel (2000) concludes that econometric analysis of a large sample of firms provides little guidance on the question of the employer's rate of return on training. The reason given by the author is that few data sets include the cost of training, that few studies have been able to control for heterogeneity among firms or addressed the question regarding the endogeneity of training.

([4]) In the shared investment model of Loewenstein and Spletzer (1998), the employer shares general training investments with the employee as a consequence of the employer's inability to commit credibly to future wages. The employer, instead, commits to a minimum guaranteed wage and shares the investment in general training and realises the returns if the minimum wage guarantee is binding. The wage floor is only binding for less productive workers. If the wage guarantee is not enforced, the worker then realises all returns and incurs all the costs of the training.

One reason for this lack of research results is the difficulty in estimating the amount invested in training. The definition of what to include in estimates of the time spent on training is unclear (e.g. informal/formal training). Similarly, the costs to be included in calculating training investments (e.g. direct/indirect costs) are not standardised. The lack of a coherent definition of training and of a standardised way of measuring training investments hampers efforts to address the question of the actual benefit of training. In many cases training is measured as the proportion of employees being trained in a year instead of the actual amount invested.

The review by Bartel (2000) is concerned with the return on investment (ROI) in training. The present overview of training literature is focused on whether there is an impact on performance and is less concerned with estimating the rate of return on these investments. However, the issue of the return on training investments is still very much an open question as few of the studies cited include the cost of training.

European research has made some important advances by incorporating measures of productivity in the statistical models. The major studies are summarised in Table 1. The results of an Irish study by Barrett and O'Connell (1999) suggest that the amount of general training has a significant positive impact on productivity, in contrast with specific company training. These results come from a first-difference approach that cancels out time-invariant effects. Barrett and O'Connell argue that a plausible explanation why only general training is significant is that general training provides a greater incentive for employees to spend more effort in the learning process.

It is worth noting that these results are realised in a model with controls for changes in corporate innovations and the introduction of new personnel policies. These two control variables show no significant relationship to changes in productivity. Because few HRM studies have used the change in HRM policies, this study also contributes to discussion of whether personnel practices or human capital investments are the main factor in generating the effects on company performance. Other interesting findings in the study by Barrett et al. (1998) include:

(a) that training and the change in productivity is significant whereas training and the level of productivity is not;
(b) that the correlation between training and tangible investments is relatively low (*Rs* 0.13) which suggests that tangible investments can only explain a small part of the impact of training in a first-difference model;
(c) an interaction term between tangible investments and general training renders the tangible investment coefficient insignificant while the general training variable remains significant.

The combined result of the study by Barrett and O'Connell suggests that training has a major influence on productivity and that other plausible and normally uncontrolled factors have little or no influence on productivity effects ascribed to training.

A study by Dearden et al. (2000) suggests that company-sponsored training generates substantial gains for employers in terms of increased productivity. Different methods are used to control for unobserved heterogeneity and potential endogeneity of training, including GMM system estimation. Their estimates consistently show that the impact of training on productivity is about twice as large as the impact on wages. Their results also suggest that formal training has a larger impact on productivity than informal training. These results are obtained by examining the direct impact of training on industrial production. They also argue that treating training as exogenous leads to an underestimation of the returns on training for employers. This is an important observation since few studies have controlled for the possibility of two-way relationships between training and company outcome variables such as productivity and profitability.

The results from Groot (1999) suggest that there is a rather weak connection between who contributes to training investment and who benefits from it. The study by Groot is based on telephone interviews with 479 Dutch firms. In about 43 % of all cases the workers either contributed through use of their leisure time and did not receive benefits or did not contribute to the training but reaped some of the benefits. Only 5 % of the workers contributed financially but more than 75 % of the workers contributed with leisure time. Groot concludes that the benefit of enterprise-related training is high, both in terms of productivity and wage effects. Average productivity growth following training was found to be 16 % while average wage growth was 3.3 %. The difference in productivity between trained and non-trained

workers was 8 %. These effects are based on estimates (0-100 % scale) of productivity growth by company personnel. The average length of training was found to be close to six months.

In a study of programming consultants in Sweden, Hansson (2001) found strong evidence that the employer paid for all programming training even though the resultant skills were highly attractive to other firms. This study is unique in the sense that it had access to employee measures such as profitability, amount of training, wages, and each employee's acquired human capital stock (approximated by the individual's competence profile). The results indicate that the employer not only paid for all direct costs associated with the training (course fees, travel expenses, etc.) but also lost a considerable amount of profit during the training. Hansson found no evidence that the individual contributed to the training investment by receiving a wage below his or her productivity. The findings also suggest that the employer recovered the investment in programming training in the long run, as individual programming skills (competence) were significantly associated with profitability. These results were realised in an environment with similar working conditions such as type of job, customer base, etc., and with a number of control variables (including a control for differences in ability among employees). Hansson argues that the investment in general human capital largely looks like any other investment scheme that firms normally undertake in their business operations (with an initial investment and a payoff in the future).

The work of Gunnarsson et al. (2001) suggests that the increased educational level of the Swedish workforce between 1986 and 1995 is an important factor in explaining IT-related productivity growth during these years. Gunnarsson et al. examined the IT productivity paradox by including measures of interaction between IT and educational level in 14 industries (manufacturing sector). The IT productivity paradox relates to the fact that massive investments in IT in the 1980s did not have any positive effects on productivity until the beginning of the 1990s. The interaction between IT and educational level is significant and contributes significantly in explaining productivity growth during this period. As the inclusion of the human capital measures increases the explanatory power substantially, the authors conclude that human capital is a key in explaining the IT productivity paradox. Other interesting findings in Gunnarsson et al. are that a marginal skill upgrading has the same effect across different levels of education and that IT-related productivity growth occurs in several industries outside the IT sector.

Other European based studies include those of Kazamaki Ottersten et al. (1996) who studied the impact of training in the Swedish machine tool industry, using an evaluation drawn upon cost functions and productivity estimations. Their analysis is based on a formal model that was applied to the panel data of eight Swedish machine tool firms between 1975 and 1993. Their results imply that training expenditures result in net decrease in total costs. The estimates of productivity effects are also positive, but smaller in magnitude (also Kazamaki Ottersten et al., 1999).

US studies that have had access to performance data on either employees or firms are mainly from the mid 1990s ([5]). Some results are given next.

Krueger and Rouse (1998) investigated workplace education programmes in two American companies in the service and manufacturing sectors respectively. The programmes included learning of generic skills such as reading, writing, and mathematics as well as more occupational skills such as blueprint maths and blueprint reading. The results indicated that participating in generic training classes had no significant impact on employee wage growth. Occupational training classes, on the other hand, yielded a positive impact. Training influence on the available performance measures was generally weak. In the service company, classes had no significant impact on whether employees received performance awards or not. The effect on absenteeism during the training period was positive in both companies but not statistically robust. The authors also conducted a survey of the personnel at both companies. With two exceptions, the variables showed no difference between employees participating in the programme and the non-participants. Participants were more likely to report that they would take additional training

([5]) Since we have not been able to find more recent papers we are uncertain whether this is caused by a lack of research or whether we have missed out on important publications or working papers.

classes in the future and they were also more likely to report that their supervisor would say that they were doing better than a year ago. The latter result might be interpreted as an improvement of self-reported job performance.

Another study focused on basic skills training is the investigation by Bassi and Ludwig (2000) of different school-to-work (STW) programmes in the US. The purpose of the study is to analyse whether those programmes providing general training also can be cost-effective for firms sponsoring them. Data comes from case studies of seven STW programmes representing a diverse set of industries and regions. Data was collected through interviews. The authors found that most of the STW firms studied were willing to pay for general training, though it is less clear whether firms would be able to recoup the full costs of this training, given labour market institutions and public policies in the US. Contrary to the predictions of the classic Becker model, the authors found that in all but one case the firm paid for some or all of the costs of general training. The results show a substantial variation in cost/benefit ratios across the STW programmes. The discounted cost/benefit ratios varied between 0.69 and 1.81. One explanation for this variation is that firms with relatively high ratios may be the ones that provide little training. Other explanations for the large variation in ratios are the ability of students to pay for training and the ability of firms to extract profits from trained workers. The findings also suggest that American labour markets are imperfect enough to motivate firms to participate in STW programmes.

The findings of Black and Lynch (1996) indicate a somewhat mixed result with regard to human capital and productivity. This study used level data in estimating the impact of human capital investments on (log) sales and a regression model with a number of control variables included in the regression. The results indicate that human capital in the form of education had a substantial impact on productivity. Formal training conducted outside the company had a significant impact on productivity for manufacturing firms whereas computer training had a significant impact for non-manufacturing firms. The proportion trained did not yield any significant relationship. Their results also indicated that training appears to have a lagged impact on productivity. Black and Lynch (1997) reworked their regression model with access to longitudinal data on productivity. The results in this estimation procedure indicated no significant relationship between training and productivity. The authors attributed this insignificant impact to increased measurement errors.

The results of Bartel (1995) indicate that receiving training increased the probability of a positive change in performance the following year. Bartel investigated 1 487 professional employees in a manufacturing firm. Different types of training and the amount of training (days) showed no significant impact. The author attributed the rather weak impact on employee performance to the sample and scale used in this specific case. The sample consisted only of employees who remained in the same job (e.g. employees who got promoted were excluded from the sample). The performance rating was executed on a single item (7-point scale). Because of these two constraints the author argues that training effects probably underestimate the real impact that training has on employee performance.

Another study by Bartel (1994) suggests that implementing training programmes generates considerable productivity effects measured as the change in log sales. This finding is robust for different personnel categories (professionals, clerical staff, etc.) and changes in personnel policies (the results are not caused by a Hawthorne effect). In addition, the results are robust to mean reversion of productivity between firms and show that low productivity firms were more likely to implement training programmes. That low productivity firms implement training programmes to a larger extent than other firms can produce downward biased or insignificant effects of training programmes in cross-sectional regressions. The effect of using cross-sectional data appears to underestimate the impact of training on productivity growth. It is important to note that the training effect on productivity is achieved in excess of changes in personnel policies, indicating once again that training is a major factor to consider in HPWS literature.

The main findings in labour economics with regard to the impact of human capital on company performance can be summarised as follows. Previous research on training and wage effects has established that firms pay for all type

Table 1: **Labour economics**

Study	Database/ survey	Data	Sample and size	Aim/ subject	Method
Dearden et al. (2000) UK	British labour force survey (LFS), COP consensus of production	Incidence of training, informal and formal training, longitudinal –industry level data	94 industries, maximum 12 years, 818-970 industry years	Impact of training on productivity and wages	First difference, fixed effect, GMM system equation
Barrett and O'Connell (1999) IRL	EU survey and a follow up survey of Irish business	In company training (continuous vocational training), general and specific training, panel data	215 firms, two points in time	Impact of training on productivity, impact of general and specific training	First difference regression
Groot (1999) NL	Telephone and questionnaire survey	Duration of formal training	479 firms with 10 or more employees	Impact of training on wages and productivity growth	Frequency/ ordinary least square (OLS) difference approach
Hansson (2001) S	Company database	Type of training, training days, competence, education	132 programming consultants	Impact of training and competence (skills) on profitability and wages	OLS
Gunnarsson et al. (2001) S	Labour force survey, employment register, investment survey, etc.	Proportion with different educational levels	14 industries over 10 years	Impact of human capital and IT on productivity growth	Industry weighted least square regression, interaction education and IT
Black and Lynch (1996) US	EQW national employers' survey	Company training. Number trained, type of training, level data	1346 manufacturing and non-manufacturing establishments	Impact of training on productivity, impact of types of training	OLS
Bartel (1994) US	Columbia Business School survey and compustat	Implementation of formal training programmes (manag., profes., clerical, produc. workers) paneldata	180 firms in manufacturing sector over three years	Impact of training programmes on productivity	Level and first difference regression
Krueger and Rouse (1998) US	Company personnel record (manufacturing and service	Type of training, basic skills education, occupational courses,	800 (of which 480 workers attending training)	Impact of training on wages and employee performance	OLS, Probit, random and fixed effect models
Bartel (1995) US	Company personnel records (manufacturing firm)	Incidence of formal training and days in formal training, type of training	1 478 professional employees	Impact of training on productivity and wages	First difference. Two–step multinomal logit model

Control variables	Outcome measures	Strength/ weakness	Findings
Tenure, age, education, occupation industry, R&D, capital intensity, firm size, etc.	Productivity measured as change in log real value added per employee	Extensive robustness tests and econometric modelling/data on incidence of training (not days in training)	Training has a positive impact on productivity and wages, with a twice as large effect on productivity. Formal training has larger impact on productivity than informal training.
Change in personnel policy, corporate restructuring/ organisation, assets, employees, etc.	Log sales growth	Days in training, panel data, important control variables	General training has a positive impact on productivity, specific training has no impact.
Tenure, age, time since training, education, mobility, etc.	Estimates (100 % scale) of productivity growth before and after, trained and not-trained	Direct estimates of differences in productivity/ estimates of productivity	Average productivity growth about 4-5 times larger than wage growth. Weak connection between who contributes to training investment and who benefits from the training
Tenure, age, gross contribution, ability, education, gender, etc.	Profitability, (revenues net of wage and overhead costs)	Direct measure of profitability and human capital stock/level data, single employer	The concurrent impact of training on profit is negative and impact on wages positive. The skill/competence of the individual is significantly related to profitability
Business cycle, non-computer equipment, IT growth, gender, etc.	Total factor productivity	Lagged IT and human capital effects	Interaction term IT and educational level is highly significant indicating that the increase in productivity growth is largely tied to increase in higher educational level
R&D, capital, TQM, multiple establishment,	Log sales growth	A number of control variables, type of training/level data	Education positively related to productivity, formal training off working hours and other training variables computer training significant with productivity, not (number trained)
Capital assets, no. employees, unions, raw material, age of firm, industry, change in personnel policy	Log sales growth	Controls for personnel policy, relation between training programme and productivity/weak training measure	Implementing training programmes positively related tochange in productivity, not due to mean reversion orchange in personnel policy. Low productivity firms more likely to implement training programmes
Education, tenure age, gender, company) type of department, type of work, etc.	Performance awards absenteeism, self-reported performance	Homogenous workers, compare results at two companies/ weak performance data	The work place education programme had generally a weak effect on the employee performancemeasures, except for perceived performance. The effect of the training was positive but not significant in many cases.
Occupational dummies, education, tenure, etc.	Change in performance rating	Controls for determinants of training/weak outcome variable (rating by managers)	Individuals receiving training significantly associated with probability of increased performance score. Days in training and type of training not significantly associated increased performance.

of training no matter whether it is general or specific. More recent findings also indicate that firms benefit from such training investments. There are even signs that general (formal) training produces greater benefits than specific training. There are also some indications that the education and skills of the individual are associated with productivity and, in some cases, with profitability.

3.2. HRM and HPWS literature

The impact of human resource management (HRM) practices on company performance has attracted considerable attention. Many special issues of management literature are devoted to HRM practice and company performance, for instance the *Academy of Management Journal* (Vol. 39, No 4, 1996), *International Journal of Human Resources* (Vol. 8, No 3, 1997), *Human Resource Management* (Vol. 36, No 3, 1997), *Human Resource Management Journal* (Vol. 9, Issue 4, 1999). The argument put forward in this line of research is that advanced HRM practices produce a higher level of productivity. The findings suggest that there is a connection between HRM practices or what is often referred to as high performance work systems (HPWS), and company performance indicators such as sales, market values, market-to-book values, profitability, productivity, etc. ([6]).

Generally, this research area has good access to company based performance measures. The disadvantage is often that the statistical methods are based on level data, which makes it difficult to establish causality. That most of the research is based on level data is largely a consequence of the fact that firms seldom make any large changes to their HRM policies. Measuring changes in HRM practices, therefore, requires extensive measurement periods (longitudinal data). Much of the inference about the impact on firm performance is thus confined to cross-sectional data. However, many papers use a research design that accounts for the heterogeneity among firms, which makes the statistical models more robust.

In HPWS literature, education and training is part of a larger package of the activities of a human resource function. The areas that are typically covered in these studies are screening and employee selection, compensation systems, employee communication, teamwork practices, etc. In many cases studies also examine how aligned or integrated these practices are with the objectives or strategy of the company. Much of the current debate centres on whether bundles of human resource practices are the source of value creation in firms or whether certain practices contribute more than others. There is also the question of whether there is a HRM practice that is generally applicable to most enterprises or whether HRM practices are firm-specific or country-specific.

For instance, a Dutch study by Boselie et al. (2001) argues that the institutional setting in Europe affects the potential to create high performance work practices because of the presence of strong labour regulations and the interaction of social partners. They maintain that to apply research on high performance work practices we need to adjust the theoretical framework to suit the European situation. Boselie et al. (2001) also provide an overview of the findings that HRM research has produced in the last decade. The results with regard to the effects of training on company performance are reproduced below. Some of these papers will be examined in greater detail in this section:

(a) training has a positive impact on the different dimensions of the performance of the firm: product quality, product development, market share and growth in sales (Kalleberg and Moody, 1994);
(b) higher investment in training results in higher profits (Kalleberg and Moody, 1994; d'Arcimoles, 1997);
(c) higher investment in training results in a lower degree of staff turnover (Arthur, 1994);
(d) training has a positive impact on the relationship between management and the other employees (Kalleberg and Moody, 1994);
(e) training has a positive impact upon perceived organisational performance (Delaney and Huselid, 1996);
(f) management development is positively related to profit (Leget, 1997);

([6]) These human resource management practices are sometimes referred to as human capital enhancing systems, or high commitment policies (systems).

(g) focus on training is positively related to perceived profit, market share and investment in the near future (Verburg, 1998);
(h) training practices affect perceived organisational performance positively (Harel and Tzafrir, 1999).

(Boselie et al., 2001, p. 1112)

Besides the issue of whether there is a generic HRM practice, there is continuing debate about whether employee development is the key factor in the HRM bundles (e.g. Barnard and Rodgers, 2000). The results presented in the previous section of this review suggest that training is a main factor in generating productivity effects, as training yields a significant impact while controlling for changes in personnel practices (Bartel, 1994; Barrett, 2001). Other studies maintain that the impact on company performance is caused by the combined effect of HRM practices (Becker and Huselid, 1997; Huselid, 1995; Becker and Gerhart, 1996). This controversy is also reflected in the selected studies of our review of this research area.

HPWS might appear to be connected mainly with the knowledge intensive sector, but human resource policies to enhance efficiency and worker commitment can work equally well in more mature sectors of the economy. Ichniowski et al. (1995) investigated HRM policies in the US steel industry. Their findings indicate that innovative human resource practices have a significant effect on productivity. Ichniowski et al. (1995) was one of the few studies to examine the productivity effect of firms changing their human resource practices. Interestingly, the impact of the first-difference (change) approach supported the results of original estimates on level data. The benefits, in the form of increased revenues, far out-weighted the costs associated with these human resource programmes. Ichniowski et al. (1995) also argue that complementarity between different human resource practices has a significant effect on worker performance, while changes in individual employment practices have little or no effect (training by itself is not enough).

D'Arcimoles (1997) utilises the disclosure of information in French company personnel reports. These reports are sanctioned by law and include unmatched firm-based information on the main aspects of HRM such as compensation, training, recruitment, dismissal, and general working conditions. Apart from having access to data on variables that researchers normally have a great difficulty in obtaining through surveys, this study also has access to data over time (panel data). The panel with training and HRM measures includes six two-year periods. The main results with regard to training are that the level of training investment is consistently associated with both the level of, and changes in, current and future productivity and profitability. Profitability is approximated by the return on capital employed and productivity by value added per employee. The impact from the change in training on the change in productivity seems to appear with a considerable lag. The results presented by d'Arcimoles suggest that the effect of training investments might take as long as two to three years before they emerge in form of increasing productivity. The results between the change in training and change in profitability are less precise. Still, these findings indicate that there exists a causal link between training and firm performance in the sense that firms invest in the current period and harvest the benefits in future periods. One might add that these results are achieved while controlling for absenteeism, hiring/dismissal, work accidents, and total rate of resignation (all control variables are considered proxies for working and social climate at the firm).

Laursen and Foss (2000) studied the relationship between HRM practices and innovation performance based on the data of the DISKO project, a large survey on innovation behaviour in 1 900 Danish firms, cofunded by the OECD. The sample includes nine sectors in manufacturing and service industries. Laursen and Foss also propose some theoretical explanation as to why HRM practices influence innovation performance, e.g. new HRM practices often increase decentralisation, in the sense that problem-solving rights are delegated to the shop floor, which might facilitate the discovery and utilisation of local knowledge and thus enhance innovation. Due to the complementarities between HRM practices, they also state that systems of HRM will be significantly more conducive to innovation than individual practices.

Laursen and Foss used principal component analysis based on nine HRM factors and identified two different HRM systems that are conducive to innovation. In the first system all

Table 2: **HRM (HPWS) studies**

Study	Database/ survey	Data	Sample and size	Aim/ subject	Method
Ichniowski et al. (1995) US	Interviews and al. company specific data	Proportion employees received off-the-job training (dummy variable)	Longitudinal data on 36 steel production lines, 2 190 monthly observations	Impact of HRM practices on productivity	Level and first difference (fixed effect) regression
d'Arcimoles (1997) FR	French company personnel report	Formal training expenses, level and change data (panel data)	61 firms level data, 42 firms panel data (7 years)	Impact of HRM, wage growth, and training on firm performance	Level regression and first difference OLS regressions
Laursen and Foss (2000) DK	Data exaggerated from the DISKO project (Database)	Classification of two HRM practices	1 900 firms	HRM Practices and their impact on innovation performance	Probit model to explain the probability to be an innovator

nine HRM variables are relevant; in the second only performance-related pay and internal training are dominant. In the latter system only these two factors out of nine have individual impact, but when all factors are combined into a single variable this is highly significant. This finding supports their thesis of the complementarities of HRM practices. In addition, they also identified some sector-specific patterns, such as the fact that firms in wholesale trades tend to belong to the second system. They conclude that the application of HRM practices is important to the likelihood of a firm being an innovator.

Table 2 presents the studies by Ichniowski et al. (1995), d'Arcimoles (1997), and Laursen and Foss (2000). These studies have made an effort to disentangle training effects from other HRM practices and two of them have also been able to examine the impact on company performance of changes in HRM and training.

Other HRM studies also measuring the effect of training separately from HRM practices include Delaney and Huselid (1996) based on US data. The training measurement in their study shows a consistent and significant relationship with perceived organisational performance (irrespective of the statistical model). The results for perceived market performance are less clear but suggest a significant influence of at least 10 %. These training effects are demonstrated in the presence of other HRM aspects such as staffing, compensation, degree of internal labour market, etc. Delaney and Huselid used cross-sectional data on 590 firms to estimate organisational performance and 373 firms to estimate stock market performance. Because this study is based on cross-sectional data it is difficult to establish the relationship between organisational performance and training measurement.

Michie and Sheehan (1999) studied the data of the UK's workplace industrial relations survey (WIRS) with regard to the impact of HRM practices on innovation. They separated three different types of HRM practice using variables such as payment, worker involvement in teams, incentives, information sharing, etc. However, they did not explicitly integrate the degree of training. Innovation is measured by research and development (R&D) expenditure and the introduction of new micro-electronic technologies. The workplace industrial relations survey contains information on 2 061 firms with more than 25 employees in various sectors. Michie and Sheehan were able to use 274 data sets that contained information on HRM as well as innovation. Based on an econometric model, which explained the probability of innovating, they were able to identify some significant HRM factors. Their results suggest that low road HRM practices – short

Control variables	Outcome measures	Strength/ weakness	Findings
HRM controls, controls for production line (maintenance, age, raw material, etc.)	Productivity measured by uptime of production line	A number of robustness tests, same production process, panel data/weak training data	Adopting a coherent system of HRM practices produces significant productivity effects. Adopting individual work practice in isolation has no effect on productivity (training).
Wages, social climate (absenteeism, work accident, social expenditures), employment variables, etc.	Productivity (change in value added), profitability (return on capital employed)	Impact of change in training measured with lag, HRM controls/ weak firm and industry controls	Level of training is consistently correlated with level and change in productivity and profitability, change in training is associated with change in performance with a two to three year lag (less stable result)
Sector, firm size, cooperation	Innovative performance	Only innovation performance is the dependent variable	The application of HRM practices does matter for the likelihood of a firm being an innovator

term contracts, etc. – are negatively correlated with investment in R&D and new technology, whereas high road practices are positively correlated with R&D investment and the introduction of new technology. This study also shows that skill-shortage is a serious obstacle for innovation and for movement towards differential and higher-priced products. Their findings also deliver evidence that the strategy to increase employment flexibility by short-term contracts, weakening trade unions, etc., does not enhance the innovation performance of firms.

MacDuffie (1995) tested the impact of human resource activities in automotive production. The sample consisted of 62 car assembly plants in the US, Asia, Europe and Australia. The study was influenced by the organisational contingency theory and the hypothesis that the internal fit between different organisational strategies and characteristics affects performance ([7]). MacDuffie separated two production systems, mass production and flexible production. Disruptions to the mass production process prevent the realisation of economies of scale with the use of buffers as an indicator for the prevalence of this system, whereas under flexible production buffers are seen as costly.

Within flexible production, the link between minimisation of buffers and the development of human capabilities is driven by the philosophy of continuous improvement. MacDuffie separated production organisation, work systems and HRM policies as three interrelated independent variables and creates corresponding indices to capture systemic differences in organisational logic between mass production and flexible production. He used different human resource variables such as job rotation, recruitment policy, training of new employees, etc., based on a cluster analysis, to classify human resource practices characterised through a consistent bundle. Performance has measured by labour productivity and quality, expressed as defects per 100 vehicles.

Regression analysis indicated that indices of mass production, flexible production, transition, and intermediate stage, were statistically significant predictors of productivity and quality. High-commitment human resource practices, such as contingent compensation and extensive training, in flexible production plants, were char-

([7]) The contingency theory stresses the importance of the link between human resource practices and other factors such as organisational strategy. In contrast, the universal approach maintains that human resource management practices have a positive effect on performance in general (independent of other factors).

acterised with low inventories and repair buffers, and consistently outperformed mass production plants. MacDuffie found empirical evidence that bundles of interrelated and internally consistent human resource practices, rather than individual practices, are better predictors of performance. Overall, evidence supports the thesis that assembly plants using flexible production systems, which bundle human resource practices into a system that is integrated with production strategy, outperformed plants using more traditional mass production in both productivity and quality. While other academics believe that either mass or flexible production will perform well if there is a good fit between their human resource and production strategies, MacDuffie found that flexible production leads to better performance for automotive plants.

A similar matter was raised by Arthur (1994) in studying the impact of human resource systems across steel mini-mills in the US. His main hypothesis was that specific combinations of human resource policies and practices are useful in predicting differences in performance and turnover. In the tenor of the contingency theory, he stated that congruent human resource and organisational policies are more significant than separate human resource practices. He separated two human resource systems, control and commitment, which stress the importance of cost reduction and commitment maximisation respectively, and shape employee behaviour and attitudes at work. Despite the contingency view of human resource systems, he stated that, in general, commitment human resource systems will be associated with higher performance, especially because of the high control and monitor cost in the control system. In addition, he was interested in the question of the impact on turnover.

Arthur expects higher turnover in firms with control systems because of the lower cost for wages and training. Empirical data were based on a questionnaire from human resource managers of 30 US steel mini-mills. Based on a cluster analysis, he separated the two human resource systems, using labour efficiency, scrap rate (number of tons of raw steel to melt one ton of finished product) and turnover as performance measures. Regression analysis indicated that the presence of commitment human resource systems was significantly related to fewer labour hours per ton and lower scrape rate, whereas turnover was higher in control systems. Arthur also found, that human resource systems moderate the relationship between turnover and performance, since there is a negative relationship between turnover and performance in commitment systems. However, the results have to be treated with caution due to the small sample size.

Baldwin and Johnson (1996) studied business strategies in Canadian small and medium-sized firms, with less than 500 employees, demonstrating varying degrees of innovation. Besides marketing, finance, and production strategies they also investigated whether innovative firms also followed specific human resource strategies. The sample size was 850, including all major industrial sectors. Innovation classification was based on the traditional question of R&D intensity and additional variables regarding innovation behaviour (patenting, source of innovation, etc.).

Baldwin and Johnson were able to verify their thesis that greater innovation accompanies greater emphasis on human resources, stressing training. They found statistical evidence that more innovative firms offered formal and informal training more often and with greater continuity, accompanied by innovative compensation packages. While almost three-quarters of the group of more innovative firms offered some form of training, just over half of the group of less innovative ones engaged in training. The authors also used quantitative data to estimate the amount of training and found that the more innovative ones spent CAD 922 on average per employee, significantly more than the CAD 789 spent by less innovative firms. Moreover, the former firms used production employees more often as a source of innovation.

In addition to linear correlation analysis, the authors used multivariate models to establish whether certain combinations of factors or all factors combined contributed to a given human resource strategy. A probit model and principal component analysis indicated that the firms that followed the most comprehensive human resource strategy (stressing all factors simultaneously) are most significant. Considering all factors studied (human resources, marketing, etc.) they found that all areas are important for innovation success and that more innovative firms take a balanced approach to their business by striving

for excellence in a number of different areas. However, Baldwin and Johnson did not carry out analysis of how far specific human resource strategies are related to other business strategies. Finally, they analysed the relationship between innovation behaviour and company performance, based on administrative data sources. Various performance criteria and indices (sales, profitability, market share, employment, and assets) suggested that more innovative firms performed better. Thus, the study delivers evidence for a relationship between sophisticated human resource strategies and company performance.

In conclusion, HRM literature stresses the importance of comprehensive HRM practices in generating effects on company performance (training by itself is not enough). However, few studies measure training separately and few studies have had the opportunity to examine changes in HRM practice and in performance. Nevertheless, there are indications that training is more efficient or generates larger effects in connection with other HRM practices.

3.3. National European surveys and cross-national comparisons

Many surveys and studies conducted by national institutions attempt to answer questions such as what generates innovation and what creates growth in their respective countries. Similarly, many cross-national comparisons are aimed at understanding the reasons for differences in growth and innovation between countries. Measurements of training and education are typically included in these types of study as part of the firm's innovative capacity. Besides human capital, studies typically include variables that are assumed to generate innovations and growth, such as investments in IT, R&D, technology, capital intensity, etc., and a number of control variables. The aim in many instances is to understand the innovative capacity of firms and not human capital per se, though this is an advantage as the results for education and training are generally more robust (as the inclusion of other variables controls for the influence of these factors).

A study by a Swedish business development agency (NUTEK, 2000) on different learning strategies shows that competence development activities are associated with both productivity and profitability. Training is measured in a broad sense by three establishment level activities (planning, learning at the job, and proportion of employees trained). In this study the effects of training activities are observed after holding other learning strategies constant (e.g. R&D, innovations, cooperation, etc.). Other findings indicate that the effect is more pronounced for larger firms and that higher educated personnel is associated with both productivity and profitability. This study uses level data, which render causality difficult to achieve. However, since both profitability (which is net of investment costs) and productivity are significantly influenced by training activities, it strengthens the interpretation that training increases productivity and that employers are able to capture some of the returns generated.

In a study of Finnish companies, Leiponen (1996a) finds a significant association between educational level and profitability. Other findings suggest that strong complementarities exist between different educational factors. It appears that a sufficient number of more highly educated employees is a prerequisite for the profitability of doctoral level researchers. The results also suggest that innovative firms are more dependent on educational competence in generating profit. The sample used in this study consists of panel data for 209 firms. The author deals with the endogeneity problem (caused by the effect of previous economic performance on the explanatory variables) by applying a two-stage regression procedure. An interesting finding is that without addressing the problem of endogeneity between profitability and other human capital variables, the results are largely insignificant. Leiponen concludes that general competences acquired in education, notably higher and post-graduate education, are beneficial for the profitability of the firm. In another study of Finnish companies, Leiponen (1996b) comes to the conclusion that innovative firms have a more educated workforce and that they are more profitable than non-innovating firms.

The German Institute for employment research (IAB) has, since 1990, conducted a large establishment survey with over 9 200 participating establishments. This is one of the most comprehensive establishment panel surveys in Europe (Bellmann, 2001).

Table 3: **National and cross national studies**

Study	Database/ survey	Data	Sample and size	Aim/ subject	Method
NUTEK (2000) S	Flex-2 survey (telephone and questionnaire survey)	Learning strategies, competence development activities (measured 0-3 scale), level data	911 establishments	The impact of learning strategies on firm's competitiveness	OLS level regressions
Leiponen (1996a) FIN	Survey data, compiled by Statistics of Finland (15 manufacturing industries)	Educational level, type of education (technical, natural science)	209 firms, time-series data (1985-93)	Impact of education on profitability and innovations	First difference GMM, two-stage weighted least square regression
Bellmann and Büchel (2000) D	IAB 1997 Survey	Amount invested in training	3 400 cross-sectional observations	Impact of training on productivity	OLS level regressions, two stage least square
Doucouliagos et al. (2000) AU	Case study	Cost and benefits of training programmes	7 cases	Application of a four-step evaluation process of training investments	Design of a cost-effective training evaluation model
Blandy et al. (2000) AU	Questionnaire similar to UK CEP survey by the LSE	Training quantity in hours	41	Effects of the on-the-job training on productivity and earnings	Regressions 'matched plant' methodology between hotel and kitchen furniture manufacturers
Maglen et al. (1999) AU	Case study based on interviews with managers and employees	Training expenditure	30 case studies in four sectors	Evaluation of the return on training depending on other factors	Comparative case studies

However, the research that has come out of the IAB survey so far is less focused on the effects of training investments for firms and more on the effects for individuals. An exception is the study by Bellmann and Büchel (2000) examining the effects of continuous vocational training on productivity. Their result is based on 3 400 cross-sectional observations from the 1997 IAB survey. The authors apply different models in estimating the impact of training, including an OLS and a two-stage regression model as well as including controls for industry, size, and employee characteristics. The initial regression results for both parts of reunited Germany indicate a significant relationship between how much is invested in training and productivity (log annual sales per employee). However, the authors argue that this finding is largely a consequence of a selection problem, such as the individuals receiving training having more ability and that certain firms are more capable providing adequate training for their employees. Bellmann and Büchel stress the importance of strategic HRM practices in generating productivity effects from training investment.

Some interesting studies have also been carried out in Australia. Blandy et al. (2000) found a positive relationship between a firm's profitability and the quantity and quality of training offered by the firm, the latter also being correlated with other forms of investment. A profitability index, based on

Control variables	Outcome measures	Strength/ weakness	Findings
Other learning strategies, R&D, IT, innovations, cooperation with partners, decentralisation, etc.	Productivity (value added), profitability (revenues to cost ratio)	Includes a large number of control variables and competing learning variables/level data, weak training data	Competence development activities have a significant effect on productivity and profitability. Larger effects for larger firms. Education is associated with profitability.
Sales, market share, capital intensity, industry dummies	Net profit margin, innovations such as patents, improvements, etc.	Use first difference, control variables, two-stage weighted least square to handle simultaneity problems and GMM	Educational competence is significantly associated withprofitability. Complementarities exist between different general skills acquired in higher education. Innovative firms are more dependent on educational level in generating profitability.
Industry, size, employee characteristics	Productivity measured by log annual sales	Large number of observations/ level data	Initial results indicate a strong association between training and productivity. However, the results are likely driven by ability. Authors stress HRM practices as main factor.
(case study)	Calculations of return on investment	Quantitative estimation of returns on training investments	Return on investment (%) calculated is between 70 and 7000
Industry	Productivity and profitability	The study uses quantitative data on training and performance/ small sample size	Profitability is directly related to i) quantity and quality of training, ii) firms paying above market wage rates, iii) firms' difficulties in finding suitable employees iv) no clear picture regarding the impact of training onthe productivity
Firm strategy and human resource policy	Labour productivity	Control variables are only used for a qualitative interpretation of the differences	In most cases training investments had led to positive returns, though dependent on human resource practices; the bundling of human resource policies is crucial; better performers also planned strategically

firms' statements on profitability compared with their main competitors, was found to be positively associated with indices of volume (expenditure on training relative to main competitors) and the quality of company training (existence of a formal training strategy, written commitments to training in workplace agreements, etc.). In addition, the more profitable firms pay above market wage rates and operate in labour markets where suitable labour is hard to find and keep. The authors conclude that the principal reason why training is profitable for firms is that it increases the productivity of their employees more than it raises their employees' wages.

In another Australian study, Maglen and Hopkins (1999) integrated variables such as work organisation, job design, employment practices and other company-specific variables to analyse returns on training. They compared enterprises that produced similar goods or services, and were similar in size. Their findings suggest that there is no key set of relationships that could be translated into a series of best practice procedures, but that the main factors in optimising business performance are links between strategic objectives and practice within the enterprise itself. This means that the effectiveness of training is contingent upon the idiosyncratic circumstances of the firm, a theory based on Becker et al. (1997) and known as 'idiosyncratic contingency'. A comparison between seven firms in four sectors

found that better performers, measured by labour productivity, included training as an integral part of strategic planning. In contrast, the poorest performers lacked these characteristics.

Doucouliagos and Sgro (2000) developed a training evaluation model, which they tested on seven Australian firms with longitudinal firm-level data, aiming to calculate the return on investment in training, both financially and non-financially. Collected data indicated that the return on investment in training programmes varied between 30 and 7.125 % for seven different training programmes. Performance and benefits were estimated by indicators such as the saving of energy after training of train drivers or increase in sales growth after the training of store managers.

Carr (1992) studied productivity differentials in the automotive sector between Britain, Germany, the US and Japan and the impact of skills differences. He based the investigation on 56 matched vehicle component manufacturers in the four countries in 1982. The study included interviews with chief executive officers and other personnel down to shop floor level. In 1990 Carr carried out 45 more interviews to gauge the effects of past differences and to capture the impact of increased labour flexibility in Britain. Despite differences in product and technical characteristics between the product areas studied, the data clearly showed productivity differentials between Britain, Germany, the US, and Japan. In nearly all areas Britain lagged behind, measured by sales per employee. The study provides some evidence that the highly educated and trained German workforce (craft apprenticeship, the high qualification of the foremen, and vocational training organised by firms) explains the productivity advantage of Germans firms. However, Carr was not able to carry out a statistical analysis regarding the relationship between specific training and its volume, measured by factors such as expenditure, and its impact on productivity. Compared with the 1980s, the data showed the UK to be catching up slowly, which he ascribes to an increase in labour flexibility in Britain, though unable to verify this statistically. Finally, he concludes that the UK has to place more emphasis on high standards of basic education and programmes aimed at continuous employee development.

Mason et al. (1992) carried out a study similar to Carr (1992), where they compared the productivity differences between Britain and the Netherlands and the impact of vocational education. Like other studies, their investigation deals with lower workforce qualifications in Britain. Mason et al. compared the skills and productivity in a matched sample of British and Dutch manufacturing plants. The study was conducted on 36 plants in two industries, engineering and food-processing. The authors also summarised the main specifics of the Dutch vocational education and training system, which relies principally on full-time vocational colleges. This system is nearer to the French schooling-based system than to the German apprenticeship system. They concluded that the higher average level of skills and knowledge in the Dutch workforce contributes to higher productivity through better maintenance of machinery, greater consistency of product-quality, greater workforce flexibility, and less learning-time on new jobs. These findings are not based on a statistical analysis regarding the two samples, but rather comparing the general profiles and characteristics of workforces in the two countries. Substantially higher proportions of vocationally qualified personnel were found at virtually all levels in Dutch plants in both industries.

Concluding, the indications are that the educational level appears to be a factor in profitability of firms. There are also some indications that differences in educational level (system) between European countries might explain productivity differentials among the countries. Most studies stress the importance of training as an integral part of strategy and other HRM practices.

3.4. Small and medium enterprise (SME) surveys

Even though some of the above mentioned studies include smaller firms in their sample and use firm size as a (control) factor, few studies exist which deal explicitly with the impact of training investment on SME performance.

Leitner (2001) carried out a study on Austrian SMEs (between 20 and 50 employees) with the aim of investigating the impact of different strategic investments on company performance. He also analysed training investments, measured with an ordinal variable, in the context of various internal strategic factors, endogenous factors and their impact on performance. He found that

the amount of training was one of the few internal factors that had a direct impact on company earnings, this correlation being highly relevant for smaller firms with less than 50 employees. In general, smaller firms invested less than bigger firms. However, no positive relationship between the different kinds of strategies pursued and the amount of training could be identified.

Furthermore, Leitner discovered a positive relationship between training and the corporate culture and communication within the company. Given the impact of external (endogenous) factors, he found that training was an essential aspect of profitability for firms in dynamic environments. He concluded that, in general, training investments allow firms in different competitive and rather hostile environments (mature product life cycles, conjuncture-dependent life cycles, dynamic environment) to perform better than other firms in similar environments. His findings partly support the idea that the impact of training on company performance depends on endogenous and firm specific factors.

Romijn and Albaladejo (2000) investigated the role of various internal and external sources of innovation capability in SMEs in the UK. Besides factors such as R&D investment and interaction with research institutions, they found that a range of internal factors, including the owners' technical education and their prior work experience, the technical skills of the workforce (measured by university-trained engineers as % of total workforce) and training (measured as training expenditure per employee and % of sales) have a significant effect on innovation capability. Furthermore, a close link to nearby training institutions also had a positive impact. Innovation capability was measured by the presence of innovations during the preceding three years and their technological complexity. However, the authors did not report any specific analysis regarding firm size and its impact.

There is considerable literature on the importance of human capital for the success of business start-ups (e.g. Trouvé, 2001). In these studies formal education, skills and experience and the talent of the founder are integrated to explain business success. However, the role that the training of the workforce or teams plays for a company's success is scarcely investigated. Bosma et al. (2002) studied the value of human capital for start-up companies in the Netherlands. The study separated general, industry-specific and entrepreneurship-specific human capital investments by the founder and measured performance according to survival, profit and employment generated. The main findings are that investments in industry-specific human capital, such as former experience, and entrepreneurship-specific human capital, such as experience in business ownership, contribute significantly to the performance of small firm founders. General investments, such as the level of higher education, play a minor role. A methodological problem of the study is that investments are only operationalised by the experience of the founder, without a direct analysis of training expenditure during the firm's life.

The Irish study by Barrett and O'Connell (1999) cited in Section 3.1.1, also analysed whether a firm's size had an impact on the relationship between general or specific training and performance but they did not find any significant differences based on the size of the firm. The study by Mason et al. (1992), carried out in British and Dutch SMEs with up to 400 employees, indicated that the Dutch productivity advantage was greatest in product areas where small- or medium-sized batches were in demand by the market. In engineering plants they found no variation in productivity with firm size, but in the food-processing industry (biscuits) they found some differences. While the largest British biscuit plants, which were highly automated, had the same productivity as the Dutch firms, smaller Dutch plants were almost twice as productive as corresponding British plants. Mason et al. ascribe this difference in productivity to the lack of technical competence of the workforce.

While few studies have examined the effects of human capital and human capital investment on the performance of smaller firms, there is nothing indicating that experience, skills and training should have any less impact on company performance. On the contrary, many of the studies emphasise the importance of these factors for smaller firms.

3.5. Other training and impact studies

The research done at the American society of training and development (ASTD) is an important source of information. ASTD perform annual benchmarking studies on employee development

Table 4: **SMEs and other training studies**

Study	Database/ survey	Data	Sample and size	Aim/ subject	Method
SME					
Leitner (2001) A	Empirical study based on a questionnaire	Importance of training	100 SMEs	Intangibles, strategy and firm performance	Correlation and Anova-Analysis
Bosma et al. (2002) NL	Panel survey among 1 100 new business founders between 1994-97	General, industry-specific and entrepreneurship-specific investment in human capital	1 100 firms	Does human capital investment enhance entrepreneurial performance?	Regressions
Romijn and Albaladejo (2000) UK	Survey of 50 SMEs (interviews)	Skills of workforce	50 information and computer technologies (ICT) and electronic firms	Internal and external sources of innovation capability in SMEs	Correlation analysis
Other studies					
Bassi et al. (2001) US	ASTD survey, Compustat	Training investment per employee	314 publicly listed firms	Impact of training investment on firm's (stock market) performance	OLS, first difference regressions
Büchel (2000) D	German Socio-economic panel (GSOEP)	Educational level	800-1 900 individuals	Impact of overeducation on productivity	Logit, survival model

and training. A clear advantage of the data collected by ASTD is the quality of the information on training. All companies subscribing to ASTD's benchmarking survey gather information on types of training, amount spent on training, etc. All measures of training are clearly defined and companies participating in this survey provide training information that is collected in a similar way. Studies based on ASTD data thus have far less variance caused by measurement errors in training than most other studies. The importance of committing firms to a common definition and standard of measuring training cannot be overstated. The lack of a common definition of what to regard as training will be discussed in more detail in the last chapter of the present study.

The possibility of connecting training data with company outcome measures is also an important advantage of the ASTD database and offers advantages to investigations of company training. The study by Bassi et al. (2002) shows that firms with higher training investments also have higher stock returns the following year, higher gross profit margins, higher return on assets, higher price to book ratio, as well as higher income per employee. The results are very similar when examining changes in performance measurements. An important aspect of being able to connect training investment with profitability and stock market performance is that we are measuring the impact net of the cost of the investment. The study by Bassi and van Buren

Control variables	Outcome measures	Strength/ weakness	Findings
Industry, size, strategy	Earnings, sales and employment growth	No quantitative measurement of training investments	Firms with regular training have higher returns
Various controls such as industry, gender, labour market histories	Survival, profit, employment	Human capital is measured only through experience	Human capital (experience of the founder) influences the entire set of performance measures
None with respect to training and performance	Innovation capability (index)	Captures various indicators to explain innovation performance, not possible to relate training directly to performance	Skill of workforce (share of university-trained) has a positive impact on innovation performance
Industry, R&D, assets, investment, price to book, beta price/earnings, previous performance, etc.	Stock market returns, income-, Tobins Q-, and sales per employee	Good quality training data, firm performance measures, and control variables	Training investments are associated with next year's stock market performance. Same result for level and change data. Changes in training investment can predict future stock returns
A number of employee characteristics, age, gender, health status, etc.	Job satisfaction, tenure, participation in on-the-job-training, health	Large number of observations/ self-reported variables	Overeducated employees are healthier, have longer tenure and are more work and career minded.

(1998) indicates a similar result, that training has positive effects on company performance.

That training investments are associated with stock market performance is more rigidly demonstrated in Bassi et al. (2001). In a well-specified regression model the authors demonstrate that the level of training expenditure (investment) per employee is associated with next years' stock market return. This training effect is demonstrated in the presence of variables capturing stock market risk and known stock market anomalies such as momentum and the book-to-market effect. While controlling for momentum effect by including a lagged dependent variable, the authors also account for (eliminate) the potential effect that training might have had on stock returns during the investment period. It is also important to note that a first difference approach (change in training investment and stock market return) gives substantially the same result. The results also indicate that the effects of training emerge with some lag and that training appears to have long-term effects on profitability.

An important aspect of training and the impact on stock returns is that this information is value relevant and that investors are currently unable to get hold of this type of information. In a perfect world, a well-informed investor would anticipate the increased earnings and returns from such human capital investments at the moment they were made. Because of the absence of information on human capital investments in corporate

reports it appears that investors are unable to gather this type of information. However, if investors had knowledge of these investments and anticipated the impact on the share price, we would be unable to document any effect on share performance the following year.

Another study that connects human capital with stock market performance is Hansson (1997) on Swedish stock market information. Because of the unavailability of training data, the author created three stock market portfolios reflecting dependence on human resources and investment in training. One portfolio mainly consisted of knowledge-intensive firms, a second reflected less dependence on human resources and consisted largely of capital-intensive firms. The third portfolio contained a mix of firms from both knowledge- and capital-intensive sectors. The basic idea of the study was that these portfolios would mimic unobserved training expenditure, with relatively higher human capital investment in knowledge-based firms compared with capital-intensive firms. The findings indicated that knowledge-based firms consistently earned higher risk-adjusted returns than the more capital-intensive firms. The author ascribed the higher returns in the portfolio with knowledge-based firms to greater investment in unaccounted (unobserved) human capital.

In a German study on overeducation and employee performance, Büchel (2000) comes to the conclusion that overeducated employees in low-skill jobs tend to be more productive than their correctly positioned colleagues. Büchel used questions from the German socio-economic panel (GSOEP) and found that overeducated personnel had better health, received more on-the-job training, had longer tenure, and were not more dissatisfied with their job than personnel with the right educational level. This study used self-reported questions on productivity. The results indicated that the risk of employing too highly educated personnel might be exaggerated since there are no indications that overeducated personnel are more negative towards their work. These findings also suggest that we may possibly be less concerned with the potential negative effects that education can have on company performance, i.e., education might have an upside but a less pronounced downside effect.

The effects of web-based training are studied by Schriver and Giles (1999) within a nuclear facility, Oak Ridge, Tennessee, US. The organisation has about 14 000 employees, with a training budget that reflects their high qualification requirements. The training for Oak Ridge is mainly organised by the centre for continuous education, which serves as corporate university. In 1995 the management decided that significant savings could be realised by using the Intranet to deliver selected courses and qualification tests. Schriver and Giles evaluated this new project, introduced in 1997. Calculating the investments in the new system such as technology, download costs, etc., and savings such as travel costs, fewer instructors, physical copies, classrooms, etc., they found that the cost-benefit ratio was 1:9.5. The return on investment was calculated at 845 %. However, despite this convincing data, the analysis should be taken with caution, since it did not assess the effectiveness of training and any intangible effects, such as networking opportunities. Neither did it calculate how much time the employees spent in front of the computer.

In summary, studies based on stock market data suggest that human capital and investment in it are important factors in understanding stock returns. Some of the studies based on the ASTD data provide convincing evidence that training generates substantial gains for firms. The study by Büchel (2000) also suggests that we might be less concerned with the potential negative impact of overeducation on firm performance.

It is important to point out that additional references to impact research can be found in Barrett (1998, 2001). While these overviews also largely cover the impact that training and skills have on firm performance, there are some overlaps with our study. We have, however, tried to distinguish our review not only by including other research papers but also by looking at some of the problems associated with this kind of research from a different perspective.

4. Cranet survey results

The Cranet network was established in 1989 by five founder countries (Germany, Spain, France, Sweden and United Kingdom). It is coordinated by the Centre for European Human Resource Management at Cranfield School of Management. The Cranet survey is now the largest and most representative independent survey of HRM policies and practices in the world. The network itself is a collaboration between 34 universities and business schools, which carries out a regular international comparative survey of organisational policies and practices in HRM across Europe.

Cranet has been running the survey since 1990 using standardised questionnaires sent to private and public organisations in different countries. The standardised questionnaire is translated into each member country's language and adapted to the different national contexts (taking into consideration such factors as legislation, labour markets and culture). During each round of the survey, amendments are made to capture new developments but the questionnaire stays mainly unchanged in order to observe developments over time.

The questionnaire is distributed by post, except in Greece where interviews are used to gather the information. The questionnaire is distributed to organisations with 200 or more employees and is addressed to the most senior human resource/personnel specialist in the organisation. The 1999 survey was distributed to over 50 000 organisations and 8 050 responses were received giving a total response rate of 15 %. The willingness of companies to respond was higher in Scandinavian countries than in Southern European countries. The current version of the 1999-survey database includes 8 487 observations from 27 countries, 17 of which are European countries. The number of observations in the forthcoming tests varies because not all companies have answered all questions. The survey is sent to both private and public organisations. The descriptive statistics in the present investigation include responses from both public and private organisations. For the analysis that includes performance variables, the sample is restricted to private organisations.

It is also important to note that the provider of the information in this survey is the firm and the figures presented here can deviate from other studies. As noted by Barron et al. (1997) employer-based surveys typically report more training than individual-based surveys. Because the survey is focused on larger organisations it is expected that the incidence and amount of training will be higher than in surveys conducted on a more distributed population.

4.1. Selected Cranet survey questions

A clear advantage of the Cranet survey is the access to two direct questions on company training. The first question concerns the amount spent on training in proportion to annual salaries. The second question is related to the proportion of employees that participated in training during the year. As with most training studies, we have very little knowledge of what the respondents regard as training. It can be anything from continuing vocational training, initial training, to in-company apprenticeship training. Other questions related to employee development include whether the organisation has a written policy for training and development, whether it analyses employees' training needs, and whether it monitors training effectiveness.

Questions related to company performance are weaker. Variables are perceptions of organisational performance (fairly common in studies) typically measured at different levels. One question is related to the performance of the organisation for the past three years. This variable is measured at five levels and could be included in the analysis as a measurement of whether profitability affects the provision of training. The most interesting performance measurements are questions on the rating of the organisation's performance compared with other firms in the same sector. These industry-adjusted questions concern productivity, rate of innovation, service quality, profitability, and stock market perfor-

mance. Variables are measured at three levels, according to whether the firm belongs to:
(a) the top 10 % of the firms in the sector;
(b) the upper half of the firms in the sector, or;
(c) the lower half of the firms in the sector.

Preferred outcome variables in this survey are measurement of stock market performance and profitability, as these are net of the investment cost of training. It is important to note that we are not working with actual performance but with perceptions of performance, which are both a 'noisier' measurement and demonstrate less variation than actual performance. Performance measurement in the survey has the advantage of being relative to other firms in the same sector (industry). Controlling for heterogeneity between industries or sectors has proved to be important in most firm-based studies of company training.

Two variables related to internal market and unionisation are utilised in the survey. The variable on unionisation is measured at six levels from 0 % to 100 %. A measure of internal market can be constructed from the question on how managerial vacancies are filled. The respondents are asked how three different levels of managers are recruited: senior, middle, and junior managers. As with most proxies this variable is only a rough measurement of the actual construct, which also includes other characteristics such as promotion, seniority, on-the-job training, etc. The respondents can select from four different types of recruitment:
(a) internally;
(b) head hunters or recruitment consultancies;
(c) advertising in newspapers;
(d) word of mouth.

From this it is possible to construct a rough measurement of the extent the firm's internal market. The number of ticked suggestions in option (a) (maximum three) related to the total ticked suggestions (maximum twelve) can work as an approximation for the degree of internal market. It is arguably a coarse measurement but it indicates whether the recruitment of managers is focused on internal employees or whether it is focused on attracting employees externally.

Other variables that can be used in explaining training are educational structure (% graduates), age structure (% above 45 years), proportion of manual workers, number of employees, and the importance of innovations. The questions used in the present study involve mainly those from the employee development section, organisational details and some questions on unions, staffing practices and the human resource function in general. The Cranet database is a rich source of information and only a small section is analysed in this report. Please refer to Annex 1 for the exact wording of all variables included in this analysis.

4.2. Cranet survey results

4.2.1. The scope of training

Table 5 provides descriptive statistics on the training variables used in this study. The table shows the mean values for the percentage of wage bill spent on training and the proportion of employees trained in each country. The average amount of wage bill spent on training in 1995 survey was 3.1 %; the figure was 2.94 % in the 1999 survey. The proportion trained in 1999 is somewhat lower than the figures given by Eurostat in the second continuous vocational training survey ([8]). The countries that deviate most from the Eurostat figures are Belgium (-14 %), Norway (-11 %), and Ireland (-10 %) while other countries show more or less the same result. The restricted sample in the Eurostat survey is slightly different because it contains enterprises with 250 employees or more compared with 200 and above in the Cranet survey. The difference in the amount of training between the original (European) countries in 1995 and the new countries in 1999 is also marginal. More striking is the fact that the proportion of employees trained has increased quite dramatically in all countries, the overall increase being 11 % since 1995 to about 45 % of the employees receiving training each year in 1999. Again there is no marked difference between European countries and other countries in the proportion of employees trained.

The number of firms answering each question is given in parenthesis. In the 1999 survey, (which is the foundation for this investigation) 5 463 public and private organisations answered the question on the amount spent on training and

([8]) Eurostat: *The second continuous vocational training survey*, 1999 (Newcronos).

Table 5: **Cranet survey, descriptive statistics**

Country	Code	1995 % spent on training	1999 % spent on training	Change	1995 Proportion trained %	1999 Proportion trained %	Change
United Kingdom	UK	2.6 (813)	2.9 (644)	+ 0.3	42.1 (903)	52.9 (784)	+ 10.8
France	F	4.8 (499)	4.2 (374)	- 0.6	44.2 (471)	49.5 (355)	+ 5.3
Germany	D	2.8 (321)	2.8 (311)	UNCH	26.4 (357)	32.8 (415)	+ 6.4
Eastern Germany	D (east)	3.2 (155)	2.5 (151)	- 0.7	27.7 (189)	31.8 (218)	+ 4.1
Sweden	S	4.3 (186)	3.7 (157)	- 0.6	51.5 (266)	66.1 (239)	+ 14.6
Spain	E	2.1 (213)	2.0 (241)	+ 0.1	37.6 (247)	51.1 (268)	+ 13.5
Denmark	DK	2.8 (427)	2.8 (306)	UNCH	37.2 (496)	49.6 (355)	+ 12.4
Netherlands	NL	3.8 (238)	3.4 (202)	- 0.4	34.0 (258)	42.2 (193)	+ 8.2
Italy	I	1.9 (65)	2.2 (63)	+ 0.3	21.4 (86)	36.2 (71)	+ 14.8
Norway	NO	2.7 (331)	3.3 (325)	+ 0.6	40.0 (317)	41.5 (344)	+ 1.5
Switzerland	CH	2.9 (170)	2.6 (113)	- 0.3	36.0 (189)	42.8 (128)	+ 6.8
Ireland	IRL	3.7 (249)	3.2 (278)	- 0.5	36.2 (308)	47.1 (381)	+ 10.9
Portugal	P		3.0 (128)			36.9 (128)	
Finland	FIN	2.7 (262)	2.5 (215)	- 0.2	45.2 (269)	61.1 (229)	+ 15.9
Greece	EL		2.5 (81)			36.0 (111)	
Austria	A		2.2 (153)			36.4 (181)	
Belgium	B	2.4 (252)	3.3 (182)	+ 0.9	27.9 (311)	45.5 (223)	+ 17.6
Northern Ireland	NI		3.1 (107)			54.4 (157)	
Estonia	EE		4.3 (304)			47.0 (388)	
Bulgaria	BG		2.9 (70)			17.4 (107)	
Czech Republic	CZ		2.3 (141)			45.3 (176)	
Cyprus	CY		1.4 (52)			34.1 (73)	
Turkey	TR	3.8 (96)	3.9 (128)	+ 0.1	27.9 (148)	49.4 (191)	+ 21.5
Tunisia	TN		4.3 (45)			24.6 (54)	
Israel	IL		3.3 (89)			47.5 (148)	
Japan	JP		1.7 (423)			31.6 (582)	
Australia	AU		3.0 (180)			56.3 (186)	
Average		3.10 (4277)	2.94 (5463)	-0.08	35.7 (4815)	45.22 (6685)	+11.0

NB: The table shows the average percentage of wage bills spent on training in each country (% spent on training) and the average proportion of employees trained during the year (Proportion trained %) in the 1995 and in the 1999 Cranet survey. Number of firms answering each question in parenthesis.

6 685 organisations answered the question on the proportion trained during the year. For some countries the number of observations is low. That some countries have too few observations is evident when the sample is restricted to private firms in the analysis of training and performance. As can be seen in Table 5, the survey is mainly focused on European countries with most of the answers from countries within the European Union.

If one compares these figures with the 1999 ASTD survey it appears that European companies spend considerably more on training than their American counterparts. In 1999 US firms spent

1.8 % of payrolls on training (van Buren and Erskine, 2002) compared with 2.9 % for the firms included in our sample. It is important to note that both surveys are completed by companies and that the question regarding the amount invested in training is similar in both studies. The measurement errors in the Cranet survey are probably larger because of less rigorous training definitions in the questionnaire. Whether this measurement problem inflates or deflates the reported figures in the Cranet survey compared with the ASTD survey is difficult to determine.

4.2.2. Correlation between variables

The investigation that follows is based on the sample of private companies for which there are performance measurements. The remainder of the analysis in this section is restricted to 5 824 private companies that answered the 1999 survey. Table 6 shows the correlation between the main explanatory variables used in the present study (number of observations in parenthesis). We have chosen variables in an effort to reflect factors used in both labour economics and human resource literature. To increase readability, only significant correlations are shown in the table. A number of interesting initial observations can be made. First, the amount spent on training is positively correlated with personnel turnover. This is an observation that goes against common knowledge that turnover reduces training. The proportion of employees in trade unions is negatively correlated with amount of training and staff turnover. That training is less in more unionised companies is possibly the result of a greater proportion of manual workers. More interesting is that turnover appears to be lower in more unionised establishments (especially since % manual workers are positively correlated with turnover). This result is in line with the argument that unions reduce personnel turnover and thereby promote more training (e.g. Booth et al., 1999).

The internal labour market measurement is negatively related to the amount of training and proportion trained, contradictory to expectations which assume that firms invest in training because internal labour markets reduce the risk of poaching. However, the prediction that turnover is lower in firms with more focus on internal promotion appears to be confirmed in the present material (negative correlation between turnover and internal market). That the internal labour market is positively correlated with the proportion of graduates and negatively correlated with the proportion of manual workers seem

Table 6: **Correlations between main explanatory variables (private sector)**

	% trained	Turnover	Absenteeism	Unionisation	Internal L.M.	% graduates	% manual	Size
% spent on training	0.179 [a] (3419)	0.041 [b] (2998)	-	-0.109 [a] (3217)	-0.105 [a] (3645)	0.102 [a] (2726)	-0.110 [a] (2774)	-
% trained		-	-	-	-0.031 [b] (4672)	0.137 [a] (3418)	-0.167 [a] (3502)	-
Staff turnover			0.089 [a] (2550)	-0.179 [a] (3757)	-0.131 [a] (4258)	-0.066 [a] (3314)	0.053 [a] (3273)	
Absenteeism				0.158 [a] (2586)	-0.133 [a] (2885)	-0.266 [a] (2336)	0.191 [a] (2261)	0.047* (2829)
Unionisation					0.059 [a] (4908)	-0.232 (3451)	0.245 [a] (3635)	-
Internal Labour Market						0.207 [a] (3879)	-0.057 [a] (4069)	-
% graduates							-0.468 [a] (3072)	-
% manual								-

(a) denotes significance at 1 % level
(b) denotes significance at 5 % level

plausible. While our measure of internal labour market is at odds with the prediction related to training, the remaining correlations appear to be in line with expectations. However, a more rigid analysis of what determines training will be performed in Section 4.2.3.

Other correlations that are also less consistent with prior expectations relate to graduates and manual workers. The size of the organisation, measured by the number of employees, is not correlated with the two training variables. This apparent inconsistency with prior findings might be due to restricting the sample to firms with 200 or more employees. A somewhat surprising result is also the very low correlation between the proportion of wage bills spent on training and the proportion of employees trained. This result suggests that these two factors measure different aspects of training. We will elaborate on this argument in more detail in the next section. In conclusion, the results of Table 6 indicate that there is also little or only moderate correlation between our explanatory variables.

4.2.3. What determines training?

A number of questions in the Cranet survey offer interesting perspectives on the amount or incidence of training. As well as including customary factors such as education, age, company size, unionisation, and manual labour, the Cranet questionnaire includes variables that might provide a better understanding of what influences the decision to train people. First are questions of whether the company has a written training policy, analyses employee training needs, and has an internal labour market. Other variables include personnel turnover and whether innovations are important. Perhaps the most interesting variable is the one that indicates prior profitability, as this describes the impact of prior performance (profitability) on the decision to train. This variable may assist in understanding the causality of training, i.e., whether profitable firms can afford training or whether training generates profitability. Finally, two different training measurements (proportion trained and proportion of wage bills spent on training) might provide some idea of whether these two common estimates of training measure the same thing. To account for what determines the amount of training and proportion trained in a company the following training regression is estimated ([9]):

TRAINING = POLICY + NEEDS + INTERNAL + UNION + AGE45 + MANUAL + GRADUATES + TURNOVER + SIZE + PRIORPROFIT + INNOVATION (1)

where:

TRAINING is the amount of training or proportioned trained (all subscripts suppressed);

POLICY is a dummy variable taking the value of one if the firm has a written training policy;

NEEDS is a dummy variable equal to 1 if the firm analyses employee training needs;

INTERNAL and UNION are internal labour market and degree of unionisation;

AGE45 is the proportion of employees 45 years or older;

MANUAL, GRADUATES, TURNOVER, SIZE are percentage of manual employees, percentage of graduates in the workforce, percentage of personnel turnover and number of employees at the firm;

PRIORPROFIT is the measurement of the performance over the past three years;

INNOVATION is a dummy variable taking the value of 1 if the firm considers innovation as very important to the organisation.

The results for estimating equation 1 are shown in Table 7. We have chosen to analyse the results of Table 7 in the light of the findings in literature that employers pay for all types of training no matter whether the training is specific, industry-specific (occupational) or general in nature. The first variable indicates that firms with a written training policy are more likely to provide training to their employees (proportioned trained) but having a written training policy is not associated with how much training is provided. The second variable indicates that firms that analyse their employees training needs also train their

([9]) Because less than 1 % of the firms answered that no employees received any training and just over 1 % of the firms answered that 0 % of salaries is spent on training, an OLS regression is estimated in the training regression.

employees to a greater extent than firms not conducting this type of analysis.

The impact from the internal labour market measurement is negative on both the amount of training and number of people trained, which indicates that firms focusing more on internal promotion provide less training. This is contrary to the findings of Delaney and Huselid (1996) for the US market. The correlation between training and their measure of internal labour market was high (0.56) indicating a that firms with a higher degree of internal labour market also provide more training. Whether this deviation in our result is caused by different measures of internal labour market or whether there exist differences between US and other (predominantly) European countries is difficult to gauge. However, the negative impact of the internal labour market measurement in our study might also be interpreted along the lines that these types of internal structures do not provide enough incentive to train or to be trained. Internal labour markets are typically based on seniority in promotion and pay levels are based on position (post occupied) rather than on competence and skills. Both the employee and the employer have less incentive to invest in training. For a more thorough discussion on the subject see Hanchane and Méhaut (2001).

The degree of unionisation at the firm has a negative impact on the proportion of the wage bill spent on training whereas the impact on the number of employees trained is positive (but not significant at 5 % level). Though we have controls for both educational level and the proportion of manual workers at the firm, the negative association between unionisation and the amount invested in training is probably caused by our inability to control for industry differences in the training regression. The impact from having more old employees in the organisation is negative on both training measures but not significant. This result might be taken as an indication that company training persists throughout the employee's career. The proportion of manual workers is associated with fewer workers being trained but not with the amount of training provided at the firm. The proportion of graduates at the firm has a positive but not significant impact on training measurements. The size of the organisation is not associated with any of the training measurements, possibly explained by our sample of larger firms.

Personnel turnover appears not to be a factor determining training since it is not significant in the training measurements. This result is qualitatively similar to those presented in Goux and Maurin (2000) for France and in Green et al. (2000) for Britain. Both studies indicate that training measured at an aggregated level had little impact on mobility. Considering the importance of staff turnover to the potential for companies to benefit from training investments we also conducted a simple analysis of aggregated country data and found a positive relationship between average personnel turnover and average proportion of wage bills spent on training. This outcome is slightly contrary to what is expected, as turnover of personnel is normally considered to lower firms' willingness to invest in training. However, turnover might force firms to increase their spending on training newly hired employees. A division of what type of training is provided by the firm might thus give a different result ([10]).

The variable that indicates past profitability shows an interesting division in the impact on the two training measurements. Prior profitability is positively and significantly associated with the proportion of employees being trained but not associated with the proportion of wage bills spent on training. This result indicates that the proportion trained in a firm is largely conditioned by past performance. It seems that measurements of training based upon proportion of employees being trained contain an element of reward or, at least, dependence on past performance. That the decision regarding the number of employees being trained is endogenous to, or mutually dependent on, past profitability makes it important to address the problem of endogeneity in studies using this measure of training.

([10]) The country comparison is based only on univariate regression and there could thus be several factors such as economic conditions, unemployment rate, etc., that might drive this outcome. However, Green et al. (2000) also come to the conclusion that different types of training have different impacts on the individual's decision to search for a new job. The large difference in personnel turnover between different countries might still indicate that this is an important variable to consider in cross-country comparison. There are considerable differences in personnel turnover between European countries, with the lowest turnover in the Netherlands (4.69) and Germany (5.70) and the highest turnover in the UK (15.06) and Portugal (13.24).

Table 7: **Training regression (private sector)**

Dependent variable	% spent on training	Proportion trained
INTERCEPT	2.795 [a]	14.637 [a]
	(5.53)	(3.25)
POLICY	0.233	9.434 [a]
	(1.22)	(5.60)
NEEDS	0 844 [a]	17.575 [a]
	(4.05)	(9.51)
INTERNAL	-1.501 [a]	-6.883 [b]
	(-4.92)	(-2.51)
UNION	-0.126 [a]	0.725
	(-2.74)	(1.75)
AGE45	-0.004	-0.072
	(-0.85)	(-1.88)
MANUAL	-0.003	-0.135 [a]
	(-0.84)	(-4.53)
GRADUATES	0.008	0.070
	(1.89)	(1.79)
TURNOVER	0.005	0.090
	(0.70)	(1.40)
SIZE	-0.000	-0.000
	(-0.27)	(-0.30)
PRIORPROFIT	0.099	4.465 [a]
	(1.21)	(6.02)
INNOVATION	0.169	0.637
	(1.03)	(0.43)
F-statistics	7.827	29.556
R^2 (adjusted)	0.05	0.167
N	1359	1566

T-values are in parentheses.
(a) Denotes significance at the 1 % level.
(b) Denotes significance at the 5 % level.

Because the proportion of wage bills spent on training is not associated with past performance, it might indicate that how much firms invest in training their employees is not dependent on whether they can afford training or not. Taking this reasoning a bit further suggests that the investment volume is not a reward for past performance but more likely seen as an investment with future benefits for the firm. That the amount spent on training is not associated with the dependent variable (prior profitability) also gives us a better basis for making interpretations in, for instance, cross-sectional estimates. In other words, examination of the amount invested in training might suggest that it is not profitable firms that can afford training but it is training that generates profitability.

The last variable, the importance of innovations, shows a positive but not significant impact on training measurements. Given the general level of analysis used in this study, the results should be interpreted with some care, particularly because the regressions do not include important variables such as controls for industries or controls for countries. However, an impression of the results presented in Table 7 is that training appears to be discretionary within firms. The measurements that show the strongest influences on training are largely determined by the firm itself. The difference between what determines the proportion being trained and what determines the amount of money spent on training is also worth noting. The large difference in impact among the explanatory variables indicates that these two measurements indicate quite different dimensions of training decisions. This finding is in line with the arguments in Orrje (2000) that the determinants of the probability of receiving training and the determinants of the amount of training are not the same.

4.2.4. What factors are indicative for top (10 %) performers?

This part of the analysis utilises the questions on how the organisation is performing relative to other firms in the same sector. Table 8 shows the mean difference between organisations belonging to the top 10 % of performers and organisations considered performing below average in the sector. Five industry-adjusted performance measures are shown in Panel A (profitability, productivity, innovations, service quality and stock market performance). The minimum and maximum number of observations used in the analysis is given in brackets in the first column. We have chosen to examine whether top performers show any differences with respect to variables normally considered in studies. The mean difference between top performers and those performing below average is shown in the table together with t-values (in parenthesis).

Panel A gives the results for the whole sample of private organisations and Panel B gives the results on profitability for United Kingdom, France

and Germany. The lack of observations for other European countries rendered further divisions unworkable. Since we are not working with actual performance but perceptions of performance we need to be cautious with interpretations. One problem with the data is that around 30 % of the firms responded that they belonged to the top 10 % of the firms in their sector, suggesting that we either have a response bias or that we have over-sampled firms performing well. To what extent this caveat influences the results presented in Table 8 is difficult to gauge, but a response bias is likely, rendering the statistics less significant.

The first column shows that top performing firms spend more on training compared with firms performing below average. This is true for all performance measurements except for service quality where there is no significant difference. For instance, firms belonging to the top 10 % with regard to profitability on average spend 0.6 % more of their wages on training than firms having a profitability below average in their respective industry. Considering that prior profitability did not have any significant impact on the amount spent on training (Table 7) it might be assumed that top performing firms are top performers in part because of their investment in training ([11]).

The difference between top performers and the below 50 % performers with regard to the proportion trained in a year is significant for all performance measurements (including service quality). That high performers in service quality train significantly more of their employees each year most likely indicates that achieving top service quality requires all staff to undergo regular training. Top performers train close to 10 % more of their staff in a year compared with firms performing below average on service quality.

Having a written training policy and analysing employee training needs appear to be indicative for top performing firms regardless of performance measurement. These two variables are important determinants of training, training policies and support functions to provide the right type of training, and they are characteristic of high performing firms whether measured by profitability, productivity, innovations, service quality, or stock market performance.

The next column indicates that firms considered as more innovative also employ more highly educated personnel (percentage of graduates in the workforce). This result is reasonably expected because of the complementarity between innovation and education (e.g. Leiponen, 1996b). That firms with better profitability and stock market performance also employ more graduates compared with firms performing below average is more interesting. This result is in line with the findings presented earlier that the educational level of employees is positively associated with productivity and profitability (Black and Lynch, 1996; NUTEK, 2000; Gunnarsson et al., 2001). That firms are able to extract higher profitability from more skilled or more educated workers is an argument put forward by those who propose that wage compression is a major reason for firms to invest in general skills (Acemoglu and Pischke, 1998, 1999a; Booth and Zoega, 1999; Brunello, 2002).

The last columns indicate that staff turnover does not vary between high and low performers, but that high performing firms have significantly less absenteeism among employees than low performing firms. An exception occurs in the results for service quality where there is no difference between the two groups with regard to absenteeism.

Panel B indicates that some of the results in Panel A might be driven by country specific circumstances since not all of the three countries shows the same response on profitability. However, the lack of significance between profitability and some of the variables is possibly more a consequence of fewer sample cases. France, with few cases shows a significant difference only in the proportioned trained whereas the UK and Germany, with more cases, also show more significant results. It is interesting to note that staff turnover is significant in Germany yet not for the total sample or for France and the UK. Another observation is that absenteeism is only significantly different in the UK. Because of the low numbers it is difficult to draw any general conclusions regarding differences between the three countries. One lesson that can be drawn from the Cranet survey is that when the respon-

([11]) Because it appears that the decision on how much to spend on training is not conditioned by how profitable the firm has been, it is more likely that training generates profitability and not the other way around that profitability generates training (since there is no association between amount of wage bills spent on training and past three years profitability in Table 7).

Table 8: **Mean difference between top 10 % and lower half of firms in sector (private sector)**

	% wages spent on training	Proportion trained %	Written training policy	Analyse training needs	% graduates	% staff turnover	Absenteeism days
Panel A All countries							
Profitability	0.60 (a)	9.21 (a)	0.08 (a)	0.06 (a)	2.46 (b)	–	-1.22 (a)
N (1498-2795)	(4.29)	(6.81)	(4.26)	(3.58)	(2.23)		(-3.21)
Productivity	0.43 (b)	7.46 (a)	0.05 (b)	0.06 (a)	–	–	-1.84 (a)
N (1243-2389)	(2.27)	(4.36)	(2.12)	(2.65)			(-3.67)
Innovations	0.73 (a)	9.80 (a)	0.12 (a)	0.09 (a)	6.62 (a)	–	-1.26 (a)
N (1253-2375)	(4.52)	(6.63)	(6.00)	(4.90)	(5.31)		(3.05)
Service Quality	–	9.92 (a)	0.10 (a)	0.11 (a)	–	–	–
N (1549-2983)		(3.90)	(3.16)	(3.48)			
Stock Market	0.55 (a)	6.34 (a)	0.06 (b)	0.06 (b)	6.04 (a)	–	-1.87 (a)
N (617-1174)	(2.74)	(3.04)	(2.26)	(2.23)	(3.42)		(-2.95)
Panel B Specific countries							
UK – Profitability	0.63 (c)	10.17 (a)	–	0.10 (b)	–	–	-1.19 (b)
N (189-381)	(1.79)	(2.64)		(2.52)			(-2.18)
F – Profitability	–	15.14 (a)	–	–	–	–	–
N (91-184)		(3.79)					
D – Profitability	–	13.26 (a)	0.25 (a)	0.15 (b)	–	-2.60 (b)	–
N (127-196)		(3.39)	(3.68)	(2.36)		(-2.40)	

T-statistics (parenthesis) whether the mean is different from zero.
(a) denotes significance at 1 % level
(b) denotes significance at 5 % level
(c) denotes significance at 10 % level

dents are requested to provide actual figures on, for instance, training, staff turnover, absenteeism, etc., the response rate drops dramatically.

4.2.5. Main findings

The investigation is based on a crude statistical analysis, compounded by the problem of perceptions of organisational performance, which tend to increase measurement errors and decrease the true variation among firms. This analysis of the Cranet data should, therefore, be seen as a first rough attempt to explore this database. However, some interesting indications have emerged from the present analysis, as summarised below:

(a) the proportion of the wage bill spent on training and of employees being trained appears not to measure the same thing because the determinants of these two variables are quite different (the correlation between the two training measures is also weak);
(b) the proportion of employees trained appears partly dependent upon whether the firm can afford the training, as indicated by the annual number of employees being trained correlating with prior profitability;
(c) the proportion of the wage bill spent on training does not correlate with past profitability, which might indicate that it is not a profitable firm that can afford training but it is training that generates profit;
(d) analysis of employee training needs and existence of a written training policy are two

important factors associated with the number of employees trained at the firm and, for the former, also the amount of training provided by the firm;

(e) most education and training-related measurements are significantly higher or more frequent in high performing firms compared with firms performing below average in their respective sector.

An interesting aspect of these results is that the decision to train is largely determined by company specific factors. Without taking the interpretation of the results too far, a general picture seems to emerge where factors that one can consider as approximations for good working conditions or the 'good employer' are also largely connected with performance measurements such as productivity and profitability. It is also important to note that firms with better profitability and stock market performance also provide more training, and train more of their employees, compared with firms performing below average in their respective industry sector. Another notable observation is that firms with better sector-adjusted profitability and stock market performance also have more educated employees.

5. Results

The amount of money spent by companies on wages (the rent for human capital) suggests that more efficient use of this production factor would have a significant impact on most firm-based performance measurements. The flaw in this reasoning is that firms do not own the labour of their employees but pay a rent for its hire. The question is whether increased efficiency arising from company training benefits the hirer of the labour or the provider. That at least some of the increases in efficiency are captured by firms is a prerequisite for any impact on company performance measurements such as profitability or stock market performance.

Research on the effects of education, training, and skills/competence on company performance has made some important advances in recent years. Increasing evidence that employers benefit from human capital, and investment in human capital, has led to a substantial increase in the number of theoretical papers seeking to explain these findings. In the following section we provide information on what empirical research has achieved in different areas.

5.1. The effects of training on company performance

5.1.1. The impact of training

A somewhat crude description of the research agenda is that the general understanding has moved from regarding all investments in employee training as unprofitable for firms, to regarding specific training as viable, and now to considering all types of training as potentially profitable. Considering that 40 years have passed since Becker (1962) wrote his seminal paper on human capital investment, research has moved slowly on the question of whether firms can benefit from training their employees. Only very recently have we seen papers showing that employers profit from investment in all kinds of training.

The majority of the papers included in this review point toward substantial gains for employers from continuous vocational training. The absence of studies indicating that employers do not profit from training investments may generate some concern over whether we have a potential bias in reporting only significant and positive results for company training. However, because research on training has largely accepted that employers pay for company training (no matter how general) the finding that employers also benefit from such investment seems progressively more plausible. Despite acceptance that firms pay for (general) training, there is still a need for additional research on the effects of training to understand better the complexities of company-provided training.

Increasingly, studies provide evidence that training generates substantial gains for employers. The most compelling evidence is presented in several recent papers connecting training investment with changes in productivity, profitability and stock market performance. The majority of these studies also establish the direction of the relationship, i.e., we can, with reasonable confidence, maintain that training generates performance effects and not the other way around. The studies that provide the strongest evidence of this are (dependent variable in parenthesis):

(a) Barrett and O'Connell (1999) based on 215 Irish firms (sales growth);
(b) Dearden et al. (2000) based on 94 British industries over 12 years (value added);
(c) Groot (1999) based on 479 Dutch firms (productivity estimates);
(d) Hansson (2001) based on a Swedish case study of programmers (net profitability);
(e) d'Arcimoles (1997) based on French firm-level data (value added, return on capital employed);
(f) Bassi et al. (2001) based on 314 US firms (stock market return, sales per employee, etc.).

There are also studies that have only been able to demonstrate a weak connection between company training and company performance (Black and

Lynch, 1997; Bartel, 1995). However, the authors of these studies attribute weak or insignificant results to measurement problems. The main impression from research is that firms profit from training their employees regardless of whether the training provided is useful to other firms. Other tentative conclusions that can be drawn from the review are briefly presented below.

5.1.2. Formal/informal and general/specific training

Few studies have been able to examine the effects of different types of training. Besides difficulties in acquiring more specific training information, the distinction between different types of training appears somewhat arbitrary since most definitions are not mutually independent. Nevertheless, the results concerning formal and informal training suggest that formal training courses have more impact on productivity than informal training (Dearden et al., 2000; Black and Lynch, 1996). This finding is puzzling, because it is likely that formal training relates more to general training and informal training more to specific training. This result would indicate that general training might be more profitable for firms to invest in than specific training. The study by Barrett et al. (1998) suggests that this might be the case. The results of Barrett et al. show that general training has a significant positive impact on productivity whereas specific training appeared to be insignificant. The authors explain this result by reasoning that general training provides greater incentive for employees to spend more effort in the learning process.

However, the results are not entirely consistent. Bosma et al. (2002) conclude that their findings support the thesis that specific investments are more influential for company success in start-ups than general investment. This difference in results with regard to general and specific training can be affected by weak definitions and measurement problems, or the difference between entrepreneurial performance and employee performance.

Other studies that can be distinguished in terms of type of training are the studies focused on teaching basic skills to employees (work place education programmes) or students (STW programmes). The impact of generic skills programmes is ambiguous in that it is difficult to assess the real pay-off for employers from this type of training investment. Though much research is needed on this subject, there are indications that basic skills training can influence firm performance positively (Bassi and Ludwig, 2000; Krueger and Rouse, 1998).

5.1.3. Timing of the effects of training

An important issue related to the impact of training is when one can expect to see the effects of the training investment. There is evidence that effects of training emerge some time after it takes place. The results and arguments forwarded in Black and Lynch (1996) and Bassi et al. (2001, 2002) based on US data, d'Arcimoles (1997) based on French data, and Hansson (2001) based on Swedish information, suggest that the effects of training materialise one to two years after the training period. The results presented in these studies suggest that we should measure the effects of training after at least one year from the point of the investment and possibly also over a longer time horizon.

However, typically the effects of training are registered in cross-sectional estimates, which implies an instant effect of the training investment. The question is whether this impact is caused by an immediate effect from the training or whether cross-sectional estimates capture the return on past training investments. This question is valid because it is likely that the level of training is continual in firms. In other words, firms that invest more in training in one period (t-1) continue to invest more in training in the following period (t). Because of delayed training effects, we might measure the effect of prior training investments in cross-sectional estimates. The question of when to expect the effects of training investment to materialise is by no means clear and it would be beneficial to have this matter determined in future research.

If the productivity effects from training lag, this has implications for the conclusions we can draw on instant wage effects from training. It has generally been accepted that wage increases in connection with training arise from resulting increased productivity. The results of the above studies imply that wage increases during training might have some other basis. Recent access to data matching employees' and firms' characteristics will possibly shed more light on this question.

5.1.4. Timing of training investments

The amount of training firms undertake is possibly affected by the economy. The general

understanding is that expansionary economic conditions, with firms hiring new employees, also are associated with an upsurge in firm-sponsored training. The results of Dearden et al. (2000) and Bartel (1994) imply the opposite – that firms train when production is low (the pit stop theory). One reason why favourable economic conditions do not produce more company training may be that only a portion of all company training is geared towards new employees. For instance, only 18 % of all training provided by publicly held companies in Sweden was introductory training for newly hired employees ([12]). Since firms train when they have slack time, we also typically underestimate the impact of training on productivity in cross-sectional analyses ([13]).

Another important finding is that the timing of training appears not to depend on tangible investments (Barrett and O'Connell, 1999). The finding that investments in training and investments in tangible assets are only weakly correlated suggest that tangible investments do not cause the training effects observed at company level (industry level). Apart from tangible investments and training, the Cranet survey results also indicate that the amount of training provided by firms is not dependent on previous profitability. Both results indicate that the decision on how much training to provide has little to do with whether the firm has done well in the past or whether the firm increases its tangible investments. These findings have importance for what conclusions that can be drawn from statistical models, especially cross-sectional regression estimates.

5.2. The effects of education, skills and competences on company performance

The effects of education or skills/competence on company performance are generally more difficult to establish, as these factors are accumulated measures of human capital stock. Compared with company training that normally varies from year to year, educational levels are much more constant. Because of this we are typically restricted to level data (with some exceptions) in analysing the impact that human capital stock might have on company performance. Educational or skills levels are normally included as control variables in most impact research but less frequently used as a main variable (at least in firm-based research). Still, this is possibly one of the more interesting areas in explaining company performance as the studies included in this review indicate that education and skills are important factors in understanding differences in performance among firms.

There is research to connect the effect of educational level or skills/competence level with productivity, with positive association in the work of Black and Lynch (1996) and NUTEK (2000). Indications that skills are an important factor in productivity are presented in Carr (1992) and Mason et al. (1992). A significant paper not restricted to cross-sectional data is the study by Gunnarsson et al. (2001) examining educational level and productivity growth over a ten-year period. Their findings suggest that the increase in the educational level between 1986 and 1995 explains a large part of the IT-related productivity growth. Their results also suggest that a marginal skill upgrading has the same effect across different levels of education. Gunnarsson et al. conclude by stating that 'measures to promote increased use of IT should be followed up by measures promoting skill upgrading. Our results actually show that, in general, upgrading skills at a given level of IT (i.e. share of computers in total capital) has a much stronger growth-enhancing effect than increasing IT investments at a given human capital structure.' (p. 44).

The findings of Leiponen (1996b) indicate that innovative firms have a more educated workforce and that innovative firms are more dependent on educational competence in generating profit (Leiponen, 1996a). The study by Michie and Sheehan (1999) also suggests that skill shortage is a severe obstacle to innovation. Similarly, the findings of Romijn and Albaladejo (2000) in SMEs propose that the owners' technical education and their prior working experiences, in addition to the technical skills of the workforce, have a significant effect on innovative capability.

Taken together, the results indicate that we have complementarities between different types of

([12]) IPF – Institute of personnel and corporate development. *The human capital survey 2002.* Uppsala: IPF, Uppsala University (please contact the authors for results).

([13]) However, as noted in the previous section this conclusion depends to some extent on when the training effects materialises.

education (Leiponen, 1996a) and between education and IT investments (Gunnarsson et al., 2001) that generate significant synergies or externalities. The evidence that the level of education or skills is related to innovation and productivity might not be too surprising since education and skills are generally considered as associated with more complex jobs and increased flexibility. What is more surprising is that we start to see studies relating education and skills to profitability.

The results of Leiponen (1996a) show that educational level is associated with profitability (net profit margin). Leiponen uses panel data and a two-stage procedure to handle problems of endogeneity, providing results that are more robust than ordinary cross-sectional estimates, especially on arguments that profitability causes firms to hire more highly educated personnel. The study by NUTEK (2000) shows that the proportion of higher educated employees is significantly associated with both productivity (value added) and profitability (revenues to cost ratio). Because educational level is associated with both productivity and profitability it gives us a more solid basis for inferring that higher education generates higher productivity and that firms are able to capture some of the benefits.

The idea that skills in the form of programming competence are associated with how much the individual produces in net contribution (profit) to the firm is presented in Hansson (2001). This investigation is based on a single firm and it is thus difficult to draw any far-reaching conclusions. Nevertheless, because the examination is based on differences in employees' net contribution this study avoids the argument that only profitable firms can afford to hire more skilled workers. Similarly, the results of the Cranet survey suggest that the more profitable firms and firms with better stock market performance in their respective industry sector also have more highly educated personnel than firms performing below average in their respective industry sector.

From the above, it is possible to speculate on the degree to which firms are able to capture returns on human capital investments that normally are considered to belong to the individual. Because prior education is a function of the individual it is assumed that the individual accrues the benefit of these investments through higher wages. However, indications that investors and beneficiaries are not always the same are presented in Groot (1999) who points out the weak connection between those who contribute to training investment and those who benefit from it.

That firms are able to extract higher profitability from more highly skilled or educated workers is an argument put forward by those proposing that wage compression is a major reason for firms to invest in general skills (e.g. Acemoglu and Pischke, 1998, 1999a). The basic reasoning is that individuals are not paid their marginal product and that firms are able to extract higher profits from more skilled workers who are not paid what they are worth for the company. Wage compression is not only a European phenomenon but can also be found in the US (Bewley, 1998). The findings of Bewley suggest that the internal equity (fairness and moral) in firms' pay structure restrains managers from paying employees the full value of their contribution. Consequently, high performing employees are more valuable to the firm. Bewley takes this reasoning one step further by arguing that low performing employees are seldom fired and, if they are, it is for gross misconduct rather than for under performance ([14]). Wage compression is one of several recent theories that try to reconcile the empirical findings that firms both invest in, and extract profit from, general human capital. The next section provides some further explanation.

5.3. How firms profit from general human capital

Explanations of why firms invest in, and are able to profit from, marketable human capital are abundant. Based on differences in bargaining power, Glick and Feuer (1984) propose that general training is superior to straight money payment as an insurance against personnel turnover and that firms should invest in general training to safeguard joint investments in specific training. In the shared investment model of Loewenstein and Spletzer (1998), the employer

([14]) However, low performers are the first to be laid off when firms are reducing their workforce and the pay for low-performing employees is often allowed to fall behind the rate of inflation. Bewley interviewed over 270 executives and managers of US based firms about wages and layoffs.

shares general training investment with the employee as a consequence of the employer's inability to commit credibly to future wages. The employer, instead, commits to a minimum guaranteed wage, shares the investment in general training and realises the returns on the training if the minimum wage guarantee is binding. Autor (2001) proposes a model in which firms offer general training to induce self-selection and perform screening of worker ability. In this model general training and ability are complementary and it is assumed that more able workers self-select to receive general training to a greater extent than low ability workers. In the model of Acemoglu and Pischke (1999a) firm-financed general training is a result of compressed wage structure. Wage compression makes employers more willing to invest in general training as firms extract higher profits from more skilled workers with increased human capital.

Another response to rent extraction from general human capital investments is that mobility thresholds reduce the ability of the individual to capitalise on such investments. Arguments against turnover (mobility) include:

(a) the loss of firm-specific investments for the individual when changing work (Glick and Feuer, 1984). Or that a recruiting (raiding) firm needs to make additional investments in firm-specific knowledge;
(b) firms use back-loaded compensation schemes that induce costs for individuals who change employer (Salop J. and Salop S., 1976). Back-loaded compensations are typically detected or defined as increasing wages with seniority over and above productivity increases;
(c) workers have incomplete information about pay elsewhere (Polachek and Robst, 1998; Bewley, 1998);
(d) individuals are constrained by liquidity or aversion to risks, forcing firms to carry these investments (Bishop, 1994);
(e) firms have superior information about the profitability (payoff) of training investments (Green and Kahn, 1983).

If it is possible for firms to redistribute investment risk through capital markets, this might cause employers of larger firms to be more willing to invest in general human capital. However, Katz and Ziderman (1990) ([15]), have attracted attention with the argument that information asymmetry between the training firm and a recruiting (raiding) firm about training received reduces the potential benefits that a worker with general training can obtain by moving to another firm. Consequently, information asymmetries render general training specific in the sense that the investment is not observable (verifiable) to other firms.

Less attention has been given to findings that both employers and employees benefit from these investments and both parties would be worse off if they did not take place. It is tempting to assume that employers increase wages for individuals receiving marketable training sufficiently to offset the increased probability of turnover. That both the employer and the employee benefit from these investments also implies that individuals employed in firms that provide training receive higher wages in the long run compared with employees of firms that do not provide training. Higher growth in wages provides a strong incentive to stay with an employer who continuously upgrades human capital instead of possibly moving to a new employer with an unknown human capital investment strategy.

Also, the employer-employee relationship is complex and it might be myopic to focus only on monetary gains. Part of the rent extraction consideration might be that these investments represent good working conditions and that the employers are committed to their employees. In this sense, training, no matter how general, is a measure of employer commitment, which is likely to reduce the probability (threat) of changing employers.

5.4. Training and HRM practices

The basic question of whether the combined effect of human resource management (HRM) practices produces good performance or whether certain practices, such as employee development, generate effects on company performance is not easy to answer. In general, there is evidence that training has a greater impact when undertaken in connection with supporting HRM practices, in particular existence of a formal

([15]) Schlicht (1996) has also covered asymmetric information and its impact on a firm's training decisions.

training strategy, written commitments to training, methods for analysing training needs, linking training and strategic objectives (e.g. Maglen and Hopkins, 1999; Blandy et al., 2000; Baldwin and Johnson, 1996). The Cranet data also indicates that support functions are important to training, with the variables on training needs and written training policy significantly associated with training provision and industry-adjusted performance measurements (profitability and stock market return) ([16]).

Whether training has an additional effect over and above high performance work practices is difficult to determine. In high performance work system (practice) literature, training is generally incorporated as a factor in the larger construct of HPWS (with some exceptions). The bundling of different human resource practices is typically based upon factor analysis or analysis of the internal consistency of the total HPWS measurement. Because training is generally part of a larger construct it is difficult to find studies that measure the additional effect of each individual variable. However, some studies account for the impact of different variables. The study by Laursen and Foss (2000) highlighted training and performance-related pay as important factors for innovation. However, the combined effect of all nine factors proved highly significant, indicating the existence of complementary HRM practices.

Other studies also concluded that internally consistent or congruent HRM practices are better predictors of performance than individual practices, for example MacDuffie (1995) and Arthur (1994). These findings do not mean that training by itself does not have a predictive ability for performance, but only that the whole set of practices combined were more informative. The study by Delaney and Huselid (1996) illustrates the problem of focusing solely on the effect of total HRM practices since the training measurements in their study constantly appeared to be related to performance measurements, even with a significant volume of variables capturing other HRM practices.

High performance work system (practice) literature is normally restricted to level data, which makes it difficult to establish the direction of the relationship. There are some exceptions to this rule. The studies by Barrett and O'Connell (1999), d'Arcimoles (1997), Ichniowski et al. (1995), and Bartel (1994) all have measurements of HRM practices and training over time. The results do not agree on whether training or HRM generates the effects on company performance. The study by Barrett and O'Connell suggests that training causes productivity effects whereas introduction of new personnel policies did not show any significant impact on productivity. The results of Bartel propose that training programmes generate considerable productivity effects, in excess of changes in personnel policies. The main results of d'Arcimoles indicate that training produces substantial effects on both productivity and profitability. The study by d'Arcimoles included controls for working and social climate at the firms investigated. A contradictory view is presented in Ichniowski et al. where innovative HRM practices have a large effect on productivity while individual employment practices had little or no effect. This result suggests that training by itself is not enough.

The common denominator of these studies is that we can, with reasonable confidence, maintain that a cause and effect relationship exists between the variables studied (training and HRM) and performance measurements. The line of research or the tradition within which the study was performed might explain the somewhat contradictory results. For instance, researchers in labour economics are possibly more used to modelling training compared with HRM variables, the converse being true for researchers in the HRM tradition. In conclusion, it seems appropriate to reason that both training and other HRM practices are important factors in explaining why some firms do better than others.

5.5. Innovation, technological change and training

There is a multiple relationship between innovation behaviour, innovation performance and training investment. The consequences of technological change and the introduction of process and product innovation, and the relationship with training investment, are important issues. The internal organisation and human resources were

([16]) With one exception, the variable 'written training policy' was not significantly associated with the amount of wage bills spent on training.

neglected for a long time in traditional, economic-oriented innovation literature. In more recent literature attention to the role of HRM and its impact has increased. In the knowledge-based economy, training investment and HRM practices are prerequisites of innovation and are necessary to realise the productivity potential of new information or advanced manufacturing technologies. In order to use the potential of new technologies, complementary investments in training are crucial. There is a growing awareness of the role of internal or organisational factors that mediate the relationship between innovation and company performance. Some authors, such as Laursen and Foss (2000), stress the importance of the complementarities between technology and learning.

A similar view is presented by Baldwin and Johnson (1996). Their findings suggest that more innovative firms place greater emphasis on human resources. Innovation requires a human-resource strategy that stresses training. They found statistical evidence that more innovative firms offered formal and informal training more frequently, that the training was more often continuous in character, and that these firms had a greater tendency to innovative compensation packages. The study by Michie and Sheehan (1999) also stresses the importance of HRM in generating an innovative environment.

That both training and skills are important determinants of innovative capability is offered in Romijn and Albaladejo (2000). The owners' technical education and their prior working experience, the technical skills of the workforce, and the amount of training provided proved to be important aspects of innovation capability. Their findings also suggest that interaction with research institutions and a close link to nearby training institutions enhance innovation capacity. As noted earlier, the composition of the workforce is important for innovating firms (Leiponen, 1996a). The findings of Leiponen indicate that innovative firms are more dependent on educational competence in generating profit.

Training associated with the introduction of new technologies or new work practices is likely to have high productivity effects. Blandy et al. (2000) found evidence for this relationship within the case studies they carried out in addition to the questionnaire survey. That IT generates a substantial amount of training is clear. In the Institute of personnel and corporate development's (IPF, Uppsala University) human capital survey 2002 (see footnote 12) about 41 % of all company-provided training was considered to be related to information technology.

In addition, innovation is frequently used as a performance measurement for companies. Innovation itself is related to various financial returns but there is no definite association between innovation performance and the financial performance of firms. However, there is broad empirical evidence that innovation is associated with the growth of firms and that, in specific industries, more innovative firms yield higher financial returns. The results of the Cranet survey also indicate a connection between innovation and a number of personnel related variables. The top (10 %) performing firms in their sector had more training, trained more of their employees, had greater supporting HRM policies for employee development, and employed more graduates than low performing firms.

5.6. Specifics of SMEs

Small and medium sized enterprises (SMEs) are usually defined as firms with less than 250 employees. They represent more than 95 % of all firms and employ around 65 % of all employees in the EU. Given their importance to the economy, there are surprisingly few empirical studies dealing explicitly with the impact of training on SME performance. Despite great heterogeneity across Europe and the diversity of industries, most surveys in different European countries show that SMEs make fewer investments in vocational training and do not use formalised forms of training. While SMEs generate many jobs and attract young people, most do not provide them with skills and improve their long-term employability. Apprenticeship is an important form of SME initial vocational training of the workforce. In general, most SMEs have difficulty in appropriating codified forms of training (Trouvé, 2001), which, in turn, leads to additional methodological problems in measuring informal training within SMEs. The organisational structure of SMEs is an important reason for the lack of vocational training by them.

The survey on continuing vocational training in enterprises, carried out by the EU in 12 Member States, shows that larger firms offer continuing vocational training more often (European Commission, 1999). Small firms, especially those with 10-49 employees, seldom offer continuing vocational training; only half the firms of this size provide it, compared with more than 90 % of firms with more than 250 employees. Correspondingly, expenditure on vocational training in SMEs is lower than in larger firms, though this is highly dependent on country, size and sector. Similarly, SMEs rarely have a clear human resource strategy, training plan, or advanced HRM practices.

The importance of human capital investment is also of interest in relation to other forms of intangible and tangible investments in explaining competitiveness and performance. Flexibility, entrepreneurship, close relations with partners and customers, motivation of the workforce, and the realisation of niche strategies are important SME strengths in comparison with larger firms (for more details see Descy and Tessaring, 2001). In addition, there is empirical evidence that smaller firms use their R&D investments more efficiently. Nevertheless, there are no theoretical or empirical facts stating that this holds for training investments. Yet, it is probable that additional training investment could yield higher returns in SMEs than in larger firms given the low level of training of the workforce.

It is difficult to deal with return on training investments in more detail, leaving us with the question why SMEs do not invest more in training. We conclude by stating that there is nothing in the current review suggesting that skills or training in SMEs have any less impact on company performance. The study by Leitner (2001) indicates that training is one of the few variables associated with company earnings. The findings of Bosma et al. (2002) suggest that certain skills, such as experience in business ownership and industry experience, contribute to the success of start-up companies. The study by Romijn and Albaladejo (2000) indicates that both skills and training are associated with the innovation capability of SMEs.

5.7. The influence of labour markets and social partners

Research that connects education, training, or skills/competence with different labour market conditions and the impact that they may have on training strategies and company performance is not very common. We have not seen any paper examining the effect of different labour market conditions on, for instance, the ability of firms to profit from training investments. However, some general remarks can be made on existing training literature and the influence of labour markets. It has been argued that differences between the US labour market and labour market in Germany an other European countries in regard to mobility and wage structure would indicate that training investment is more likely in Europe (e.g. Acemoglu and Pischke, 1998; 1999a). These arguments have been supported by different empirical reasoning based mainly upon observations that firms invest in general training, such as in the German apprenticeship system ([17]). Nevertheless, there are no clear empirical results indicating that less efficient labour markets make training investments more profitable for firms, though mobility has the ability to reduce this potential. Similarly, it is likely that more equality in wages (compressed wage structure) has a positive influence on the ability to extract profits from training investments (and prior education). Still, we have not been able to locate research verifying differences in return on company training between different labour market systems.

There are some indications that differences in productivity between countries can be explained by differences in national education and training systems. For instance, Mason et al. (1992) found substantially higher proportions of vocationally qualified personnel on all job levels in the Netherlands compared with Britain. They also argue that the higher average level of skills and knowledge in the Dutch workforce contributes to higher productivity through better maintenance of machinery, greater consistency of product quality, greater workforce flexibility, and less learning time on new jobs. Similarly, Carr (1992) found that

([17]) Other features of the German apprenticeship system are that firms screen potential employees and that the apprentice system provides a better matching of employee and employer. According to Euwals and Winkelmann (2001) apprentices staying within their firm after graduation have higher wages and longer first job duration than apprentices leaving the training firm.

Britain had substantially lower productivity (measured by sales per employee) than, for instance, Germany. Carr maintains that the highly educated and trained German workforce, the high qualification of the foremen, and extensive vocational training by firms, explains the productivity advantage of German firms. Carr also ascribed improved productivity growth in Britain during the 1980s to increased labour flexibility during this period. However, it is important to note that neither study is based on any (significant) statistical test but more on reasoning based upon gathered information.

A somewhat contradictory argument on the effect of increased labour flexibility is put forward in Michie and Sheehan (1999). Their findings suggest that strategies to increase employment flexibility by short-term contracts, weakening trade unions, etc., do not enhance innovation performance. This study leads us to the effects that social partners may have on training outcomes. Again we have not come across any study that connects the influence of social partners on the decision to train employees and what effect this may have on company performance. The role of the social partners is not explicitly treated in any of the analysed studies.

Nevertheless, there are some general observations that can be made. The role of social partners is strongly connected with the different national funding systems for education and training. As argued by Mason et al. (1992) and Carr (1992), education and vocational training may, in turn, have an effect on productivity. Other observations that can be made are, for instance, that higher wages and lower mobility in unionised establishments typically promote training (Booth et al., 1999).

The Cranet survey results also cast some light on the question of whether different labour market systems or the social partners have any effect on the decision to train. The training regression is based on about 1 400 company responses mainly from European countries. The results indicated that unions might have a negative impact on the amount of training provided but a positive (not significant) impact on the number of employees being trained in a year. As mentioned earlier, the negative association between unionisation and the amount invested in training is probably caused by our inability to control for industry differences in the training regression. The indication that unions might affect the training decision by providing more employees with company training is more interesting. However, this is not statistically verified in the analysis of the Cranet survey. The correlation analysis also indicated a lower personnel turnover in more unionised establishments, which is in line with the findings of Booth et al. (1999).

Our measurement of the degree of internal labour market appears to confirm that these types of structures do not promote training and learning. In spite of the indication of lower personnel turnover in firms with more internal promotion, training is less provided in these types of establishments. The result of the training regression also revealed that personnel turnover itself does not determine training. This finding might be interpreted as an indication that turnover does not reduce the incentive to train employees or that personnel turnover induces training by forcing firms to train newly hired employees. We also see large differences in turnover among different European countries but this seems to affect the amount of training provided to a minor degree.

It is important to note that these findings only concern the provision of training and not the potential effect that different labour markets systems may have on training outcomes. This is clearly an area that needs much additional work. We conclude this section by merely stating that there are indications that labour market conditions and the role of, for instance, unions may have an effect on company training outcomes by their effect on mobility, wages, and the incentives to train and be trained.

6. Summary and discussion

A growing number of papers focus on the effects of human capital and human capital investments on company performance. Previously, this subject was largely disconnected from company based impact research as human capital (investments) are not owned or controlled by firms. However, more studies are needed to understand how education, training and skills/competence affect firms, in an effort to comprehend fully what generates profits and growth. The main findings of this review of literature on the impact of education, training, and skills/competence may be summarised as follows.

(a) The type of training firms provide to their employees is not so much a question of whether the training is general or specific but possibly more a question of what is needed to stay ahead of competitors. A growing body of literature suggests that firms are financing all types of training (general as well as specific).

(b) More recent research findings also suggest that investments in training generate substantial gains for firms irrespective of whether the training is useful to other firms. The evidence that employers profit from training investment comes from different countries including Ireland, Britain, the Netherlands, Sweden, France, as well as the US. In most of these studies we can, with reasonable confidence, maintain that training generates performance effects and not the other way around.

(c) The effects of education and skills/competence on productivity and innovation are generally positive and significant. That we also start to see studies that connect education and skills with profitability might be somewhat more unexpected. That firms extract profit from prior education is also related to the ability of firms to capture returns from general training investments.

(d) Employee development practices, such as training policies and methods for analysing training needs, appear to be important elements in explaining the provision of training and training outcomes. Similarly, innovative or advanced HRM practices are generally associated with firm performance.

(e) Innovation and IT not only cause firms to invest more in training but are also highly dependent on education, skills and training in generating profit from these investments. Other findings suggest that training, together with comprehensive HRM practices, is closely related to firms' innovative capacity.

(f) The lack of studies connecting SMEs, labour market characteristics, and social partners with training strategies and company performance measurements such as productivity or profitability makes it difficult to draw any conclusions. This research gap provides an important incentive to investigate these types of question more thoroughly in the future.

In conclusion, research concerning the effects of education and training on firm performance is gathering momentum. Much more research on this subject will appear in the near future. However, the findings thus far raise questions and issues that we will discuss in more detail in the next section.

6.1. Implication of firm financed general human capital investments

That firms invest in general training implies that there might be a market failure in vocational training. Several authors, (Acemoglu and Pischke, 1999a; Bassi and Ludwig, 2000; Booth et al., 1999), see in rejection of Becker's theory on company training evidence of under-investment in vocational training. In a perfect labour market, individuals pay for their general training by accepting a lower wage than their productivity during the training. The individual then captures all benefits from the training by an increased wage after the training. In this case it is likely that the provision of training is close to the social optimal level as the investment decision is made by the individual. Acemoglu and Pischke (1999a) noted that in a perfectly competitive labour market, insufficient investments in skills could only arise because workers are severely credit constrained. But in this case, the solution may be better loan markets rather than direct subsidies to training.

When the firm makes the training decision it is most likely that too little training is provided. Or, as Booth et al. (1999) put it, when training is general to an industry, firms will choose a suboptimal level of such training, since they realise that workers would take these skills with them when they leave for other firms in the same industry. However, human capital is not lost to society so a market failure arises. The findings that firms are active in, and profit from, general human capital investments might thus warrant government regulations and subsidies for training, as these findings suggest under-investment in vocational training. However, such a definite statement is not warranted by the present state of research on company training. More research is required to be certain that company-based decision-making concerning the provision of general training leads to fewer investments in training.

That firms profit from all types of training investments indicates that we have underestimated the benefits from company training. Because most (formal) training is general in nature, research on the impact of training has been largely focused on the effects for the individual (wages); the benefits for employers have been considered to a lesser extent. As noted by Dearden et al. (2000) by only examining the effect of education and training on wages, economists may have underestimated the importance of training for modern economies. The authors' conclude that it is time to start casting the net wider than wages in seeking the impact of training on corporate and national economic performance.

It appears that it is not only researchers who have underestimated the effects of training investments but, perhaps more severely, also the owners of the companies and investors. The findings of Bassi et al. (2001) indicate that firms investing more in training have a better stock market performance. This result suggests that investors are not aware of the investments in training and that this type of information has relevance for investors. The lack of information about training investment and the consequent benefits leads to a suboptimal allocation of resources to training in the capital market. It is conceivable that the lack of information about company training leads to under-investment in profitable training projects (training projects with a positive net present value). So another implication of the evidence that training predicts stock market returns is that investors possibly need more information about these investments in order to make better decisions about where to allocate their financial resources. The issue about information to the capital markets will be discussed in more detail in the next section.

The problem of allocating enough resources is, however, complex as information asymmetries is one of the more prominent reasons given for the existence of firm financed general human capital investments. According to Katz and Ziderman (1990) information asymmetries between the firm carrying out the training and other firms make firms more willing to invest in general training. This is because the lack of information about the training investment reduces the potential benefits that a worker with general training can obtain by moving to another firm. If Katz and Ziderman are right, providing more information about training investments to capital markets might have a negative effect on the provision of training.

However, another information-based argument implies the opposite effect. Acemoglu and Pischke (1999b) argue that firms train their employees because they have sufficient monopsony power over their employees due to information asymmetries. While asymmetric information encourages firms to invest in training, it reduces the workers' incentive to invest in their skills, as most of the returns on training will be appropriated by the firm. This means, in contrast to Katz and Zidermann's argument, that asymmetric information in labour markets might undermine the existence of training by not giving enough incentives to workers. More information about the training investment in this case leads to more investment in training ([18]).

6.2. Information on training and intangibles to capital markets

We proposed earlier that investors possibly need more information about training investments.

([18]) The divergent views of the outcome of more information about training investments between Katz and Ziderman (1990) and Acemoglu and Pischke (1999b) appear largely a consequence of different opinions about how inefficient the labour market really is.

Johanson (2003) proposes that capital market actors are hesitant regarding recent knowledge gathered from research on the importance of human capital investments because of the following five reasons.

First, capital market actors might be ambivalent because they fail to understand the importance of a certain human capital investment. They probably are not aware of recent research on the profitability of human capital investments. They lack the necessary understanding of the potential of human capital investments in a specific firm. They have little or no appreciation of how human capital contributes to the value creation process. This inability to comprehend the meaning of human capital could be conceptualised as a 'knowledge' problem.

Second, even if capital market actors do understand the connection between indicators and the vision of the firm, they are probably hesitant about human capital investments because they do not know if they can rely on the indicators. Do indicators of human capital transform adequate information? Are they valid? And are the methods of measurement reliable? These issues of validity and reliability could be referred to as the 'uncertainty' problem.

Third, this reluctance might be connected to the lack of ownership of intangibles related to people. For example, because an organisation cannot own individual competence, the risk of loosing this competence might be overly exaggerated. This condition could be known as the problem of 'ownership'.

A fourth problem could be that capital market actors are ultimately hesitant and indecisive because they do not know if the measurements matter in the management control processes of the firm. Is information taken care of? Does management take the necessary action on data, i.e. a 'management' problem?

The final problem suggested by Johanson (2003) concerns the 'mentality' of different capital market actors, who are neither used to considering human capital investments as important factors that drive firm performance nor encouraged to do so.

These five barriers are probably relevant not only for capital market actors but also for company management and policy makers.

There is a need to develop a new way of measuring and reporting internally as well as externally on training investments with the potential to increase understanding of the financial impact of education and training. Our proposal at this point relates to the debate about human resource costing and accounting, intellectual capital (IC), balanced scorecard, etc. (here referred to as the IC-movement).

During the last decade numerous initiatives have been taken to encourage the development of a new global framework for the measurement, management and reporting on intangibles. Major initiatives have been taken by the OECD and the European Commission. In 1998 the Commission decided to support a six-nation (Denmark, Finland, France, Norway, Spain and Sweden) research project named *Measuring and reporting intangibles to understand and improve innovation management* (Meritum, 2002). The Meritum work, which was performed between the years 1998 and 2001 was organised in four different activities:

(a) definition and classification of concepts, e.g. intangibles and intellectual capital;
(b) investigation of how management control of intangibles was performed at company level;
(c) capital market implications of the poor information from firms on intangibles;
(d) development of guidelines for the reporting and management of intangibles.

The guideline was subject to a Delphi test at the end of the project.

The Meritum work is presently subject to a follow-up project E*KNOW-NET which is also financed by the European Commission. The aim of the follow-up project is to spread the findings from the Meritum work, to improve guidelines and to propose a research and education agenda regarding intellectual capital.

The Meritum and E*KNOW-NET works are based upon the belief that firms are facing a major transformation in the value creation process. Intangibles, including, more specifically, knowledge, are increasingly becoming the major driver of firms. These changes pose a great challenge to firms because intangible resources are not easily identified, not measured, and not reported internally or externally. Another basic assumption is that there is a need to develop a common framework, which involves definitions and classifications of intangibles and a guideline for measuring, managing, and reporting intangibles.

The mismeasurement of knowledge may lead to inefficient allocation of financial and human resources. As the European Commission states in its report *Towards a European research area*, 'the European financial market has not yet sufficiently discovered the economic value to investment in knowledge' (European Commission, 2000, p. 7). This is partly due to the fact that the information provided by companies to the financial markets is primarily based on traditional tangible investments, whereas value increasingly relies on investment in intangibles.

Efforts are needed both to provide information on how knowledge is produced and accumulated, and on the way knowledge can be transformed into profits. The generalisation of good practice in the management of intangibles also needs to be encouraged. New common procedures, documents, rules, etc., should be provided in order to improve the informative capacity of the firm's financial statements. This is precisely the main purpose of the *Guidelines for managing and reporting on intangibles* (Meritum, 2002), hereafter referred to as *Guideline*.

The *Guideline* document attempts to support firms in the process of developing their ability to identify, manage and value their intangible assets. To start with, a set of definitions on intangible resources and intangible activities is provided; it is integrated with a classification used for the proposed intangible management system (human capital, structural capital and relational capital). Based on the experience of best practice firms, a model for the measurement and management of intangibles is suggested, which covers three different phases: identification, measurement and monitoring of intangibles.

The *Guideline* also contains information on the structure and contents of an external document called the *Intellectual capital statements*. Three different parts are considered for inclusion in that document:

(a) vision of the firm,
(b) a summary of intangible resources and activities, and
(c) a system of indicators.

To overcome the barriers proposed by Johanson (2003) it is important, as well as challenging, to develop understandable indicators on issues related to training investments. The indicators have to be measurable and valid. Because the very idea behind the development of training indicators is to increase the understanding of the importance of knowledge, the indicators have to be clearly related to the vision of the firm or the value creation process. It is probable that this new kind of standardised indicator also needs to be subject to independent audit.

6.3. Strength and weakness of data and methods

The lack of information on training investments also poses a problem for researchers, as the data has to be gathered from different sources. Depending on how one defines training, the estimate of working time spent on training varies considerably. The IPF at the Uppsala University regularly carries out surveys of companies listed on the Stockholm stock exchange. The human capital survey of 2002 included questions on what firms defined as company training. Some companies report only training conducted outside the firm (12 %), some report internal and external training sessions with a defined curriculum (39 %), and others report anything from formal training sessions to such informal training as learning by doing and self studies (45 %).

The lack of a coherent definition of training that is used and reported consistently by companies is one of the more important issues for research on company training. The problem of varying measurements of training is not likely to be solved by defining what is regarded as training in different surveys. Firms are unlikely to change their data collecting methods regarding training for each new survey. It seems likely that what companies report as training is what they have data for, no matter what is defined as training in each specific survey. At best one can expect the provider of the information to make some professional judgement or correction of their data for different surveys. Some straightforward guidelines or general agreement among researchers and companies on what to define as training seems be warranted.

Apart from a common definition and standard of training, another problem with the data concerns agreement on what type of costs should be included in training measures. The variety of measurements of training costs in different studies

and in different databases hinders the opportunity to make comparisons across countries and across different studies. A comprehensive measurement of training investments in companies will not only work as a foundation for comparison and across countries and studies but also facilitate comparison with other types of tangible investments. If investments in human capital can be compared with, and have the same credibility as, tangible investments we would advance understanding of what drives firms and, ultimately, what generates wealth for firms and society.

However, varying views of what is to be considered as company training do not mean that inferences drawn from, for example, current cross-sectional data are not valid. If there is a true relationship between training and company performance, vague definitions of training typically make estimates less precise and less significant. In other words, as long as it cannot be shown that profitable firms are constantly using a broader definition of training, and also account for more training investment, than less profitable firms, the consequence of vaguely defined training measures is a downward bias in the impact of training. Increased variance due to measurement problems (errors) leads normally to less significant results or, in the case of severe measurement problems, insignificant results. Definition problems might partly explain the low or insignificant impact of training in some of the studies reviewed in the present paper.

In the case of studies based on panel data the definition problem is less important since we are largely concerned with changes in variables over time in this type of investigation. If we follow the same company at different time intervals this means that we cancel out all time-invariant effects that can bias the results. As long as the unit of analysis (e.g. the company) does not change its definition over time the differences between how companies measure training is of less importance. The fact that we can draw stronger conclusions from panel data studies also mitigates problems with vague definitions.

In general, the weakness of data and the weakness of methods used in the reviewed studies do not exaggerate the results but, on the contrary, work against finding positive responses to human capital investments and thus tend to underestimate their impact on company performance.

6.4. Policy implications and future research

This review of research has highlighted a number of questions that possibly need more attention in an effort to establish a common understanding of how human capital and human capital investments influence growth and performance on firms. The general impression of the research that has been reviewed in this study is encouraging in that the economic effects of education, skills and training can be observed in company data. That firms appear to benefit from all types of training (no matter how general) is an important finding that also generates a number of other training related questions and implications. We will highlight some of the implications and research questions we feel should be pursued in the future.

(a) What are different aggregated measures of training actually measuring?
We have seen in the Cranet survey that two common ways of measuring training (the proportion of employees being trained and percentage of wage bills spent on training) are determined by quite different factors. Whether this is the case in other samples and whether it has any meaningful interpretation in regard to company performance would be useful to determine in future research.

(b) What influence has firm performance on the provision of training?
We have also discussed the timing of training. We have seen a number of studies indicating that training is more likely to be carried out in times of weak productivity; we have also seen in the Cranet survey that how much firms invest in training is not conditioned by past performance. Clarification of any mutual dependence between training and economic conditions is important as the answer would facilitate interpretation of cross-sectional results.

(c) When do the effects of training materialise?
Some of the studies reviewed suggest that it takes some time before the effects of training are seen in company performance measurements. Whether this is the case is an important research question as it influences interpretations made in cross-sectional estimates (are we measuring the effects of past training or the effects of current training efforts?) and

it also influences the time horizon within which we can expect benefits from training.

(d) Are certain types of training or certain ways of conducting training more efficient?
The current state of research typically uses very coarse and aggregated measurements. A more precise division of human capital and human capital investments might give us a better understanding of the type of education and training that generates profit and growth for firms.

(e) Do firms benefit from employing more educated and skilled workers?
More research is warranted that connects skills, competence and education with company measurements such as profitability and stock market return.

(f) How important are supportive HRM practices for generating training and performance effects?
There is a need to understand how and in what way HRM practices influence training decisions and to what extent are they increase efficiency in training and training outcomes.

(g) More research is needed on the impact of training for SMEs, and on the influence of social partners and the labour market.
While smaller firms undertake less training, more research is needed to explain the reasons for this. Research is also warranted on the influence that social partners and different labour market systems might have on the ability of firms to benefit from training investment. We see quite large differences between different countries in company training and an explanation for these differences might be found in the effect that these two factors have on the provision of training and training outcomes.

(h) Another important issue is a common standard for defining and measuring training and training costs.
There is a significant difference between asking individuals about training and asking firms about their training. Gathering information on training in large organisations consumes considerable resources and training data is not easily changed in accordance with different surveys. A common definition of what to regard as training and a common definition of costs in training investments would be beneficial not only for researchers but to compare companies, industries, and countries on company training.

(i) More information for capital markets about training investments appears to be warranted.
A way of providing information on how much firms invest in training appears to be an important issue in establishing a more efficient allocation of resources to firms with good investment opportunities. More company-based information on training might also lead to a better allocation in the human capital (labour) market.

List of selected abbreviations

GMM	General method of moments
HPWS	High performance work systems
HRM	Human resource management
IC	Intellectual capital
IT	Information technology
LFS	Labour force survey
OLS	Ordinary least square
R&D	Research and development
SME	Small and medium enterprise
STW	School-to-work
TQM	Total quality management

Annex — Selected Cranet questions

Training related questions

3:1 a) Approximately what proportion of the annual salaries and wages bill is currently spent on training?

———————————————— % 1❑ don't know

b) Approximately what proportion of employees have been on internal or external training activities within the last year?

———————————————— % 1❑ don't know

3:3 Do you systematically analyse employee training needs?

1❑ Yes 2❑ No 3❑ Don't know

3:5 Do you monitor the effectiveness of your training?

1❑ Yes 2❑ No 3❑ Don't know

3:6 Does your organisation have a policy for the following personnel/human resource management areas:

	Yes, written	Yes, unwritten	No	Don't know
C. Training and development	❑1	❑2	❑3	❑4

Performance related questions

7. If you are a private organisation would you say the gross revenue over the past 3 years has been:

A. Well in excess of costs ❑1
B. Sufficient to make a small profit ❑2
C. Enough to break even ❑3
D. Insufficient to cover costs ❑4
E. So low as to produce large losses ❑5

9. Compared to other organisations in your sector, where would you rate the performance of your organisation in relation to the following?

	Top 10 %	Upper half	Lower half	Not applicable
A. Service quality	❑1	❑2	❑3	❑4
B. Level of productivity	❑1	❑2	❑3	❑4
C. Profitability	❑1	❑2	❑3	❑4
E. Rate of innovation	❑1	❑2	❑3	❑4
F. Stock market performance	❑1	❑2	❑3	❑4

Questions related to internal job market and unionisation

2:5 How are managerial vacancies generally filled? (Please tick as many as applicable for each management level).

	Senior Management	Middle Management	Junior Management
A. Internally	❑1	❑1	❑1
B. Recruitment by head hunters/consultancies	❑1	❑1	❑1
C. Advertise in newspapers	❑1	❑1	❑1
D. Word of mouth	❑1	❑1	❑1

5:1 What proportion of the total number of employees in your organisation are members of a trade union?

1❑ 0 % 2❑ 1-10 % 3❑ 11-25 % 4❑ 26-50 %
5❑ 51-75 % 6❑ 76-100 % 7❑ Don't know

Employee related questions

6:3 Please provide the following information about your workforce:

A. Annual staff turnover	_____% turnover per year	❑1 don't know
B. Age structure	_____% of employees over 45 years	❑1 don't know
C. Absenteeism	_____average days per year	❑1 don't know
D. Education structure	_____% of graduates	❑1 don't know

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