# Determinants of employer-provided training in construction firms: evidence from transition economies

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## Abstract

**Purpose** – This paper aims to investigate the determinants of employee training provision in construction across Central and Eastern Europe and Central Asia.

**Design/methodology/approach** – Using Business Environment and Enterprise Performance Survey (BEEPS) 2019 data, the study analyses 1,372 construction firms (1,098 after listwise deletion) across 28 countries. A probit model with average marginal effects examines how managerial experience, perceived workforce education adequacy, innovation activity, firm size and locality size influence training provision. Institutional grouping controls and extensive robustness checks are reported.

**Findings** – Training provision is predominantly reactive, driven by perceived skill deficiencies rather than strategic planning. Perceived workforce education inadequacy is jointly significant as a determinant of training (Wald test $p = 0.011$), though the graduated intensity pattern observed in point estimates is not statistically distinguishable from a simple binary effect. Manager experience, perceived education inadequacy, firm size, innovation activity and smaller locality size significantly increase training likelihood.

**Practical implications** – Policy should address skill deficiencies through vocational partnerships and place-based strategies rather than relying solely on financial subsidies. If the association between managerial experience and training reflects a causal pathway, management development programmes can indirectly benefit workforce training. Training initiatives should target smaller localities, where firms demonstrate greater receptivity.

**Originality/value** – The findings challenge the assumption that training decisions in construction follow the strategic optimisation logic of human capital theory, revealing a reactive pattern shaped by bounded rationality. The study provides sector-specific evidence from 28 transition economies. The finding that firms in smaller localities are more likely to provide employee training contributes new evidence on place-based workforce development.

**Keywords** Employee training, Construction industry, Human capital theory, Transition economies, Place-based development, Reactive training

**Paper type** Research paper

## Introduction

The construction industry contributes approximately 9% of global GDP and employs over 13 million people in Europe (Horta *et al.*, 2013; Cedefop, 2023). Yet the sector consistently suffers from low productivity and inefficiency (Barbosa *et al.*, 2017). Labour shortages in European construction in 2023 were nearly three times higher than levels observed a decade earlier (Cedefop, 2023), and the World Economic Forum (2025) estimates the global

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industry could lose $40tn in potential output by 2040 without urgent workforce investment. Human resource management (HRM) practices, particularly employee training, are key drivers of organisational performance (Koch and McGrath, 1996). However, the construction industry shows a persistent underinvestment in workforce development. The 2017 European Investment Bank survey found that countries with the lowest shares of firms investing in training are concentrated in Southern and Eastern Europe. Over 40% of firms in Bulgaria invested nothing in training, compared to below 15% in the Czech Republic and Slovakia (Brunello and Wruuck, 2020). This variation raises questions about what drives training decisions in the first place.

The urgency of understanding these training decisions has intensified. The European construction industry requires an estimated 3 million workers to be upskilled or reskilled by 2027, with up to 1.5 million additional positions needed by 2030 (Cedefop, 2023). This demand is driven by the twin green and digital transitions reshaping the sector. Construction 4.0, the increasing integration of automation, artificial intelligence, building information modelling (BIM) and modular construction, is transforming design, production and management processes (García de Soto *et al.*, 2022). Simultaneously, the shift towards circular construction and green retrofitting is creating entirely new occupational profiles. The ILO (2021) projected that these transitions will eliminate 22 million traditional construction jobs globally while creating 29 million new roles. The sector cannot meet these transitions through reactive responses to skill shortages. Understanding what drives employer training decisions is, therefore, not only an academic question but a policy imperative.

Research focused on occupational training within construction remains limited (Detsimas *et al.*, 2016; Maqbool *et al.*, 2024). While existing studies establish the positive impact of training on labour productivity, they largely overlook the factors determining whether employee training is provided. The construction sector's distinctive features, project-based production, mobile workforces and cyclical demand, create conditions that may shape training decisions differently from other industries. These same features also shape the nature of workplace learning in construction, where much skill development occurs informally through participation in project-based work rather than through formal training programmes (Billett, 2004; Ellström, 2011).

This is especially relevant in the transition economies of Central and Eastern Europe and Central Asia. The European Bank for Reconstruction and Development (EBRD) has identified skills shortages across these regions as a key barrier to firm productivity and growth (EBRD, 2018). Education systems in many of these countries create obstacles to workforce upskilling, while the emigration of skilled workers has worsened shortages. The EBRD (2024) reported that navigating industrial transformation in these economies requires place-based approaches to skills development that account for local labour market conditions. The construction sector, already characterised by high labour turnover and informal employment practices, is particularly exposed.

This paper addresses the following research question: what managerial, organisational and contextual factors determine whether construction firms in transition economies provide employee training? Specifically, we examine the roles of managerial experience, perceived workforce education adequacy, innovation activity, firm size and locality size in shaping training decisions.

Drawing on human capital theory (HCT) (Becker, 1964) and the resource-based view (RBV) (Barney, 1991; Boon *et al.*, 2018), supplemented by insights from workplace learning theory (Billett, 2004; Ellström, 2011) encompassing the concept of reactive training, we analyse the Business Environment and Enterprise Performance Survey (BEEPS) 2019 data covering 1,372 construction firms across 28 countries. The sample spans diverse institutional

contexts, from EU member states such as the Czech Republic and Poland to Central Asian economies such as Kazakhstan and Uzbekistan. A probit regression model with average marginal effects is estimated. This approach mirrors that of Roshchin and Travkin (2017), who used probit estimates on Russian enterprise data to examine training determinants. Our study extends this line of inquiry by focusing specifically on construction and by including a broad set of transition economies.

The study contributes to the training and development literature in three ways. First, it provides sector-specific evidence from an underexplored geographical context, responding to calls within the training literature for more sector-specific and geographically diverse evidence on what drives employer-provided training (Hansson, 2007; Brunello and Wruuck, 2020). Second, it challenges the assumption that training decisions in construction follow the strategic optimisation logic central to HCT, revealing instead a reactive pattern driven by perceived skill deficiencies and shaped by bounded rationality (Tan, 2014). Third, it reveals locational patterns in training provision that contradict metropolitan-centric thinking in workforce development research and support place-based approaches to training policy (Rodríguez-Pose, 2018; EBRD, 2024).

## Literature review

### *Employee training, human capital and workplace learning in construction*

HCT suggests that investments in education, training and skill development generate increased productivity and economic growth (Becker, 1964; Schultz, 1961). The primary benefit of investing in people is the improvement in performance at individual and organisational levels, leading to higher production and profitability (Nafukho *et al.*, 2004). The ILO's Human Resources Development Recommendation (No. 195) reinforces this view, emphasising the role of training in both economic and social development (ILO, 2000). Complementing HCT, the RBV argues that a highly productive workforce can constitute a valuable strategic asset (Koch and McGrath, 1996). Porter (1985) contended that HRM practices, such as training, enable a company to produce more productive workers than competitors, constituting a competitive advantage.

However, HCT's assumption of strategic optimisation, that firms rationally calculate the returns to training investment and act accordingly, has been questioned. Tan (2014) argued that bounded rationality and institutional constraints often prevent alignment between company interests and training investment that the theory predicts. Auerbach and Green (2025) reinforced this critique, arguing that HCT's grounding in methodological individualism sidelines both external effects of learning and social factors shaping demand for education and training. This critique is particularly relevant in construction, where project-based temporality, cyclical demand and uncertain future skill requirements make long-term training planning difficult. When future project requirements are unknown, firms may logically defer training until specific gaps appear. This represents a practical response to an operating environment characterised by uncertainty.

Workplace learning theory offers a complementary perspective. Billett (2004) demonstrated that much skill development occurs through participation in work activities rather than through formal training programmes. Ellström (2011) distinguished between adaptive learning, which responds to immediate task demands, and developmental learning, which involves critical reflection and the capacity to handle novel situations. In construction, the prevalence of project-based work means that much learning is inherently adaptive and situated within specific project contexts. Fuller and Unwin (2004) extended this analysis through their expansive-restrictive framework, which examines how organisations create learning environments that either support or constrain both formal and informal skill

development. In expansive environments, employees have access to a broad range of learning opportunities; in restrictive environments, learning is narrowly task-focused. Applied to construction, project-based structures can create either expansive environments (diverse projects, mentoring, varied skill demands) or restrictive ones (repetitive tasks, time pressure, minimal investment in development). Consequently, understanding what drives formal training decisions remains important, as formal training is more amenable to policy intervention and more likely to address systematic construction skill gaps identified by the ILO (2015).

These three theoretical perspectives are combined in this study. HCT provides an economic rationale for training investment and frames a cost–benefit calculus driving business decisions. RBV frames managerial capability and internal resource development as strategic assets, explaining why firm-level characteristics such as management experience may shape training decisions. Workplace learning theory contextualises formal training within the broader learning environment of construction projects, acknowledging that formal training provision (the dependent variable in this study) captures part of the skill development picture [1].

Given the labour-intensive nature of construction, the industry's success depends heavily on its human capital. Human capital, the knowledge, skills and capabilities of individuals that have economic value to an organisation (Bohlander *et al.*, 2001) are the foundation on which construction productivity depends. For construction firms, investment in workplace training is essential for systematic skill enhancement (Detsimas *et al.*, 2016). Ramadan *et al.* (2023), surveying over 2,400 construction workers, confirmed a statistically significant positive link between training hours and worker performance, underlining the importance of understanding what drives the provision of employee training. Yet the industry identified skill gaps as particularly acute in construction (Association for Talent Development, 2018). Although the evidence base has grown, sector-specific research on what drives training decisions in construction remains limited (Watson, 2007; Detsimas *et al.*, 2016; Maqbool *et al.*, 2024).

The skill gaps have direct consequences. Increased project complexity exposes gaps in workforce knowledge and skills, with consequences for quality and productivity (Marshall and Tucker, 1992; Maqbool *et al.*, 2024). Dainty *et al.* (2004) linked this directly to inadequate investment in training and skill development. Maqbool *et al.* (2024) demonstrated that skills shortages in the UK construction are compounded by Brexit-driven labour reductions, an ageing workforce and the pandemic, with training and development identified as the fundamental corrective mechanism. The ILO (2015) reported that many employers in construction face difficulty finding skilled workers, partly because training programmes are out of date and do not meet industry needs. This problem is especially acute in developing and transition economies, where shortages of medium-skilled construction workers are severe (ILO, 2015; ILO, 2021).

Applying HCT and RBV to construction requires careful consideration. Construction's project-based nature creates irregular employment, which may disrupt direct relationships between training investment and productivity returns that are central to traditional HCT. Multi-firm coalitions, typical in construction projects, blur the boundaries between firm-specific and general training, a distinction fundamental to HCT's economic calculus (Dubois and Gadde, 2002). Workers move between firms and projects, so a firm providing training may not be the firm capturing returns. In transition economies, these challenges are compounded by institutional uncertainty. Estrin *et al.* (2009) demonstrated that firms in post-socialist economies face distinctive strategic constraints, including underdeveloped labour market institutions and unstable regulatory environments, that shape HRM investment decisions in ways that HCT does not fully capture. These characteristics suggest that while

HCT and RBV provide useful theoretical lenses, training determinants may operate differently in construction compared to more stable organisational contexts.

*Reactive training in project-based industries*

A distinctive pattern of training provision in construction can be identified, termed "reactive training", defined as training responding to perceived skill deficiencies rather than undertaken as part of a forward-looking workforce development strategy. This concept draws on the intersection of three conceptual foundations. First, bounded rationality (Simon, 1955; Tan, 2014; Balarezo *et al.*, 2024) suggests that when information processing capacity is limited and future skill requirements are uncertain, firms satisfice rather than optimise, deferring training investment until skill gaps become salient enough to trigger action. Second, construction's project-based structure means that skill requirements change with each project, making long-term training planning inherently difficult, grounded in project-based temporality (Dubois and Gadde, 2002). Third, the structural features of the sector – high labour turnover, cyclical demand and multi-firm coalitions – create conditions where the returns to proactive training investment are uncertain (Porter, 1985).

While reactive training is a practical adaptation to an environment characterised by uncertainty, it carries high costs. If training is only triggered by problems, firms miss opportunities for developmental learning (Ellström, 2011) and proactive skill building. This is especially urgent as Construction 4.0 technologies demand new digital competencies that cannot be developed reactively (García de Soto *et al.*, 2022). Reactive training leads to a testable prediction: if training in construction is reactive, we should observe a significant positive association between perceived skill deficiencies and training provision.

Alternatively, it is possible that learning-oriented firms both perceive skill gaps more readily (given more developed assessment processes) and provide more training because they value workforce development. If this is the case, the association between perceived skill gaps and training would reflect organisational culture rather than reactive decision-making. Because cross-sectional analyses cannot definitively adjudicate between these two interpretations, we return to this issue later.

*Managerial characteristics*

In construction, managerial experience is crucial. Experienced managers bring industry expertise and problem-solving skills that lead to better project outcomes (Ghoddousi *et al.*, 2015). A UK survey of construction project managers found that 64% gain requisite experience through participation in up to 10 projects before attaining their role (Edum-Fotwe and McCaffer, 2000). Leadership style has also been identified as a factor influencing construction management quality (Toor and Ofori, 2008) and human resource productivity (Odusami *et al.*, 2003). Ghoddousi *et al.* (2015) surveyed 116 Iranian construction projects and found that management policies and leadership strategies had high effects on productivity.

Yet managers can also be obstacles to training. Padachi and Lukea Bhiwajee (2016) identified managers as one of the primary barriers to training provision in SMEs. Some authors argue that managers overlook the importance of human resources as essential assets (Beaver and Hutchings, 2005). Others suggest that managers, deeply engaged in daily operations, prioritise short-term profitability over longer term workforce development (Matlay, 1999; Panagiotakopoulos, 2011). This creates a tension: managerial characteristics can both enable and constrain training decisions. In a construction project-based environment, experienced managers may be better placed to recognise recurring skill gaps across projects and to see the value of addressing them through training.

*Innovation and training*

Training is a key strategy for benefiting from technological progress (Baldwin and Johnson, 1996). Innovative firms prioritise employee skills more than other firms. Hansson (2007), using the Cranet survey, found that innovation is a significant company-based determinant of employee training. Roshchin and Travkin (2017) confirmed this for Russian enterprises, showing that innovative activity and the technological state of manufacturing are decisive factors in explaining firm training provision.

The construction industry has, however, been slow to adopt new technologies. In spite of the potential of innovations such as BIM, adoption rates have been slower than expected (Walasek and Barszcz, 2017; Holt *et al.*, 2015). García de Soto *et al.* (2022) argued that Construction 4.0 technologies are reorganising workforce hierarchies, demanding new digital skills that traditional training structures are not equipped to deliver. The ILO (2015) noted that the greening and digitalisation of construction require new skill sets and training approaches that go beyond traditional building competencies. This creates a clear link between innovation activity and the need for complementary training. As construction firms in transition economies innovate, the demand for employee training is likely to grow.

*Firm characteristics and geographical context*

Firm size is a recognised determinant of training provision. Larger firms are more likely to invest in training because they have dedicated HR departments and budgets (Hansson, 2007). The EBRD (2018) noted that in its regions, a relatively small number of large firms account for the majority of employment, benefiting from economies of scale and greater capacity for innovation. Kotey and Slade (2005) describe training as an unaffordable luxury for SMEs, while Storey and Westhead (1997) argue that small businesses deliver inadequate training because expected benefits do not outweigh costs.

The geographical context in which firms operate is theoretically important for training decisions and has received insufficient attention in the construction training literature. Becker's (1964) distinction between general and firm-specific training has a spatial dimension. In large metropolitan labour markets, workers trained in general skills can move freely between employers, creating a free-rider problem that discourages firm-level investment. In smaller, thinner labour markets, worker mobility is more constrained and firms may invest in training with greater confidence that they will retain the returns.

Felstead *et al.* (2009) found that learning environments vary significantly by geographical context. Their research found that smaller localities often feature more integrated training networks between firms and local institutions, with closer employer–provider relationships and more responsive programme design. Rodríguez-Pose (2018) argued that peripheral areas, often overlooked by national policy, develop distinctive economic dynamics that shape firm behaviour in ways that metropolitan-centric frameworks miss. Iammarino *et al.* (2019) reinforced this, demonstrating that regional innovation systems vary substantially in their capacity to support skill development, with implications for training provision. Corradini *et al.* (2023) also show that spatial imbalances in skills supply and demand call for regionally tailored policy responses rather than uniform national strategies. The EBRD (2024) has increasingly advocated place-based approaches to economic development in transition economies, arguing that national-level strategies often miss the distinctive dynamics of local labour markets. These arguments suggest that locality may be treated as a theoretically grounded variable in models of training determinants, not merely as a control.

Thus, the literature identifies factors that may operate distinctively in construction's project-based environment. Managerial experience accumulates across discrete projects rather than within continuous operations, meaning its effect on training decisions may reflect

pattern recognition across varied skill demands. Perceived skill gaps are particularly salient in construction because they manifest as visible project problems rather than abstract performance metrics. Innovation activity in construction creates immediate, concrete skill demands (a new BIM system, a green retrofit technique) that trigger complementary training needs. And geographical context shapes the labour market conditions, worker mobility and employer–provider relationships that determine whether training investment is likely to be retained. These features motivate the hypotheses:

*Hypotheses*

*H1*. Managerial experience is positively associated with the probability of employee training provision in construction firms.

*H2*. Firms that engage in innovation activity are more likely to provide employee training.

*H3*. Firms that perceive an inadequately educated workforce as an obstacle are more likely to provide employee training.

*H4*. The association between perceived workforce education inadequacy and training provision is graduated, with firms perceiving more severe skill deficiencies being progressively more likely to provide employee training.

*H5*. Firms in smaller localities are more likely to provide employee training than those in larger cities.

*H3* tests the core reactive training proposition, that perceived skill deficiencies trigger training provision. *H4* tests whether this reactive response is graduated, with more severe perceptions producing stronger training responses, or whether any level of perceived inadequacy is sufficient to trigger training. *H5* is grounded in the spatial dimension of human capital theory and the place-based development literature.

## Data and methodology

*Data*

This study uses cross-sectional data from the BEEPS 2019, conducted by the EBRD in collaboration with the World Bank (World Bank, 2023). BEEPS collects firm-level data through face-to-face interviews with a senior manager or owner of each firm using stratified random sampling. Strata consist of firm size, industry sector and geographical region within each country. The survey covers firm attributes, financial access, workforce composition, innovation and performance indicators.

The 2019 wave contains 18,254 observations across 893 variables. Filtering for the construction sector [2] yields 1,372 firms across 28 countries in Central and Eastern Europe and Central Asia. Armenia and Belarus, though included in the original sampling frame, were unavailable for individual download from the Enterprise Surveys portal at the time of this analysis. The full list of countries and their institutional groupings is provided in Appendix Table A1.

The 28 countries in the sample span three broad institutional contexts: EU member states (11 countries), the Western Balkans (6 countries) and other transition economies (11 countries). These groupings reflect differences in vocational training infrastructure, labour market regulation and economic development and are included as dummy variables to control for compositional differences between country groups (see Results). While

individual country-fixed effects are precluded by sample size constraints (several countries have fewer than 30 construction firm observations), the geographical diversity of the sample is a strength.

*Variables*

The dependent variable is employee training provision (ETP), a binary variable taking the value of 1 if the firm provides employee training and 0 otherwise. In the sample, 36.1% of construction firms provide employee training. The remaining 63.9% do not. This low rate is consistent with the broader pattern of training underinvestment in the EBRD regions (Brunello and Wruuck, 2020).

The study uses several independent variables to test the hypotheses. Manager years of experience (MgrExp) is a numerical discrete variable. The mean is 20.4 years (SD = 11.1), ranging from 1 to 57 years. Female manager (FMgr) is a dummy variable where 1 indicates a female manager.

Inadequately educated workforce as an obstacle (InadEdu) is an ordered categorical variable ranging from 0 (no obstacle) to 4 (very severe). It captures managers' perceptions of how far workforce education inadequacy constrains firm growth. This perception-based measure aligns with our focus on decision-making processes, as managers' perceptions directly influence training decisions more than objective measures (Detsimas *et al.*, 2016). Two control variables are included. The number of employees (E) controls for firm size. A binary variable for whether the firm introduced a new product or service (Tech) controls for innovation activity. Locality size (Pop) is an ordered categorical variable with four population categories: less than 50,000, 50,000–250,000, over 250,000–1 million and over 1 million. It is a density/size-based indicator to proxy potential for business network thickness. Table 1 summarises the variables and descriptive statistics.

The independent and control variables were selected to test theoretically motivated hypotheses derived from the training determinants literature (Roshchin and Travkin, 2017; Neycheva and Baltov, 2024) [3].

The probit regression uses 1,098 observations after listwise deletion, a reduction of 20% from the full construction sample of 1,372. The primary driver of missingness is the labour cost variable, which accounts for 241 of 274 excluded observations (88%). Systematic comparison of included and excluded firms found no significant differences in training rate (36.8% vs 33.3%, Chi-squared $p = 0.293$), firm size ($p = 0.387$), manager experience

**Table 1.** Variable descriptions and descriptive statistics

| Variable | Role | Type | Obs. | Mean | SD | Min. | Max. |
|---|---|---|---|---|---|---|---|
| Employee training provision (ETP) | DV | Binary | 1,362 | 0.361 | 0.480 | 0 | 1 |
| Manager years of experience (MgrExp) | IV | Numerical | 1,344 | 20.37 | 11.07 | 1 | 57 |
| Female manager (FMgr) | IV | Binary | 1,372 | 0.084 | 0.277 | 0 | 1 |
| Inadequately educated workforce (InadEdu) | IV | Ordered cat. | 1,358 | 1.677 | 1.322 | 0 | 4 |
| Number of employees (E) | Control | Numerical | 1,359 | 66 | 145 | 1 | 2,500 |
| New product or service (Tech) | Control | Binary | 1,365 | 0.190 | 0.392 | 0 | 1 |
| Locality size (Pop) | IV | Ordered cat. | 1,371 | – | – | 1 | 4 |

**Note(s):** DV = dependent variable; IV = independent variable. $n = 1,372$ construction firms across 28 countries. Locality distribution: <50,000 (32.4%), 50,000–250,000 (21.4%), 250,000–1 million (23.8%) and >1 million (22.3%). InadEdu distribution: no obstacle (26.8%), minor (17.2%), moderate (25.9%), major (19.2%), very severe (9.8%)
**Source(s):** BEEPS 2019 (World Bank, 2023)

($p = 0.947$), InadEdu distribution ($p = 0.837$), innovation activity ($p = 0.524$), female manager proportion ($p = 0.993$) or institutional grouping ($p = 0.198$). One significant difference was identified: excluded firms are more evenly distributed across locality sizes ($p = 0.012$), whereas included firms show greater concentration in smaller localities. This should be borne in mind when interpreting the locality results.

*Statistical analysis*

Given the binary dependent variable, a probit regression model is estimated:

$$\Pr(\text{ETP} = 1) = \phi(\beta 0 + \beta 1\text{MgrExp} + \beta 2\text{FMgr} + \beta 3\text{InadEdu} + \beta 4\text{E} + \beta 5\text{Tech} + \beta 6\text{Pop})$$

Average marginal effects (AMEs) are calculated for each variable. AMEs estimate the average change in probability of training provision for a one-unit change in each predictor. For categorical variables, they represent the difference in probability relative to the base category. This approach follows Roshchin and Travkin (2017). Because probit models assume normally distributed error terms, heteroskedasticity is addressed within the model specification. A correlation matrix was constructed to assess multicollinearity. No problematic correlations were identified among the independent variables (all variance inflation factors below 1.5, mean VIF = 1.23; see Appendix Table A3). All analyses were conducted using Stata 17 (StataCorp, College Station, TX).

## Results

We first report the base specification (Tables 2 and 3), and then add institutional grouping controls (Table 5), following the convention used in comparable analyses (Roshchin and Travkin, 2017; Neycheva and Baltov, 2024). The probit model is estimated on 1,098 observations after accounting for missing values. Table 2 presents the model statistics.

The model is highly significant overall ($\text{Prob} > \text{Chi}^2 = 0.000$), indicating that the independent variables collectively explain significant variation in training provision. The McFadden pseudo R-squared is 0.043. As is common in cross-sectional probit models designed to identify significant determinants rather than maximise predictive power, this value reflects the influence of unobserved factors not captured in the data set (Veall and Zimmermann, 1994). Additional model diagnostics support adequate fit: the model correctly classifies 64.5% of observations, the area under the ROC curve is 0.649 and the Hosmer–Lemeshow goodness-of-fit test is borderline ($\text{Chi}^2 = 15.52$, $p = 0.050$). These

**Table 2.** Probit regression model statistics

| Statistic | Value |
|---|---|
| Number of observations | 1,098 |
| LR $\text{Chi}^2$ ($\text{Prob} > \text{Chi}^2$) | 0.000 |
| McFadden pseudo-$R^2$ | 0.043 |
| Correctly classified | 64.5% |
| Area under the ROC curve | 0.649 |
| Hosmer–Lemeshow $\text{Chi}^2(8)$ | 15.52 ($p = 0.050$) |

**Note(s):** Dependent variable: employee training provision (binary). McFadden pseudo $R^2$ measures improvement in log-likelihood relative to the null model (Veall and Zimmermann, 1994). The AUC of 0.649 indicates modest discriminatory power consistent with the model's explanatory purpose
**Source(s):** Authors' analysis of BEEPS 2019 data

**Table 3.** Average marginal effects from probit regression

| Variable | AME | SD. | $p>\|z\|$ | 95% Conf. interval |
|---|---|---|---|---|
| *Panel A: hypothesised variables* | | | | |
| Manager experience (MgrExp) | 0.003 | 0.0013 | 0.032* | 0.000 to 0.005 |
| Female manager (FMgr) | 0.082 | 0.0509 | 0.107 | –0.018 to 0.182 |
| *InadEdu (base: no obstacle)* | | | | |
| Minor | 0.124 | 0.043 | 0.004** | 0.039 to 0.209 |
| Moderate | 0.088 | 0.038 | 0.022* | 0.013 to 0.163 |
| Major | 0.082* | 0.042 | 0.052 | –0.001 to 0.165 |
| Very severe | 0.159 | 0.054 | 0.003** | 0.053 to 0.264 |
| Labour cost (LC) | 1.59e−11 | 2.05e−11 | 0.438 | –2.42e−11 to 5.60e−11 |
| *Panel B: control variables* | | | | |
| Employees (E) | 0.0003 | 0.0001 | 0.001*** | 0.000 to 0.000 |
| New product/service (Tech) | 0.110 | 0.035 | 0.002** | 0.041 to 0.179 |
| *Locality size (base: <50,000)* | | | | |
| 50,000–250,000 | –0.090 | 0.040 | 0.026* | –0.170 to 0.011 |
| 250,000–1 million | –0.135 | 0.038 | 0.000*** | –0.209 to 0.060 |
| >1 million | –0.076 | 0.040 | 0.058 | –0.154 to 0.003 |

**Note(s):** ***$p<0.01$, **$p<0.05$, *$p<0.10$. $n=1{,}098$. Base categories: InadEdu = no obstacle; Pop = <50,000. Wald test for joint significance of InadEdu: $Chi^2=13.02$, $p=0.011$. Wald test for equality of InadEdu coefficients: $Chi^2=2.50$, $p=0.475$ (graduated pattern not statistically confirmed)
**Source(s):** Authors' analysis of BEEPS 2019 data

diagnostics confirm that the model has modest but meaningful discriminatory power, consistent with its explanatory rather than predictive purpose. Full probit coefficients are reported in Appendix Table A2.

To interpret the probit output, Table 3 presents the average marginal effects, which provide a more meaningful interpretation than the probit coefficients.

*Managerial characteristics*

The manager years of experience exhibits a positive and significant effect on training provision (AME = 0.003, SE = 0.0013, $p = 0.032$). For every additional year of experience, the probability of providing employee training increases by approximately 0.3 percentage points, holding all else constant. However, this effect is non-significant when institutional grouping controls are added (AME = 0.0018, $p = 0.165$; see Table 3 Panel B). This suggests that the effect in the base model reflects compositional differences between country groupings. The AME remains positive and in the expected direction, and the country-sensitivity analysis shows significance in 23 of 28 leave-one-out specifications, but the finding should be interpreted cautiously. This supports *H1* in the base specification and is consistent with the broader literature linking managerial capability to strategic HRM decisions (Koch and McGrath, 1996). Edum-Fotwe and McCaffer (2000) documented how construction managers build competence through successive project involvement, and our findings suggest that this accumulated experience is associated with a greater propensity to invest in workforce training.

The female manager variable is not significant (AME = 0.082, $p = 0.107$). Manager gender does not appear to affect training likelihood in this sample. The wide confidence interval reflects the small proportion of female managers in the sample, which limits the statistical power to detect an effect.

*Workforce education perceptions*

Perceived workforce education inadequacy has a positive and significant effect on training provision, supporting *H3*. The four InadEdu categories are jointly significant (Wald $Chi^2 = 13.02$, $p = 0.011$). Relative to the base category of no obstacle, firms perceiving an inadequately educated workforce as a minor obstacle are 12.4 percentage points more likely to provide employee training ($p = 0.004$). Those viewing it as moderate are 8.8 percentage points more likely ($p = 0.022$). A major obstacle increases the likelihood by 8.2 percentage points ($p = 0.052$). A very severe obstacle makes it 15.9 percentage points more likely ($p = 0.003$).

While the point estimates suggest an escalating pattern, with the very severe category showing the largest effect, a formal Wald test cannot reject the null hypothesis that all four InadEdu category coefficients are equal ($Chi^2 = 2.50$, $p = 0.475$). The very severe category is not significantly different from the minor category ($p = 0.558$). The evidence supports *H3* (perceived skill gaps trigger training provision) but not *H4* (a graduated intensity pattern). Perceived workforce education inadequacy is an identified determinant of training, but the graduated dose–response relationship suggested by the point estimates is not statistically distinguishable from a simple binary effect (any obstacle versus no obstacle).

*Control variables*

Firm size has a small but highly significant positive effect (AME = 0.0003, SE = 0.0001, $p = 0.001$). This supports findings in Hansson (2007). Regarding innovation activity, firms introducing new products or services are 11.0 percentage points more likely to provide employee training (AME = 0.110, $p = 0.002$). This supports *H2* and is consistent with Baldwin and Johnson (1996), Hansson (2007) and Roshchin and Travkin (2017).

Locality size shows the pattern predicted by *H5*. Relative to localities with fewer than 50,000 people, firms in cities of 50,000–250,000 are 9.0 percentage points less likely to provide employee training ($p = 0.026$). Firms in cities of 250,000–1 million are 13.5 percentage points less likely ($p < 0.001$). Firms in cities with over 1 million people are 7.6 percentage points less likely, though this effect is marginal ($p = 0.058$). The pattern supports *H5*: firms in the smallest localities provide significantly more training than those in mid-sized cities, although the relationship is not strictly monotonic, with the very largest cities not significantly different from the smallest. We summarise the outcome of each hypothesis test in Table 4.

*Institutional controls*

Table 5 reports the probit model with institutional grouping dummies (EU member states as base category).

The institutional groupings are jointly significant. Western Balkans firms are 13.5 percentage points more likely to provide employee training than EU firms ($p = 0.009$), while firms in other transition economies are 8.9 percentage points less likely ($p = 0.007$). Model pseudo *R*-squared improves from 0.043 to 0.057. The InadEdu, firm size, innovation and locality effects remain robust with institutional controls. The principal change is that manager experience becomes non-significant ($p = 0.165$).

*Robustness checks*

Six robustness analyses were conducted. *First*, a logit specification produces AMEs virtually identical to the probit results (for example, MgrExp: 0.0026 vs 0.0027; InadEdu very severe: 0.158 vs 0.159; Tech: 0.109 vs 0.110), confirming that the results are not sensitive to the

**Table 4.** Summary of hypothesis testing

| Hypotheses | Key finding | Practical interpretation | Outcome |
|---|---|---|---|
| *H1*: Managerial experience is positively associated with training provision | AME = 0.003/year ($p = 0.032$); not significant with institutional controls ($p = 0.165$) | Positive association, but sensitive to model specification. Significant in 23/28 leave-one-out runs | Partially supported |
| *H2*: Firms engaging in innovation are more likely to provide employee training | AME = 0.110 ($p = 0.002$); robust to institutional controls ($p = 0.006$) | Innovating firms 11.0pp more likely to train. Effect robust across specifications | Supported |
| *H3*: Firms perceiving an inadequately educated workforce are more likely to provide employee training | InadEdu jointly significant (Wald $Chi^2 = 13.02$, $p = 0.011$); robust in all 28 country-sensitivity runs | Perceived skill gaps trigger training. Association robust to institutional controls and all robustness checks | Supported |
| *H4*: The association is graduated (more severe gaps → stronger response) | Wald test for equality: $Chi^2 = 2.50$, $p = 0.475$. Very severe, not different from minor ($p = 0.558$) | Point estimates suggest graduation but not statistically confirmed. Threshold rather than dose–response effect | Not supported |
| *H5*: Firms in smaller localities are more likely to provide employee training | 50k–250k: −9.0pp ($p = 0.026$); 250k–1m: −13.5pp ($p < 0.001$); >1 m: −7.6pp ($p = 0.058$). Base = <50k | Mid-sized localities show significantly lower training than the smallest. Supports place-based argument | Supported |

**Note(s):** pp = percentage points
**Source(s):** Authors' analysis

**Table 5.** Average marginal effects with institutional grouping controls

| Variable | AME | SD. | $p>\|z\|$ | 95% conf. interval |
|---|---|---|---|---|
| Manager experience (MgrExp) | 0.002 | 0.0013 | 0.165 | –0.001 to 0.004 |
| Female manager (FMgr) | 0.091 | 0.0553 | 0.085* | –0.012 to 0.194 |
| *InadEdu (base: no obstacle)* | | | | |
| Minor | 0.133 | 0.043 | 0.002*** | 0.049 to 0.218 |
| Moderate | 0.087 | 0.038 | 0.023** | 0.012 to 0.162 |
| Major | 0.083 | 0.042 | 0.047** | 0.001 to 0.165 |
| Very severe | 0.164 | 0.054 | 0.002*** | 0.059 to 0.269 |
| Labour cost (LC) | 2.79e−11 | 2.06e−11 | 0.176 | –1.25e−11 to 6.83e−11 |
| Employees (E) | 0.0003 | 0.0001 | 0.006*** | 0.000 to 0.000 |
| New product/service (Tech) | 0.096 | 0.035 | 0.008*** | 0.027 to 0.172 |
| *Locality size (base: <50,000)* | | | | |
| 50,000–250,000 | –0.092 | 0.040 | 0.020** | –0.170 to 0.015 |
| 250,000–1 million | –0.108 | 0.039 | 0.005*** | –0.184 to 0.033 |
| > 1 million | –0.027 | 0.043 | 0.534 | –0.110 to 0.057 |
| *Institutional grouping (base: EU)* | | | | |
| Western Balkans | 0.135 | 0.052 | 0.009*** | 0.033 to 0.236 |
| Other transition | –0.089 | 0.033 | 0.007*** | –0.153 to 0.024 |

**Note(s):** *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. $n = 1{,}098$. Pseudo $R^2 = 0.057$. Average marginal effects from probit estimation; SE is the delta-method standard error; member states as base category for institutional grouping
**Source(s):** Authors' analysis of BEEPS 2019 data

distributional assumption. *Second*, subsample analysis by institutional grouping reveals that the results are driven primarily by non-EU transition economies ($n = 679$). In the EU subsample ($n = 419$), only firm size is significant. The non-EU subsample shows significant effects for InadEdu (minor: +15.2pp, $p = 0.004$), innovation (+19.1pp, $p < 0.001$) and female managers (+17.1pp, $p = 0.006$). This pattern likely reflects both lower statistical power in the smaller EU subsample and genuine institutional differences in training determinants.

*Third*, subsample analysis by firm size (split at the median of 21 employees) shows that the InadEdu effect is strong and significant (from 0.111 to 0.179) in smaller firms ($n = 555$) but insignificant in larger firms ($n = 543$). Innovation is a significant determinant of training provision only in larger firms. Hence, perceived skill gaps drive training most strongly in smaller firms with less formalised HR processes. *Fourth*, the MgrExp × firm size interaction is not significant ($p = 0.988$). Manager experience operates similarly regardless of firm size. *Fifth*, leave-one-out country sensitivity analysis across all 28 countries confirms that the InadEdu (very severe) AME is significant ($p < 0.05$) in every single specification, ranging from 0.130 to 0.189. The MgrExp AME is significant in 23 of 28 specifications [4]. No single country drives the core results. Table 6 summarises the robustness checks.

## Discussion

### *Reactive training: a challenge to strategic optimisation*

Results confirm the reactive training proposition developed in the literature review. Perceived workforce education inadequacy is a significant and robust determinant of training provision (Wald test $p = 0.011$, significant in all 28 country sensitivity specifications). Firms that perceive skill gaps as an obstacle to their operations are significantly more likely to provide employee training than other firms. This finding is consistent with bounded

**Table 6.** Robustness checks: AME comparison across specifications

| Variable | Base probit | With inst. controls | Logit | EU only | Non-EU | Small firms | Large firms |
|---|---|---|---|---|---|---|---|
| MgrExp | 0.003* | 0.002 | 0.003* | 0.003 | 0.002 | 0.002 | 0.002 |
| FMgr | 0.082 | 0.088 | 0.082 | –0.090 | 0.171** | 0.032 | 0.139 |
| InadEdu: minor | 0.124** | 0.133** | 0.124** | 0.049 | 0.152** | 0.140* | 0.057 |
| InadEdu: Moderate | 0.088* | 0.087* | 0.087* | 0.093 | 0.068 | 0.147** | 0.003 |
| InadEdu: major | 0.082 | 0.083* | 0.082 | 0.078 | 0.084 | 0.111* | 0.055 |
| InadEdu: V. severe | 0.159** | 0.164** | 0.158** | 0.167 | 0.137* | 0.179* | 0.104 |
| Tech | 0.110** | 0.096** | 0.109** | –0.035 | 0.191*** | 0.083 | 0.107* |
| E | 0.000** | 0.000** | 0.000** | 0.001** | 0.000 | 0.003 | 0.000 |
| *N* | 1,098 | 1,098 | 1,098 | 419 | 679 | 555 | 543 |

**Note(s):** ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$. AMEs reported. Locality effects omitted for space (consistent across specifications). Small/large split at median of 21 employees. Additional checks: MgrExp × firm size interaction not significant ($p = 0.988$). Leave-one-out country sensitivity: InadEdu (very severe) significant in all 28 runs; MgrExp significant in 23/28 runs. Subsample analyses (EU/non-EU and small/large firms) are estimated without institutional grouping controls. For EU/non-EU, this is structurally necessary; for the firm-size split, it preserves comparability with the base specification
**Source(s):** Authors' analysis

rationality operating within the structural constraints of project-based work: firms respond to perceived problems rather than anticipating future skill needs (Simon, 1955; Tan, 2014).

However, the graduated intensity pattern suggested by the point estimates is not statistically confirmed. The Wald test for equality of the four InadEdu category coefficients cannot be rejected ($p = 0.475$). This means we find strong support for *H3* (skill gaps trigger training) but not for *H4* (more severe gaps produce proportionally stronger responses) [5]. The reactive training pattern is better characterised as a threshold effect: perceiving any level of skill inadequacy triggers training, rather than a graduated dose–response relationship. Indeed, the threshold pattern may be more theoretically consistent with bounded rationality than a graduated response would be. Graduated responses imply calibration, whereas the threshold pattern we observe, where any level of perceived inadequacy triggers training regardless of severity, is characteristic of satisficing behaviour (Simon, 1955).

An alternative interpretation also deserves attention. It is possible that learning-oriented firms both perceive skill gaps more readily and provide more training. If firms that invest in workforce development have more developed assessment processes, they may score higher on InadEdu, not because they face worse skill gaps but because they are better at identifying them. Cross-sectional data cannot definitively adjudicate between these two interpretations. However, three features of the data are more consistent with the reactive interpretation: first, the BEEPS InadEdu question asks about obstacles to current operations, eliciting problem identification rather than post-training reflection; second, in construction, skill gaps typically become visible through project failures and delays rather than formal assessment; third, the association is robust to the inclusion of institutional controls, which capture some of the cross-country variation in organisational culture. We acknowledge this limitation and identify longitudinal designs as a priority for future research.

*Managerial experience: a resource for training decisions*

The positive association between managerial experience and training provision (0.3 percentage points per additional year, $p = 0.032$ in the base model) is consistent with the RBV perspective that managerial capability is itself a valuable resource influencing strategic

decisions (Barney, 1991). However, this finding requires careful interpretation. The effect becomes non-significant when institutional controls are included ($p = 0.165$), suggesting that some of the association reflects compositional differences between country groupings. Country sensitivity analysis shows significance in 23 of 28 leave-one-out specifications, indicating that while the finding is not driven by any single country, it is not uniformly robust. We retain *H1* as partially supported because the effect is consistent in direction across all specifications, significant in the base model and in 23 of 28 country sensitivity runs. The loss of significance with institutional control inclusion likely reflects the absorption of cross-country variation in manager experience by the institutional dummies rather than the absence of a genuine firm-level association. As shown in Appendix Table A4, mean managerial experience differs significantly across institutional groupings ($F = 20.43$, $p < 0.001$), with managers in Other transition economies averaging 3–5 fewer years than those in EU and Western Balkans firms. Variance inflation factors confirm that this is compositional rather than a multicollinearity issue (MgrExp VIF = 1.03 base, 1.06 with institutional controls).

Additionally, the mechanism may operate through selection rather than experience, causing a shift in training behaviour. Firms that value workforce development may recruit experienced managers, in which case the association reflects organisational priorities rather than a causal effect of experience on training decisions. We cannot distinguish between these mechanisms with cross-sectional data. Edum-Fotwe and McCaffer (2000) documented how construction project managers build competence through successive project involvement. If this association reflects a causal pathway, it suggests that management development is not separate from workforce training – but may be a prerequisite for it.

*Smaller localities: supporting H5*

The finding that firms in the smallest localities (<50,000) provide significantly more training than those in mid-sized cities (50,000–1 million) supports *H5* and the place-based development literature (Rodríguez-Pose, 2018; EBRD, 2024). In smaller labour markets, the external talent pool is limited. Firms cannot simply recruit skilled workers from the open market and may instead need to develop them internally. This is a straightforward RBV argument: when a resource cannot be acquired externally, firms invest in building it. The subsample analysis reinforces this interpretation: the locality effect is concentrated in smaller firms (below the median of 21 employees), where reliance on the local labour market is likely greatest.

*Innovation and training: a complementary relationship*

Firms introducing new products or services are 11 percentage points more likely to provide employee training ($p = 0.002$). This confirms the findings of Hansson (2007) and Roshchin and Travkin (2017). The subsample analysis shows this effect is driven by larger firms (AME = 0.107, $p = 0.037$) and by non-EU transition economies (AME = 0.191, $p < 0.001$), suggesting that the innovation-training complementarity is strongest where firms are both large enough to absorb the cost and operating in contexts where innovation is less routine. The effect is robust to the inclusion of institutional controls (AME = 0.096, $p = 0.006$).

**Limitations and future research**

Several limitations should be noted. First, the cross-sectional design limits causal inference because associations and not causal effects are identified. This is especially important for the InadEdu variable, where reverse causality and potential endogeneity are genuine concerns. Firms that already provide employee training may have more developed assessment processes, making them more attuned to skill gaps and potentially inflating their InadEdu

scores. We have presented analytical arguments for why the reactive interpretation is more plausible (the BEEPS question shows problem identification; skill gaps in construction are visible through project outcomes; the association survives institutional controls), but we cannot rule out the alternative. The BEEPS panel structure (waves in 2008, 2013, 2019) could potentially support instrumental variable approaches, but the rotating panel design means that the construction sector subsample in earlier waves is too small to provide reliable instruments. Future research could exploit longitudinal designs that track the temporal sequence of skill perceptions and training decisions. Quasi-experimental designs, such as difference-in-differences analyses around training policy reforms in specific transition economies, would provide stronger causal evidence. Second, the formal test of the graduated pattern (*H4*) is not significant (Wald test $p = 0.475$). This supports the reactive training contribution, which rests on the joint significance of perceived skill gaps rather than on a graduated intensity pattern.

Third, the manager experience effect is sensitive to model specification. It is significant in the base model ($p = 0.032$) but not with institutional controls ($p = 0.165$). We report both specifications. Fourth, the model's pseudo-*R*-squared of 0.043 indicates that additional factors beyond those available in the BEEPS data set influence training decisions. The AUC of 0.649 and classification rate of 64.5% (Table 2) confirm that while the model identifies significant determinants, substantial unexplained variation remains. Unexplained variance likely reflects factors including managerial leadership style (Toor and Ofori, 2008; Ghoddousi *et al.*, 2015), organisational learning culture (Neycheva and Baltov, 2024), the expansive or restrictive nature of workplace learning environments (Fuller and Unwin, 2004) and informal training arrangements.

Fifth, the binary measure of innovation activity is a simplified indicator for a complex construct. Additionally, the data capture neither informal training nor on-the-job learning, which may be particularly important in construction, where apprenticeship-style learning is common (ILO, 2015; Billett, 2004). Fuller and Unwin's (2004) expansive-restrictive framework suggests that the relationship between formal training provision and broader workplace learning is an important area for future research. Finally, the BEEPS data are from 2019, prior to the COVID-19 pandemic, which may have significantly altered training patterns in the construction industry.

**Practical implications**

Of note is the observation that approximately two-thirds of construction firms in the sample provide no employee training, which demands attention from policymakers and training professionals alike. With European construction requiring an estimated 3 million workers to be upskilled by 2027 (Cedefop, 2023), and Construction 4.0 technologies creating demand for entirely new competencies (García de Soto *et al.*, 2022), the question of what drives employer training decisions has direct consequences for whether the sector can meet the twin green and digital transitions. Our results yield four practical implications, each grounded in what the data reveal.

First, make skill gaps visible before they become crises. The reactive training pattern we observe means that firms respond to perceived skill deficiencies, but only after those deficiencies have materialised. The joint significance of the InadEdu variable ($p = 0.011$) confirms that this responsiveness is real and robust. If vocational institutions, industry bodies and regional development agencies can make emerging skill needs visible to construction managers earlier, through skill needs forecasting, audit tools or sector-specific labour market intelligence, training decisions may be triggered before shortages become acute.

Second, target training policy at smaller localities. The finding that firms in the smallest localities (under 50,000 population) are significantly more likely to provide employee training than those in mid-sized cities (50,000–1 million) challenges the default assumption that training infrastructure should be concentrated in capital cities and metropolitan centres. The EBRD (2024) and Rodríguez-Pose (2018) have advocated place-based approaches to economic development. Our data suggest that smaller construction markets, where external recruitment is difficult and worker mobility is lower, contain firms that are more receptive to training.

Third, bundle training with innovation. The complementary relationship between innovation activity and training (11.0 percentage points, $p = 0.002$) confirms that firms engaging in new activities recognise the need for new skills. This effect is robust across model specifications. If technology adoption programmes in construction include an integrated training component from the outset, reactive gaps between adoption and skills development can be closed.

Finally, consider investing in construction managers as potential gatekeepers of training. The association between managerial experience and training provision suggests that who leads a construction firm may shape whether its workers receive training. However, this finding should be interpreted cautiously: it is not robust to the inclusion of institutional controls and the mechanism could operate through selection (firms that value recruiting and training experienced managers) rather than through experience itself. If the association reflects a causal pathway, structured mentoring and management development programmes could transfer training know-how to less experienced managers. Table 7 maps each finding to its policy implication and supporting evidence.

## Conclusion

This study analysed the determinants of employee training provision across 1,098 construction firms in 28 transition economies. Perceived workforce education inadequacy, firm size, innovation activity and locality size significantly influence whether firms provide

**Table 7.** From findings to practice: summary of implications

| Finding | Implication for policy and practice | Supporting evidence |
|---|---|---|
| Perceived skill gaps trigger training (Wald $p = 0.011$; robust in all 28 country runs) | Improve skill needs assessment and forecasting; align vocational curricula with emerging construction competencies before gaps become severe | ILO (2015, 2021); Cedefop (2023); Detsimas *et al.* (2016) |
| Firms in the smallest localities show higher training (50k–250k: −9.0pp; 250k–1m: −13.5pp vs base < 50k) | Adopt place-based training strategies; establish locally governed training partnerships. Effect concentrated in smaller firms | EBRD (2024); Rodríguez-Pose (2018); Felstead *et al.* (2009) |
| Innovation and training complementary (+11.0pp, $p = 0.002$; robust to controls) | Bundle training with innovation adoption programmes; position training professionals as partners in implementation | Baldwin and Johnson (1996); Hansson (2007); García de Soto *et al.* (2022) |
| Managerial experience positively associated with training ($p = 0.032$ base; $p = 0.165$ with controls; 23/28 leave-one-out) | If the association reflects a causal pathway, invest in management development as a prerequisite for expanding training provision. However, selection effects cannot be ruled out | ILO (2000, 2015); Edum-Fotwe and McCaffer (2000) |

**Note(s):** pp = percentage points relative to base category. Effect sizes from probit AMEs (Table 3)
**Source(s):** Authors' synthesis

employee training. The central finding is that training in construction is reactive, triggered by perceived skill deficiencies rather than driven by strategic planning. The joint significance of perceived skill gaps as a training determinant (Wald test $p = 0.011$) provides robust support for this conclusion, though the graduated intensity pattern is not statistically confirmed. This challenges human capital theory's optimisation logic and is better explained by bounded rationality operating within the structural constraints of project-based work. The finding that firms in the smallest localities are more likely to provide employee training than those in mid-sized cities further challenges metropolitan-centric assumptions and supports the place-based approaches increasingly advocated by the EBRD (2024) and Rodríguez-Pose (2018).

These results matter because the construction sector cannot meet the green and digital transitions through reactive training alone. The observation that firms act on a perceived gap provides a lever for policy. However, that lever must be pulled earlier than firms are currently pulling it themselves. Future research should exploit the BEEPS panel structure to track how training determinants evolve over time, examine how institutional differences across countries shape these relationships, investigate the relationship between formal training provision and the informal workplace learning that characterises much skill development in construction and pursue quasi-experimental designs that can move beyond the correlational evidence presented here.

## Notes

[1.] The relationship between formal training decisions and informal, situated learning that characterises some construction work is an important area for future research.

[2.] Defined as ISIC Rev. 3.1 Section F, codes 45.1 to 45.5, covering site preparation, building construction, civil engineering, building installation and building completion.

[3.] The BEEPS data set contains additional variables (for example, foreign ownership, export status, access to finance) that relate to broader firm performance questions. These were not included because they do not correspond to the specific training determinant hypotheses under investigation. Including variables without theoretical motivation risks specification searching and inflated Type I error.

[4.] The five countries whose exclusion renders MgrExp non-significant ($p \geq 0.05$) are Czech Republic, Croatia, North Macedonia, Kazakhstan and Moldova. They span all three institutional groupings (two EU, one Western Balkans, two Other transition), and four of the five $p$-values fall between 0.066 and 0.094, suggesting marginal rather than structural sensitivity.

[5.] While point estimates suggest graduation, with the very severe category showing the largest effect (15.9 percentage points), this is not statistically distinguishable from the minor category effect (12.4 percentage points).

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## Appendix

**Table A1.** Countries included in the sample

| Country | Institutional grouping |
|---|---|
| Bulgaria | EU member state |
| Croatia | EU member state |
| Czech Republic | EU member state |
| Estonia | EU member state |
| Hungary | EU member state |
| Latvia | EU member state |
| Lithuania | EU member state |
| Poland | EU member state |
| Romania | EU member state |
| Slovak Republic | EU member state |
| Slovenia | EU member state |
| Albania | Western Balkans |
| Bosnia and Herzegovina | Western Balkans |
| Kosovo | Western Balkans |
| Montenegro | Western Balkans |
| North Macedonia | Western Balkans |
| Serbia | Western Balkans |
| Azerbaijan | Other transition economy |
| Georgia | Other transition economy |
| Kazakhstan | Other transition economy |
| Kyrgyz Republic | Other transition economy |
| Moldova | Other transition economy |
| Mongolia | Other transition economy |
| Russia | Other transition economy |
| Tajikistan | Other transition economy |
| Turkey | Other transition economy |
| Ukraine | Other transition economy |
| Uzbekistan | Other transition economy |

**Note(s):** While Armenia and Belarus were included in the original BEEPS 2019 sampling frame, their data was not included in the Enterprise Surveys data at the time of this research.
**Source(s):** BEEPS 2019 (World Bank, 2023)

**Table A2.** Full probit regression coefficients

| Variable | Coefficient | SD. | *z* | *p* >\|z\| | 95% conf. interval |
|---|---|---|---|---|---|
| Manager experience (MgrExp) | 0.0076 | 0.0036 | 2.13 | 0.034* | 0.001 to 0.015 |
| Female manager (FMgr) | 0.228 | 0.142 | 1.61 | 0.108 | –0.050 to 0.507 |
| *InadEdu (base: no obstacle)* | | | | | |
| Minor | 0.349 | 0.121 | 2.88 | 0.004** | 0.111 to 0.587 |
| Moderate | 0.251 | 0.110 | 2.28 | 0.022* | 0.036 to 0.467 |
| Major | 0.235 | 0.120 | 1.96 | 0.051 | –0.001 to 0.471 |
| Very severe | 0.439 | 0.147 | 2.99 | 0.003** | 0.151 to 0.727 |
| Labour cost (LC) | 4.41e−11 | 5.69e−11 | 0.77 | 0.439 | –6.75e−11 to 1.56e−10 |
| Employees (E) | 0.0008 | 0.0003 | 3.15 | 0.002** | 0.000 to 0.001 |
| New product/service (tech) | 0.306 | 0.099 | 3.09 | 0.002** | 0.111 to 0.500 |
| *Locality size (base: <50,000)* | | | | | |
| 50,000–250,000 | –0.245 | 0.111 | –2.20 | 0.027* | –0.462 to 0.027 |
| 250,000–1 million | –0.373 | 0.107 | –3.48 | 0.001*** | –0.584 to 0.163 |
| >1 million | –0.203 | 0.108 | –1.88 | 0.061 | –0.416 to 0.009 |
| Constant | –0.680 | 0.122 | –5.56 | 0.000*** | –0.919 to 0.440 |

**Note(s):** ***$p < 0.01$ **$p < 0.05$ *$p < 0.10$. $n = 1{,}098$. Log likelihood = –691.54. LR $Chi^2(11) = 61.55$. Pseudo $R^2 = 0.043$. Probit coefficients shown; average marginal effects in Table 3
**Source(s):** Authors' analysis

**Table A3.** Pairwise correlations and variance inflation factors

| Variable | ETP | MgrExp | FMgr | InadEdu | LC | E | Tech | Pop | VIF |
|---|---|---|---|---|---|---|---|---|---|
| ETP | 1.000 | | | | | | | | – |
| MgrExp | 0.084* | 1.000 | | | | | | | 1.03 |
| FMgr | 0.042 | –0.088* | 1.000 | | | | | | 1.02 |
| InadEdu | 0.084* | 0.026 | 0.063* | 1.000 | | | | | 1.25–1.49 |
| LC | 0.050 | 0.004 | 0.004 | –0.036 | 1.000 | | | | 1.09 |
| E | 0.114* | 0.077* | –0.040 | 0.034 | 0.267* | 1.000 | | | 1.10 |
| Tech | 0.129* | 0.081* | 0.010 | 0.090* | 0.028 | 0.087* | 1.000 | | 1.04 |
| Pop | –0.075* | –0.076* | –0.027 | 0.100* | 0.003 | 0.064* | –0.071* | 1.000 | 1.30–1.33 |

**Note(s):** *$p < 0.05$. Pairwise correlations for complete cases ($n = 1{,}098$). VIFs from OLS estimation. All VIFs are well below conventional threshold of 10; no multicollinearity concerns. Highest pairwise correlation: E and LC ($r = 0.267$). Mean VIF is 1.23.
**Source(s):** Authors' analysis

**Table A4.** Managerial experience by institutional grouping and conditional variance inflation factors

| Institutional grouping | Mean (years) | SD | *n* |
|---|---|---|---|
| *Panel A: Mean managerial experience by institutional grouping* | | | |
| EU member states | 21.99 | 10.64 | 496 |
| Western Balkans | 23.31 | 10.56 | 153 |
| Other transition economies | 18.57 | 11.18 | 695 |
| *Total* | *20.37* | *11.07* | *1,344* |
| *Panel B: Variance inflation factor for manager experience* | | | |
| *Specification* | *MgrExp VIF* | *Mean VIF* | |
| Base model (no institutional controls) | 1.03 | 1.23 | |
| With institutional grouping controls | 1.06 | 1.27 | |

**Note(s):** Panel A: One-way ANOVA: $F(2, 1341) = 20.43$, $p < 0.001$. Bartlett's equal-variances test: $x^2(2) = 1.75$, $p = 0.417$. Panel B VIFs from OLS auxiliary regression on the same right-hand-side variables as the probit model. Both VIFs are well below conventional thresholds for multicollinearity concern (VIF > 5 or > 10), indicating that the loss of significance for MgrExp when institutional controls are added reflects compositional absorption of cross-country variation rather than multicollinearity
**Source(s):** Authors' analysis of BEEPS 2019 data

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