




Training for Growth: Skills shortage and companies' willingness to train in Colorado

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Skills shortage and companies'
willingness to train in Colorado

An application of the KOF Willingness to Train Survey

Dr. Ursula Renold, Dr. Thomas Bolli, Dr. Katherine Caves, and Jutta Buergi

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CEMETS

Center on the Economics and Management of Education and Training Systems

Training for Growth:

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An application of the KOF Willingness to Train Survey

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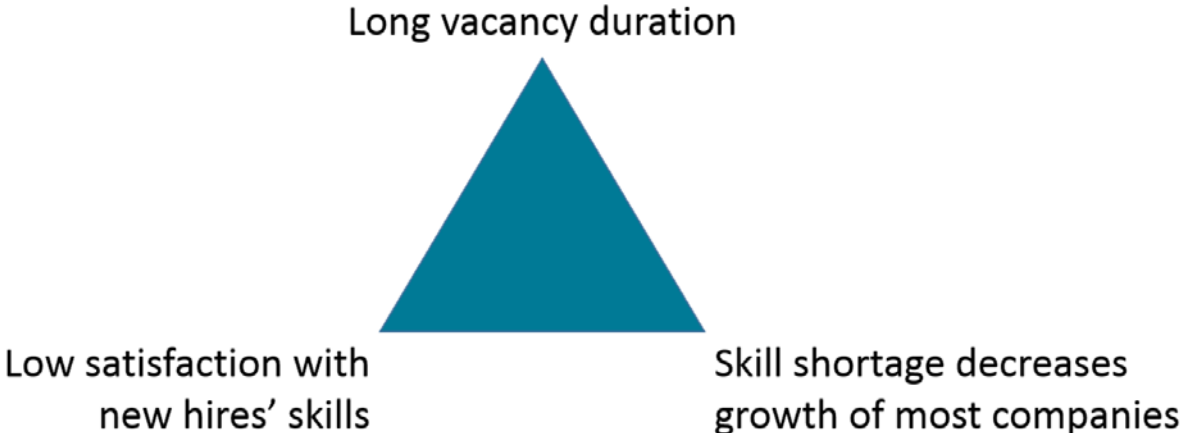
Executive summary

This report analyzes KOF Willingness to Train Survey responses from up to 377 companies in Colorado to understand the current situation of skills and how companies train to produce more skills when necessary. It also assesses how Colorado’s stakeholders cooperate and interact to facilitate training. Finally, we report what companies want from new training programs and give recommendations for how those can be constructed to reduce the skill shortage for companies and provide workers with the skills they need to succeed on the labor market. This section summarizes our main findings.

1. Companies in Colorado face a substantial skills shortage.

Three dimensions indicate skills shortage, shown in Figure i. There is a shortage of skills when companies cannot fill open positions quickly, when new hires lack the skills they need, and when the lack of skills prevents companies from growing as quickly as they want.

Figure i: Indicator dimensions of skill shortage in Colorado

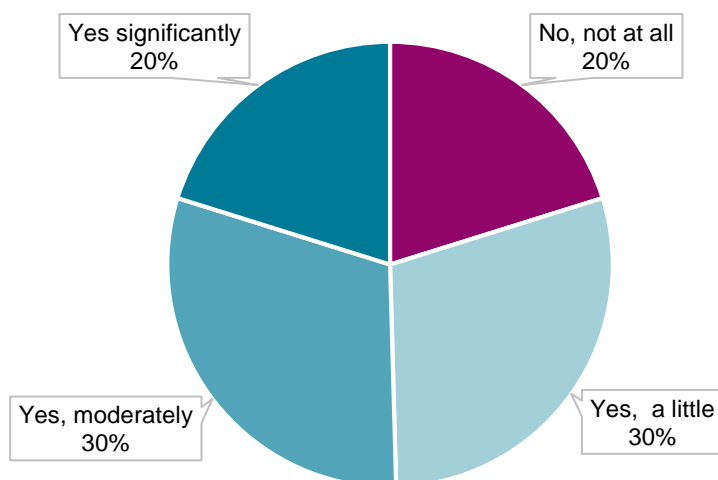


When companies have vacancies in skilled positions, they last for 7.4 weeks. In unskilled positions, the delay is only 4 weeks. **Vacancy durations are not out of hand, but they do indicate that companies struggle to fill skilled positions.**

Companies are not able to find the skills they need on the Colorado labor market. Although companies report that they prefer to hire from within Colorado, they are not impressed with the skills available as shown in Table i. For hard skills, companies report that new hires' skills are just barely above neutral, scoring 3.2 on a 1-to-5-point scale. The soft skills of new employees are slightly more satisfying (3.7), but this analysis suggests that companies in Colorado face substantial skill shortage.

All three indications of skills shortage are present in Colorado. **80% of surveyed companies report that skills shortages slow down their growth.** As shown in Figure ii, 20% of companies report the effect is significant. The problem is moderate and minor for two 30% segments of Colorado companies, and only 20% say growth is not slowed by skills shortage.

Figure ii: Effect of skill shortage on company growth



Notes: The figure displays the share of companies that consider the effect of skill shortage on company growth unimportant, a little important, moderately important, or significantly important. N=228.

The construction sector suffers more from skill shortage than the manufacturing or services sectors. Skills shortage increases with company size and is highest for large companies.

2. Workplaces are the best environment to learn important skills.

We asked companies where the skills they need are best learned: in school or at work. **For every skill except advanced math and communication, companies state the skill is better learned at work than in school**, shown in Table i. Even skills like job-related theoretical knowledge are better learned at work. Hence, companies consider workplace learning important to acquire both hard and soft skills. For skills employers consider more important, they are even more likely to claim the workplace is the best environment for learning.

Table i: Skills demand, supply, and ideal learning location

| Hard Skill | How important are the following skills for your business?* | How well do typical new employees fulfill these skill requirements?* | Where do you think these skills can best be learned?* |
|-----------------------------------|--|--|---|
| Health & safety certifications | 3.22 | 2.56 | Work (2.34) |
| Advanced math skills | 3.27 | 3.04 | School (1.53) |
| Handling unfamiliar situations | 4.18 | 3.14 | Work (2.70) |
| Job-related theoretical knowledge | 4.19 | 3.18 | Work (2.53) |
| Job-related practical skills | 4.41 | 3.29 | Work (2.86) |
| Problem solving skills | 4.44 | 3.37 | Work (2.48) |

| Soft Skill | How important are the following skills for your business?* | How well do typical new employees fulfill these skill requirements?* | Where do you think these skills can best be learned? ** |
|-----------------|--|--|---|
| Resilience | 4.35 | 3.40 | Work (2.36) |
| Friendliness | 4.44 | 3.96 | Work (2.20) |
| Communication | 4.45 | 3.48 | School (1.74) |
| Teamwork | 4.59 | 3.69 | Work (2.31) |
| Efficiency | 4.60 | 3.38 | Work (2.51) |
| Commitment | 4.69 | 3.68 | Work (2.29) |
| Motivation | 4.71 | 3.78 | Work (2.27) |
| Reliability | 4.87 | 3.84 | Work (2.32) |
| Trustworthiness | 4.90 | 4.08 | Work (2.20) |

*Importance & Availability on scales from 1 (low) to 5 (high)

**Best learned on a scale from 1 (school) to 3 (work)

This finding—that companies believe skills are best learned in the workplace—is very important for Colorado. In a context where companies report a skills shortage and the companies themselves state they are the best place to learn new skills, there is a huge opportunity for new training programs and initiatives. Companies want skills that can best be trained at work, so a training program that includes substantial workplace training is a clear next step.

3. Some training already exists in Colorado, but it is not perfect.

About half of Colorado’s companies offer training, through either internships (28%), traineeships (28%) or apprenticeships (10%). However, these programs are not strongly related to education programs and most do not offer credentials that trainees can use to advance their careers. Trainees in all three program types spend only about 10% of their time on training, with the rest spent on unskilled, skilled, and project work.

Companies also provide training to new hires: they report that it takes new employees in skilled positions 12 weeks to reach full productivity, and they spend 37% of their time during that period on training. Colorado’s companies are providing substantial training to their employees, to the extent that onboarding is more training-intensive than actual training programs.

Cooperation for training is surprisingly common among Colorado companies that train, with 27% reporting cooperation. However, most of the cooperation that exists is between companies and educational institutions, not among companies or companies and intermediaries. Colorado’s companies are leery of working too closely with educational institutions beyond what they already do, so company-to-company cooperation—possibly facilitated by intermediaries—might be the best way to maximize economics of scale, broaden skill sets, and create an environment that enables cost-effective training.

Apprentice-training companies cooperate most with community colleges and other companies. Companies with interns report community colleges and universities as their most important partners. Cooperation is least common for traineeships, and community colleges are the most

important partners. In general, Colorado’s companies are willing to engage in further cooperation but are wary of potential bureaucracy, wasted time, and wasted resources.

Colorado’s existing training is probably generating benefits for companies, since the content trained is almost entirely applicable to workers’ immediate productivity. However, training participants also receive relatively high wages that might limit returns to training for companies. Average interns earn 34% of skilled workers’ pay, while trainees earn 59% and apprentices 51% during training. This might have to do with the relatively high age of trainees (27 years) and apprentices (28 years), compared to interns at age 22. Finally, while internships (6 months) and traineeships (12 months) are relatively short, apprenticeships last 33 months so initial investments can be recovered.

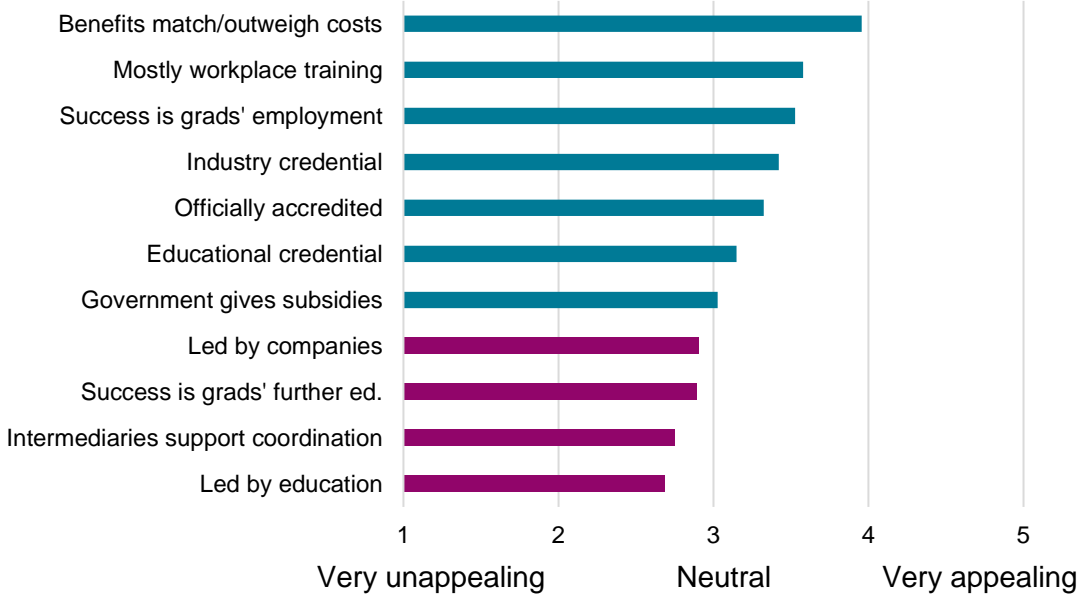
Overall the results show that **Colorado companies are motivated to welcome new training programs**. Many have some experience with creating training programs and cooperating with educational partners to optimize training, so they have most of the tools they need to begin creating an ecosystem that fosters effective and financially sustainable training.

4. Balancing the costs and benefits of training is critical.

Companies say they train when it is the only way they can equip employees with the specific skills they need. Training in those cases creates a clear benefit for the company. Companies shy away from training when they foresee high startup costs, do not think they need a program, or worry about high program costs.

When we ask about ideal training programs, **Colorado companies are clear that they want programs that make financial sense and avoid bureaucracy**. As shown in Figure iii, benefits outweighing costs is the most important feature of the ideal program. Companies also want programs to be mainly workplace-based, employment-focused, and high-quality as assured through accreditation and credentialing.

Figure iii: Appeal of new training program features



Notes: The figure displays how appealing various features of a new training program are. N=114.

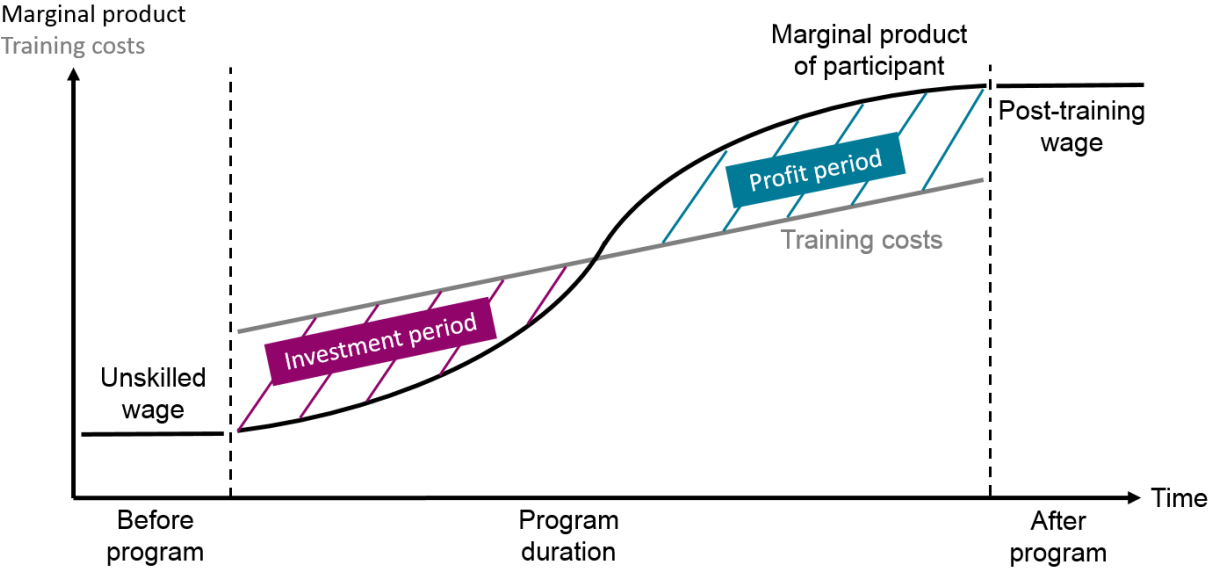
Interestingly, companies neither want to lead nor be led by education, suggesting that **a new program should balance the power of actors from both the education and employment systems**. This goes hand in hand with the previous finding that companies need to cooperate with one another, not just education institutions. Multiple-company partnerships are also more able to counterbalance and cooperate with education institutions.

Finally, companies report that their **ideal training program starts young**—around age 18 after finishing high school—and lasts between six months and a year.

5. Creating cost-benefit-balanced programs is feasible.

The general model for profitable training programs is shown in Figure iv. After an initial investment period where trainees are less productive than training costs, they become more productive and eventually balance out or exceed the total cost of the program through their productivity. However, the model depends on building an ecosystem that supports cost-effective training. More companies can share system overhead costs among themselves or through intermediaries, design well-structured curricula that cover broad skill sets, and potentially attract better trainees. All of these make cost-benefit-balance more likely.

Figure iv: Stylized model of benefits and costs during the training period



Notes: The figure displays a stylized model of the development of training costs and benefits over the course of the training program. Training costs increase due to the assumption that participant wages increase over time. Benefits in terms of the marginal product increase as the participant becomes more skilled and hence can be employed more productively. Since benefits increase faster than costs, the beginning of the program represents an investment period, which can be remedied in the profit period. Source: Own depiction based on Lerman (2014).

There are a number of factors that can move parts of the graph in Figure iv. Here are some of the most important and how they stand in Colorado:

- **Content Balance:** Mixing job-specific skills with transferrable content balances trainee and company incentives. Training is usually job-specific in CO.
- **Cooperation:** Companies can work with educational institutions and one another to provide transferrable content and lower costs. 16% of CO companies cooperate with schools and/or colleges, and inter-company training is not well established.
- **Intermediaries:** Intermediaries like sector and regional associations can reduce time and personnel investment, and are often a pre-requisite for cost-benefit-balanced training. 7% of CO companies train with intermediaries.
- **Certification:** Recognizing training with certification attracts better trainees, who are more productive. Most current CO training programs are not certified.
- **Trainee Age:** Younger trainees can afford to accept lower wages in exchange for training, partly because they usually live at home. CO companies' ideal age is 18.
- **Program Duration:** In longer programs, the profit period outweighs the investment period; 3-4 years is ideal. CO companies prefer programs between 1 and 2 years.
- **Skilled Work:** Spending time on skilled work is more productive. In CO, trainees currently spend 51% of their time on skilled work, 39% unskilled work, and 10% training.
- **Time Division:** Time at work is productive; time in class increases productivity in the return period. Surveyed CO companies prefer >50% of trainees' time spent at work.

Recommendations

1. **Create a platform for dialogue among companies, educators and administrators to address the findings in this report**
2. **Establish industry-level or occupational training programs that combine classroom education with workplace training**
3. **Design programs so that benefits exceed costs for companies**
 - a) Balance costs from participants' wages with benefits from participants' productivity and program length
 - b) Support companies and intermediaries as they set up training programs
 - c) Minimize financial subsidization to companies
4. **Ensure the quality of workplace training**
 - a) Emphasize curriculum-guided workplace training in all programs
 - b) Provide recognized credentials upon successful completion
5. **Empower intermediary organizations to establish state-wide linkage between actors from the employment and education systems.**

Recommendations

Based on our findings and companies' reported preferences, we provide recommendations for new training programs in Colorado. First, this report can be used to **start conversations about training**: what employers see as necessary and missing in training programs, and where education and workforce development stakeholders in Colorado want to go.

- 1.** Use this report to **ignite dialogue on training in Colorado**. Communication is the first step to resolving Colorado's situation in a way that benefits companies, individuals, and the state.
- 2.** Reducing skills shortage in Colorado requires training programs that **combine classroom education with workplace training**. Workplace training is something companies consistently emphasized in the most appealing and successful training programs, and it is a critical feature of cost-benefit-balanced programs. Classroom education emphasizes transferable skills, create further educational opportunities, and attracts better trainees who might be more productive.
- 3.** Companies consistently—and quite rationally—prefer financially sustainable training models. **New training programs need to be designed so benefits accrued during the program balance or even exceed the costs arising from the program**. This is done by balancing participants' wages and other training costs against their productivity—which is improved by better-quality training and increased in longer-lasting programs. Companies might need extra support while they are setting up and implementing new programs, but financial subsidies to companies for training are a risky and potentially counterproductive solution. When the system needs financial support, it should go to classroom education, specific problems, individual students, or capacity-building solutions like intermediaries.
- 4.** Like companies, **individuals choose to participate in training when there are net benefits for them**. Participants will pay for their training by accepting lower wages—a good alternative to accruing debt for education, but still a cost—so their investment must be repaid. The first tool for quality assurance is curricula for both the classroom and workplace so participants actually learn the skills they are promised. Successful program completers need to be given credentials recognized by the education system and employers on a state-wide level.
- 5. Establishing and supporting intermediary organizations is a strategy for following the other recommendations.** Functional training systems need a lot of coordination and linkage between actors from the education and employment systems, plus government, communities, and other stakeholders. Intermediary organizations can take on these tasks and more without the perverse-incentive risks that come with company subsidization.

Colorado's skills shortage is a problem for the state. Companies are less able to grow, workers are less able to progress in their careers, and the economy is slower due to all the lost productivity and growth. However, **companies have demonstrated that they are willing to train**. Training that gives workers the skills they need to compete will also give companies the human resources they need to grow. Individual companies and the state as a whole can tackle the skills shortage while earning returns on investments into education and training.

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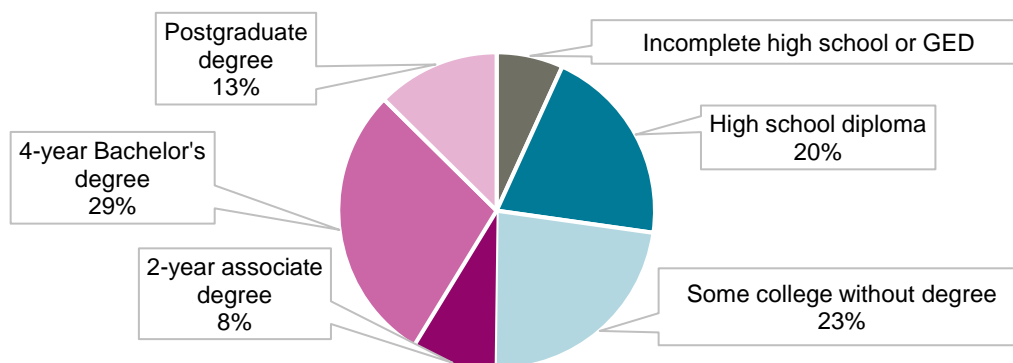
1. Introduction

This report analyzes skill shortage and the current state of skills and training in Colorado. The Center for the Economics and Management of Education and Training (CEMETS) at the KOF Swiss Economic Institute of the ETH Zurich in Switzerland surveyed Colorado companies on their skills needs and challenges, recruiting and training strategies, and opinions on future training programs with funding from CareerWise Colorado. This report describes and analyzes the responses and offers some recommendations for improving training and skills in Colorado.

Training is increasingly important in the American labor market. According to the Georgetown Center on Education and the Workforce, approximately two-thirds of American jobs will require postsecondary training by 2020¹. Certificates of training are the United States' fastest-growing postsecondary credential, and can be a low-cost ticket to middle-skill jobs². Such jobs are expected to be roughly half of all job openings between 2012 and 2022³. This shows that training outside the bachelor's degree is key for individuals, companies, and economies. Therefore, training programs like apprenticeships are increasingly at the center of the national discussion⁴.

Training is important to Colorado's economy, both for companies since training makes workers more productive (see, e.g., Dearden et al., 2006, De Grip and Sauermann, 2012, Georgiadis and Pitelis, 2014) and for individuals who earn more as a result of training (see, Dearden et al., 2006, and Bassanini et al., 2006 for an overview). By 2020, 74% of Colorado's jobs will require postsecondary education—the third-highest in the nation behind the District of Columbia and Minnesota. Figure 1 shows that this breaks down into 42% requiring a bachelor's degree or more and 31% that require postsecondary training that is not a bachelor's degree (Carnevale et al., 2015). Those statistics do not include informal training companies give newly hired employees, so may even underestimate the role of postsecondary training in Colorado.

Figure 1: Expected job requirement structure in 2020



Notes: The figure displays the expected education requirements of jobs in Colorado by 2020. Source: Own depiction based on Carnevale et al. (2013).

¹ <https://cew.georgetown.edu/cew-reports/recovery-job-growth-and-education-requirements-through-2020/>

² <https://cew.georgetown.edu/cew-reports/certificates/>

³ <http://www.nationalskillscoalition.org/resources/publications/file/middle-skill-fact-sheets-2014/NSC-United-States-MiddleSkillFS-2014.pdf>

⁴ <https://www.americanprogress.org/issues/economy/reports/2016/11/18/292558/now-is-the-time-to-invest-in-apprenticeships/>

The purpose of this report is to help policymakers, reform leaders, training providers, workers, and the companies themselves understand what the training-related trends, issues, and opportunities are in Colorado. We describe the current situation with regard to skills and training, then explore opportunities for expanding training.

Ideally, stakeholders in Colorado can use this report's findings to start discussions about how companies can participate in training the workforce. They can use those discussions to reach an agreement about possible future steps to improve the skilled workforce and opportunities for youth in Colorado.

What is training?

Training—any pre-planned activity designed to increase the training participant's skills—is extremely diverse. Formal training programs are guided by a curriculum or syllabus and end in accreditation or recognized certifications upon passing some examination or assessment. Non-formal training might have similar structure, but does not typically end in certification. Informal training is not guided by any program or syllabus, does not include any exam or assessment, and does not end in certification. Informal training can be very difficult to measure because it leaves little evidence, so this report focuses on formal and non-formal training.

The skills learned through training can be specific to a particular company, job, or occupation so they only increase productivity in that specific company, job, or occupation, respectively. Trained skills can also be general, meaning they increase productivity in a range of contexts. Since general training fosters abstract and theoretical skills, which have a broader range of applicability and are valued by many companies, it makes workers more mobile on the labor market. In contrast, skills fostered through company-, job or occupation-specific training, decrease the worker's mobility on the labor market, since these are valued by fewer companies. Therefore, from a theoretical perspective, workers are generally willing to accept lower wages for general-skills training, while companies are always willing to pay for specific-skills training (Becker, 1964).

Furthermore, training can happen in a variety of settings. Companies host on-the-job training, internal courses or certifications, and apprenticeships. Programs for certificates, some associate's degrees, and certain licenses are taught in classrooms and training centers. Finally, schools and colleges can provide training, for example high school career and technical education (CTE) classes or university lab skills courses. In the American training landscape, training providers can be companies, schools, community colleges, technical schools and colleges, universities, workforce centers, private institutions, or multi-actor partnerships.

Training is not tied to any particular income or skill level. Very often the concept of training (especially postsecondary training) is associated with middle-skilled jobs, but training is not limited to that skill level. Although the most familiar postsecondary training options are typically linked with middle-skilled jobs—especially certificates, associate's degrees, and technical certifications—training applies to all levels of skill. Workers classified as unskilled like assembly-line factory workers might receive training that prepares them for their tasks and familiarizes them with the safety procedures at the factory. Workers considered extremely

skilled like medical doctors are required to complete internships and then residencies to train their skills once their education is complete. Training applies throughout the labor market.

To be clear, training is not the same as education—though some programs like the dual apprenticeship models in Europe do combine education and training. Education provides general or transferable skills designed to help students prepare for life, work, citizenship, and further education. Formal education results in diplomas and degrees that are widely recognized. Training is mostly concerned with preparing trainees to carry out a job, occupation, or career and should include transferrable skills along with specific skills. Training can be part of educational programs—as with medical doctors' internships and residencies—but can also stand alone.

Goals and questions

Because the training landscape is so complex, it can be difficult for employers, policymakers, and potential training participants to understand where the best programs and biggest gaps are. Therefore, this report details the results of a survey conducted among Colorado employers that asks about the strengths, weaknesses, and opportunities for training in the state. Specifically, we address the state of skills in Colorado today, the training activities that companies currently use to find and develop skilled workers, how and why companies cooperate with public and private partners to improve training, and the potential for new training programs in the state.

The survey helps us answer the following questions, among others:

- Do Colorado companies face a skill shortage?
 - Can companies find the workers they need?
 - Which skills have the largest gaps and where can these be learned best?
- What is the current training landscape in Colorado companies?
 - What types of training exist in Colorado, and how common are they?
 - What are the major challenges and opportunities to training in Colorado?
 - Do companies in Colorado cooperate in providing training?
- How should a new training program in Colorado look like?
 - How strong is the demand for improved training programs in Colorado?
 - What are the key features that Colorado's companies want from new training programs?

2. Method

Who is surveyed?

We used the network available to us through CareerWise Colorado to conduct an email survey. The survey was disseminated through emails to industry mailing lists containing a link. Individual respondents are not targeted or identified outside of their survey responses. The link went out to six mailing lists in Colorado, with memberships ranging from regional chambers of commerce to state-wide industry associations.

Because of the nature of these mailing lists it is difficult to determine the exact number of people who were sent an email, received that email, and opened it. However, the approximate total number of addresses to which the survey was sent is around 10,000.

Overall we received 566 responses, 377 of which are usable. Using the approximate 10,000 number of emails sent out, that is a response rate of 5.66%, or 3.77% usable. In this type of email survey, that is not unusual. The responses are not all complete, with 131 respondents completing the survey. We use responses when we have them, so sample sizes are noted in figures that refer to specific questions. About half of responding companies train, which is likely to be an overestimate of real training rates because training companies are probably more likely to complete this survey.

Who are the respondents?

This section provides simple descriptive statistics of the companies that have responded to the survey, thereby providing an overview over the analyzed companies. Furthermore, comparing these results to the data from alternative statistical sources allows to assess the quality of the responses and potential biases in the non-response behavior.

The size of the surveyed companies varies between one and several thousand (full-time equivalent) employees. However, 77% of the 377 surveyed companies are small (less than 50 FTE employees). 10% are medium-sized companies (50 to 150 FTE employees) and 14% of companies are large (more than 150 FTE employees). Hence, the majority of the respondents are small companies. However, the share of small companies in the company population is even larger, suggesting that larger companies have a higher response rate.

Furthermore, most of the respondents have their headquarter located in Colorado (94%) and only relatively few companies have headquarters located in another state or outside of the US (6%), which is expected given the relatively small average company size of respondents.

Table 1 describes the data in terms of the industry structure.⁵ The results show that Natural Resources and Mining represent a negligible share of the sample, while construction makes up 15% of the surveyed companies and 6% of companies stem from the manufacturing sector. Hence, the majority of the sample stems from the service sector, where “Trade, Transportation and Utilities”, “Professional & Business Services”, “Education and Health Services” and “Other Services” each represent 15% of the sample.

⁵ We use the 1-digit level of the North American Industry Structure (NAICS) 2007.

Comparing this to the employment shares in these industries according to the Bureau of Labor Statistics⁶, shown in Table 1, suggests that the construction share is too high in our sample and our sample underestimates the relevance of “Leisure and Hospitality.” Finally, only 4% of employees work in “Other Services” compared to 15% in our sample, which might reflect problems of respondents to assign their company into the classification.

Table 1: Sample vs. population industry distribution

| Industry | Sample | Population |
|-------------------------------------|--------|------------|
| Mining & Logging | 0% | 1% |
| Construction | 15% | 6% |
| Manufacturing | 8% | 5% |
| Trade, Transportation and Utilities | 15% | 17% |
| Information | 2% | 3% |
| Financial Activities | 8% | 6% |
| Professional and Business Services | 15% | 16% |
| Education and Health Services | 15% | 13% |
| Leisure and Hospitality | 5% | 13% |

Notes: The table displays the distribution of companies across industries. N(Sample)=373.

Table 2 shows the distribution of degrees held by employees of the surveyed companies. The results reveal that only about 5% of employees have not finished high school. 28% of the employees have only finished high school and an additional 11% have attempted to continue into college but failed to receive a college degree. Another 9% of employees hold an associate degree. Furthermore, about a third of employees holds a Bachelor degree and 13% have completed a postgraduate degree. Comparing these results to the educational attainment of adults that are living in Colorado and are 25 years and older⁷ broadly supports the validity of these findings. However, the comparison suggests that the share of employees with a Bachelor’s degree is somewhat higher in our sample at the expense of the share with some college or less education.

Table 2: Sample vs. population educational attainment

| Educational attainment | Sample | Population |
|---------------------------------|--------|------------|
| Less than high school diploma | 5% | 10% |
| High school diploma (& GED) | 28% | 22% |
| Some college, no degree | 11% | 22% |
| Associate degree | 9% | 8% |
| Bachelor's degree | 34% | 24% |
| Graduate or professional degree | 13% | 14% |

Notes: The table displays the average share of employee education. N(Sample)=377.

⁶ <https://www.bls.gov/eag/eag.co.htm>

⁷ <https://www.colorado.gov/pacific/sites/default/files/2015%20Talent%20Pipeline%20Report.pdf>

What are the major limitations of this study?

The most important limitation of the study refers to the relatively small sample of the survey. The results regarding skill shortage use around 200 observations, which already represents a relatively small sample for a detailed analysis of subsamples. Furthermore, the number of observations decreases even more for the questions regarding the current state of training activities, which rely on around 130 observations. This low number of observations matters particularly because the characteristics of current training activities only exist for companies providing particular training. Hence, the corresponding information uses between 10 and 33 observations. This problem becomes aggravated for questions regarding training cooperation, which only uses 4 to 8 observations. However, the number of available observations for preferences regarding a new training program rises to about 120 observations again.

Given the relatively small sample size, the company characteristics in terms of industry and education of employees remain relatively close to the overall population. However, the analysis also reveals that large companies have a higher response rate than small companies. Hence, the small response rate of the survey suggests that responding companies might not be representative for the full company population.

Since the aim of the study consists of analyzing the potential and barriers to a new training initiative, we focus on three types of training that are relatively intense. Hence, the report fails to capture training programs that are less intense. Our mission is to understand the most relevant skills for Colorado's workforce, whether they are available, and where they can be learned.

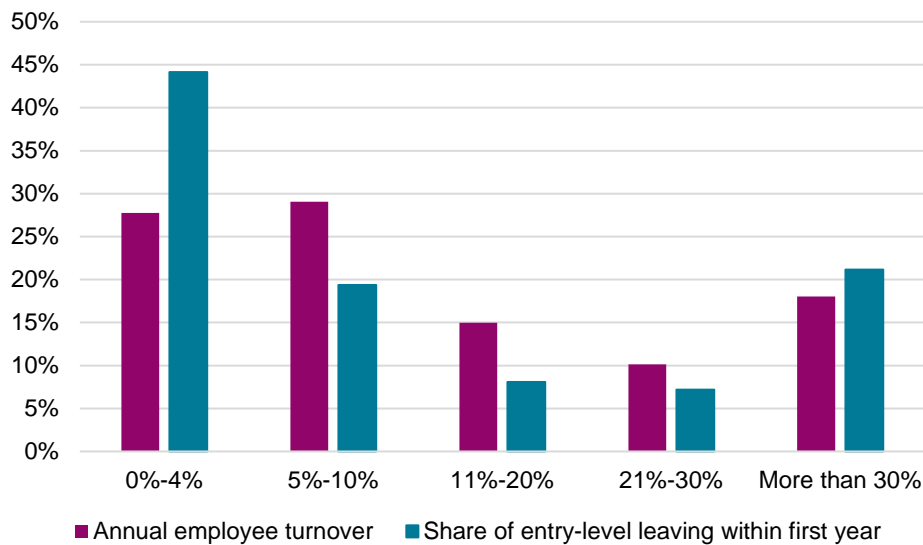
3. Results

3.1 Skills shortage

The supply of skilled workers in Colorado seems to be too low relative to companies' demand. Companies need new skilled workers when old ones leave or when the company grows. High turnover means companies find themselves with gaps left when workers leave. It also means tenures are shorter and both companies and individuals might be less willing to invest in training. Without a sufficient supply of skills, new hires take longer to reach full productivity and companies have to spend time searching for candidates. When supply of skills is lower than the demand for skills, companies cannot grow as fast as they might like because they cannot find the workers they need. All of these are costly for productivity and growth.

Turnover is a major factor in the demand for skilled workers in Colorado. Figure 2 shows that on average, **about one in five (18%) employees leave their company every year**. Furthermore, 10% of companies experience turnover rates between 21% and 30% and 18% of companies have turnover rates of more than 30%. The results for entry-level employees show a similar picture. Roughly 19% of entry-level hires do not make it through the first year and 21% of companies lose more than 30% of their entry-level employees. Colorado workers' **relatively low average tenure of five years** suggests that companies and workers have relatively little incentive to invest in the skills of the workforce—keeping the supply of skills low.

Figure 2: Turnover of employees and entry-level employees



Notes: The figure displays the *share of employees leaving the company each year* and the *share of entry-level employees leaving within the first year*. N=227 and 222 for all employees and entry-level employees, respectively.

Low incentives to invest in providing or pursuing training make transitions slow, reducing productivity. Respondents indicate that **it takes the median new hire in a skilled position 12 weeks to reach the same productivity levels as their experienced colleagues**. Furthermore, 12% of companies report that this period is about a year long and 10% of companies have even longer introductory periods. During that introductory period, the average new hires to skilled positions spends 37% of their time training and only 63% on productive work. This shows that though new hires undoubtedly have some skills before starting, they are insufficient and create costs for productivity.

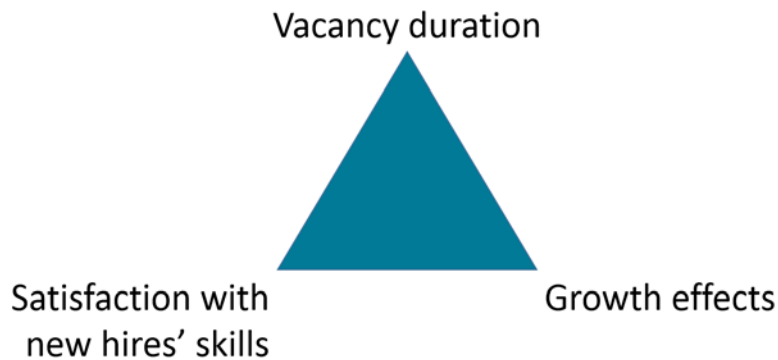
Can companies find the workers they need?

In order to analyze whether companies in Colorado face a skill shortage, we analyze three indicator dimensions as shown in Figure 3. The first indicator dimension investigates how long open vacancies remain unfilled. The second dimension analyzes whether companies consider skill shortage to hamper company growth. Finally, the last indicator dimension assesses whether new employees have the skills needed by the company. This further allows to analyze how well these skills can be learned in school or need to be learned in workplace training.

Vacancy duration

In addition to skilled workers leaving and new employees needing time to become productive, companies have trouble finding potential new hires in the first place. The surveyed companies can fill open positions for unskilled workers within four weeks, but it takes substantially longer to fill skilled positions: 7.4 weeks. This is evidence that skill shortage is a substantial problem in Colorado.

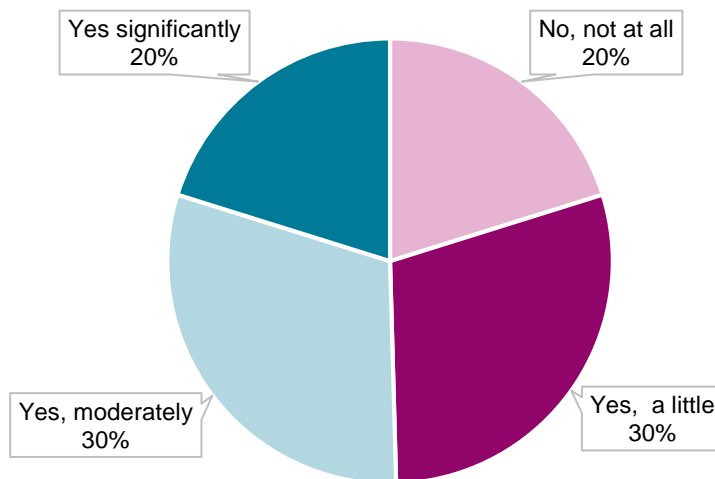
Figure 3: Indicator dimensions of skill shortage in Colorado



Growth effects

We also ask whether companies consider the lack of skilled workers to affect company growth. The results are shown in Figure 4, which displays how many companies consider a lack of skilled workers to have no, a little, a moderate, or a significant effect on their growth. The results suggest that skill shortage affects the growth of 80% of companies. Furthermore, 50% state growth is affected “moderately” or “significantly.”

Figure 4: Effect of skill shortage on company growth



Notes: The figure displays the share of companies that consider the effect of skill shortage on company growth unimportant, a little important, moderately important, or significantly important. N=228.

Which skills have the largest gaps and where can these be learned best?

The third indicator dimension of skill shortage assesses to what extent new hires' fulfil the demands of the companies. Beside of providing evidence regarding skill shortage, we also need to know more about what types of skills are available or missing. Skills can be broadly

divided into two categories: “hard” skills and “soft” skills. The differentiation between the two types is not totally clear-cut, so we use the Robles (2012) definition. Hard skills come from knowledge, practice, and aptitude. For example, a health care worker uses hard skills to deliver medicine, deal with insurance information, and follow institutional protocols. Conversely, soft skills do not depend entirely on acquired knowledge, and include interpersonal skills and personal attributes⁸. The same healthcare worker uses soft skills when communicating, working with others, and pleasantly interacting with patients and coworkers. Companies in all industries need employees with both hard and soft skills, and we investigate which specific skills are the most in-demand.

For each skill, we asked companies to assess whether typical new employees fulfill their skill requirements on a 5-point scale ranging from weak to skilled. Hence, higher values indicate lower skill shortage. We also ask them how important each skill is for their company on a 5-point scale ranging from low to high. Finally, we ask companies whether these skills can best be learned in school or at work. This tells us which skills are available or undersupplied on the labor market, how strong the demand is for each skill, and who companies think should be the supplier of each skill. The results are displayed in Figure 5 and Figure 6, and Table 3 displays the corresponding results numerically.

Table 3: Skills demand, supply, and ideal learning location

| Hard Skill | How important are the following skills for your business?* | How well do typical new employees fulfill these skill requirements?* | Where do you think these skills can best be learned?*** |
|-----------------------------------|--|--|---|
| Health & safety certifications | 3.22 | 2.56 | Work (2.34) |
| Advanced math skills | 3.27 | 3.04 | School (1.53) |
| Handling unfamiliar situations | 4.18 | 3.14 | Work (2.70) |
| Job-related theoretical knowledge | 4.19 | 3.18 | Work (2.53) |
| Job-related practical skills | 4.41 | 3.29 | Work (2.86) |
| Problem solving skills | 4.44 | 3.37 | Work (2.48) |
| Soft Skill | How important are the following skills for your business?* | How well do typical new employees fulfill these skill requirements?* | Where do you think these skills can best be learned?*** |
| Resilience | 4.35 | 3.40 | Work (2.36) |
| Friendliness | 4.44 | 3.96 | Work (2.20) |
| Communication | 4.45 | 3.48 | School (1.74) |
| Teamwork | 4.59 | 3.69 | Work (2.31) |
| Efficiency | 4.60 | 3.38 | Work (2.51) |
| Commitment | 4.69 | 3.68 | Work (2.29) |
| Motivation | 4.71 | 3.78 | Work (2.27) |
| Reliability | 4.87 | 3.84 | Work (2.32) |
| Trustworthiness | 4.90 | 4.08 | Work (2.20) |

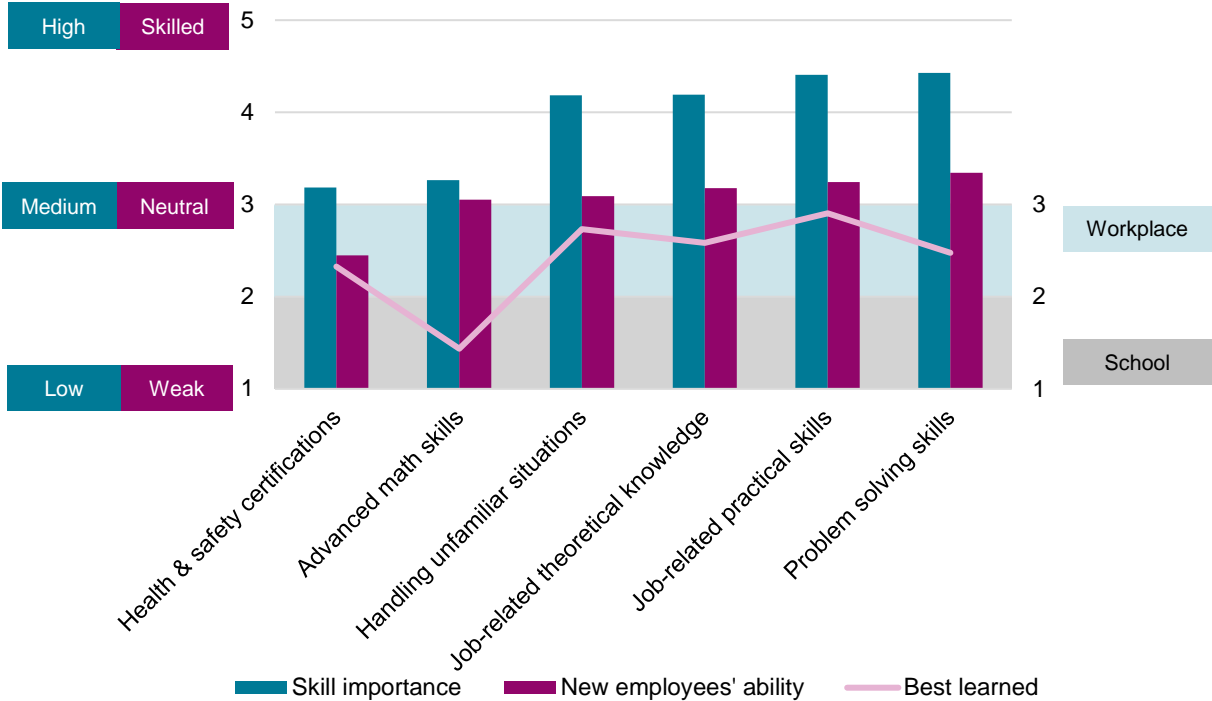
*Importance & Availability on scales from 1 (low) to 5 (high)

**Best learned on a scale from 1 (school) to 3 (work)

⁸ see, e.g., James and James, 2004, Perreault, 2004, Robles, 2012

We begin with **hard skills**: job competencies workers need to learn or practice in order to do their jobs well. Figure 5 displays the results for several hard skills in terms of their importance for companies and how well newly hired employees fulfill companies' skill requirements. The four most important hard skill categories are problem-solving (4.4), job-related skills (4.4), job-related theoretical knowledge (4.2), and the ability to handle unfamiliar situations (4.2). All of these skills are rated by employers as nearly "high" importance, but new hires' skills are only rated just above the neutral point between weak and strong. This suggests that companies experience skill shortage in respect to these important skills. Two hard skills have markedly lower importance: advanced math skills (3.3) and certifications on health and safety (3.2). While advanced math skills of new employees are about neutral between weak and skilled (3.0), new employees score low in terms of health and safety skills (2.6). Since Figure 5 supports the finding that companies face a substantial skill shortage, we need to know where these skills should be coming from. We ask employers whether they think each hard skill can best be learned in school or in the workplace, with results shown as the pink line in Figure 5. For all but one of the skills, employers report that workplaces are the better place to learn the skill than school. The only skill that falls on the school side of the divide is advanced math skills (1.5). It appears that schools are doing their part to supply skills, but companies are failing to provide training in the skills they need. The low investment in training discussed in the previous section is definitely related to skills shortage.

Figure 5: Hard skills: importance, skill level of new employees and best learning place

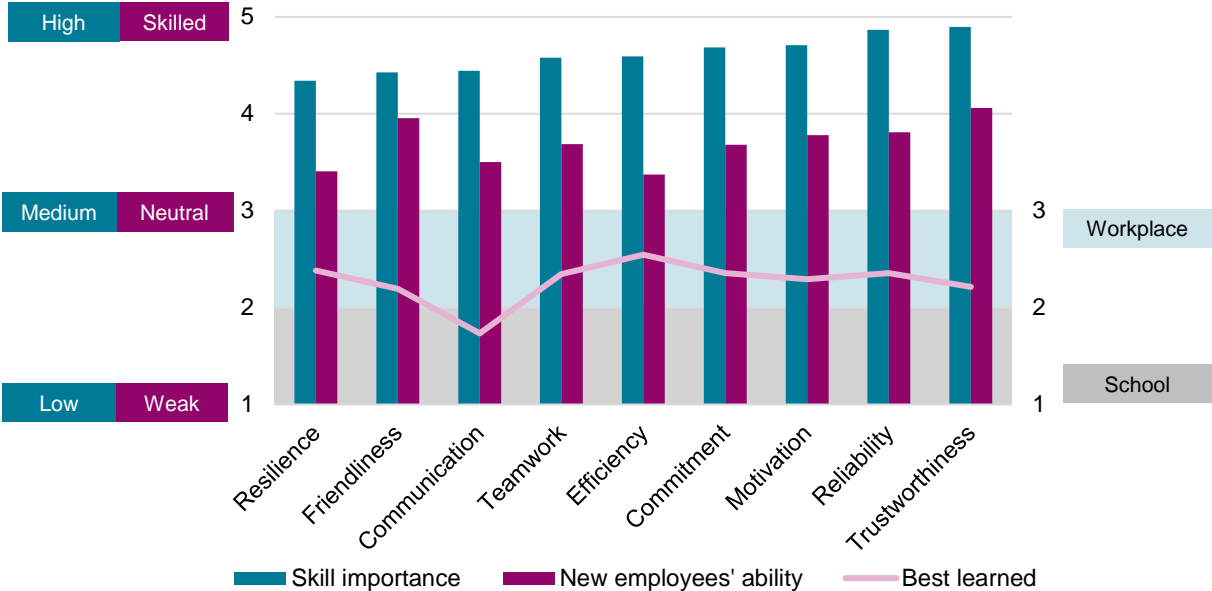


Notes: The figure displays for several hard skills how important these skills are for the company (blue, left scale, 1-5), to what extent newly hired employees fulfil the needs of the company (dark pink, left scale, 1-5) and whether the skill can be learned best in school or in the workplace (pink, right scale, 1-3). N=189, 152 and 147 for skill importance, new employees' ability and best learned, respectively.

The second category of skills are “**soft**” skills—sometimes called **21st century skills**—that reflect learned personal characteristics that facilitate and improve the application of hard skills. Figure 6 shows that **employers rate all of the soft skills as highly important to them**, with trustworthiness (4.9) and reliability (4.9) the most important and friendliness (4.4) and resilience (4.4) relatively less important. Soft skills of new employees are highest for trustworthiness (4.1) and friendliness (4.0). **The highest skill shortages are for efficiency (3.4), resilience (3.4) and communication (3.5).**

As with hard skills, we asked employers to report where they thought soft skills are best learned. Again, most of the soft skills can be learned better at the workplace than in school. **The only exception is communication, for which the respondents consider the school the more effective learning place (1.7).** Since communication represents an important skill to companies, this might be an area schools can emphasize more in the future.

Figure 6: Soft skills: Importance, skill level of new employees and best learning place



Notes: The figure displays for several soft skills how important these skills are for the company (blue, left scale, 1-5), to what extent newly hired employees fulfil the needs of the company (dark pink, left scale, 1-5) and whether the skill can be learned best in school or in the workplace (light pink, right scale, 1-3). N=171, 153 and 154 for skill importance, new employees' ability and best learned, respectively.

If we compare the results for hard and soft skills, we can see that soft skills are generally more important than hard skills. Furthermore, employees are more content with soft skills of new employees than with their hard skills. We can also see that respondents consider companies a better learning environment for both skill categories, though the comparative advantage of workplaces is stronger for hard skills (2.4) than for soft skills (2.2).

Though the list of skills is not fully comparable, our findings are generally similar to those of Bolli and Renold (2015), who show in Switzerland that the workplace has a comparative advantage. In that study the skills list is slightly difference and the workplace advantage is higher for soft skills than for hard skills, but the workplace advantage is consistent. The high comparative advantage of hard skills in Colorado might suggest that companies in Colorado have a particularly high share of company-specific skills needs that each company has to train their own workers. Alternatively, it could be that respondents consider schools so narrow that

no occupation-related skills are taught. The latter is supported by the low average tenure of employees: if skills were highly company-specific, companies and employees would incur costs by switching. Therefore, companies might underestimate inter-company training because existing programs fail to deliver the appropriate skills.

Which companies have the most and least trouble finding skilled workers?

Different companies need different skills, so each will be affected by the skill shortage differently. We have discussed how long vacancies remain unfilled, how skills shortage affects growth and explored which skills are available on the labor market. This section looks at how those outcomes vary by industry sector, company size, and the education level of companies' typical workers.

We divide companies into categories for comparison. For economic sector, we differentiate companies in the construction, manufacturing, and service sectors. For size, we separate small (1-49 FTE employees), medium (49-149 FTE employees), and large (150+ FTE employees) companies. Finally, we differentiate between companies whose proportion of university-educated employees is above or below the average.

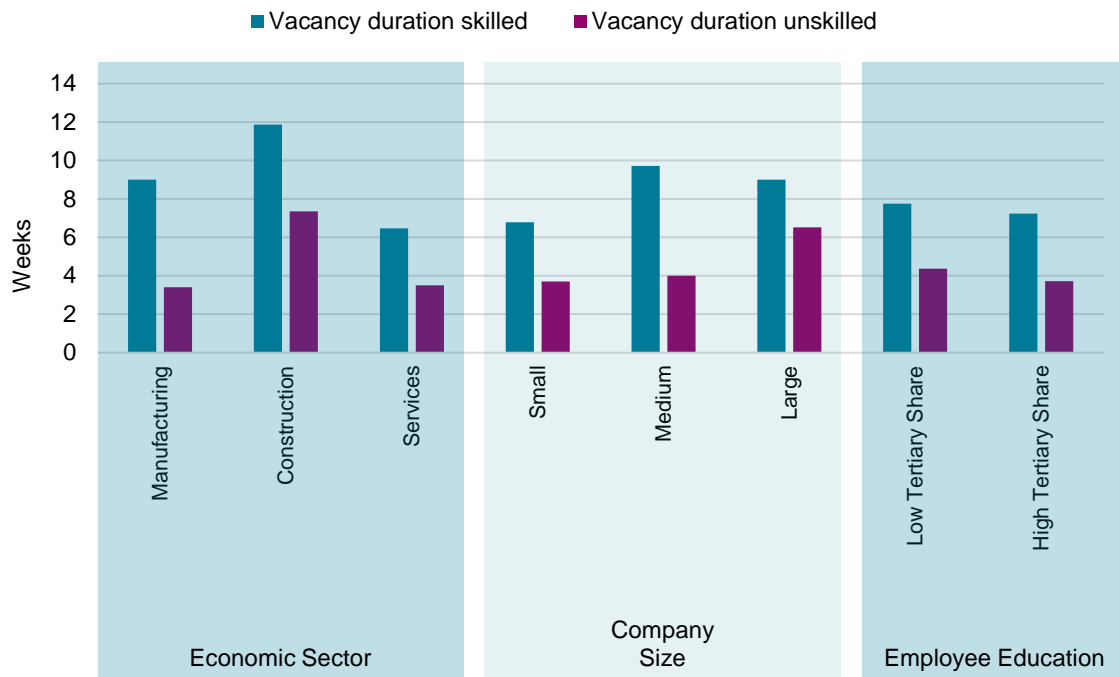
Figure 7 shows how long skilled and unskilled vacancies remain unfilled. Figure 8 shows the effect of skill shortage on company growth. Figure 9 displays the results for skill shortage for hard and soft skills. In order to improve readability, skills are combined into a single average each for hard and soft skills. Finally, Figure 10 summarizes the results based on a principal component analysis that aggregates the different indicators of skill shortage in a single indicator as shown in Table A2 in the appendix. Table A3 in the appendix shows regression results that control for the correlations of the other characteristics. This allows to disentangle correlations among the three categories, for example that manufacturing companies are generally larger than construction or services companies. Furthermore, these estimates provide evidence regarding the statistical significance of differences.

In all categories, it takes companies longer to fill skilled positions than unskilled positions, suggesting that there is at least some competition on the labor market for skilled workers. The construction industry is the most-affected economic sector, requiring 11.9 and 7.4 weeks to fill skilled and unskilled positions, respectively. Unskilled vacancies remain open for about 3.5 weeks in both the manufacturing and services sectors, and skilled vacancies last about 9 weeks in manufacturing or only 6.5 weeks in services.

Company size matters only to a limited extent for vacancy durations in skilled and unskilled positions. While skilled vacancies remain open longer in medium and large companies, these differences can largely be explained by other factors and remain statistically insignificant. Unskilled vacancies on the other hand last longer in large companies. Both skilled and unskilled vacancies tend to be longer to fill for companies where most employees have tertiary-level education, but the insignificant difference remains very small.

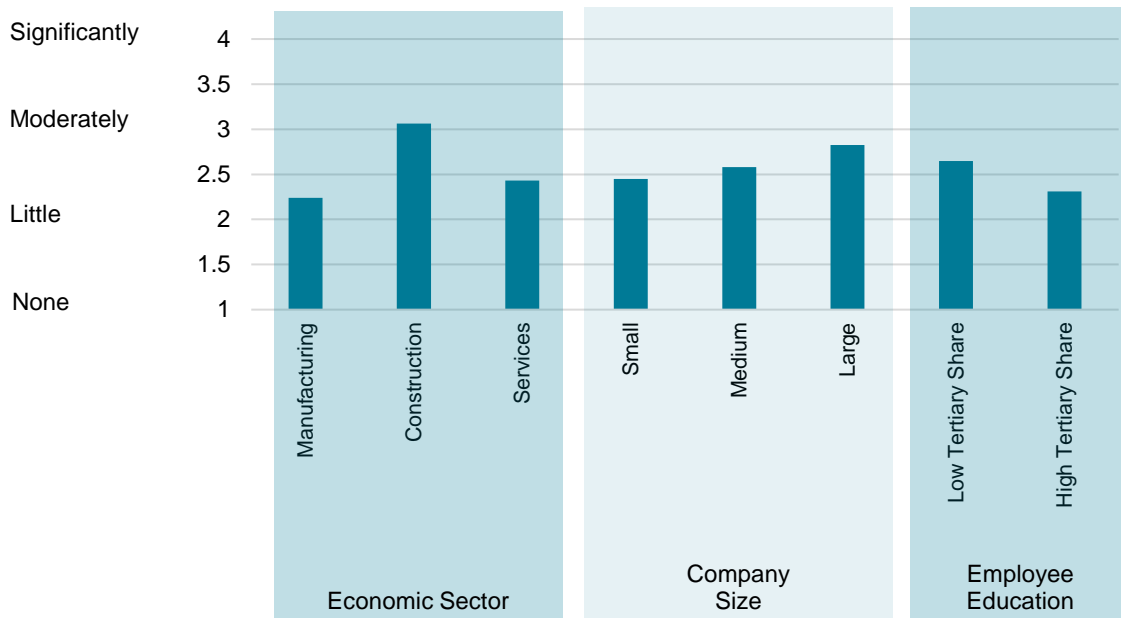
Figure 8 shows the effect of skills shortage on growth by industry, size, and education profile. Skills shortage affects growth to some extent in every category. Among economic sectors, the construction sector suffers more than the manufacturing or service sectors. Figure 8 further shows that skill shortage affects large companies with more than 150 employees more strongly than small- and medium- sized companies. Finally, the effect of skill shortage on company growth is similar for companies with more or less employees who have tertiary-level education.

Figure 7: Heterogeneity of vacancy duration (in weeks)



Notes: The figure shows average duration of vacancies in a skilled position and unskilled position. N~19, 29 and 156 for manufacturing, construction and services. N~165, 18, and 22 for small, medium and large companies. N~101 and 93 for low and high tertiary share.

Figure 8: Heterogeneity of skills-shortage effects on company growth



Notes: The figure displays the share of companies that consider the effect of skill shortage on company growth unimportant, little, moderately or significantly. N=21, 32 and 169 for manufacturing, construction and services. N=183, 19, and 23 for small, medium and large companies. N=108 and 103 for low and high tertiary share.

Figure 9 displays to what extent new employees fulfil the demands of companies. Hence, higher values indicate lower skill shortage. In all categories, respondents report that new employees' soft skills are better than their hard skills—though none are considered much above a neutral skill level. Once again the construction sector has a pronounced skills shortage, with a lower reported employee soft skills. Employees' hard skills are low in the construction sector and also low in manufacturing, while being higher in services. Rather surprisingly, the results suggest that medium-sized companies are more satisfied with their new employees in terms of both hard and soft skills, but large companies are less satisfied with soft skills than small companies. Companies with more-educated workers are more satisfied with both hard and soft skills than those with less-educated workers.

Figure 9: Heterogeneity of new employees' skills



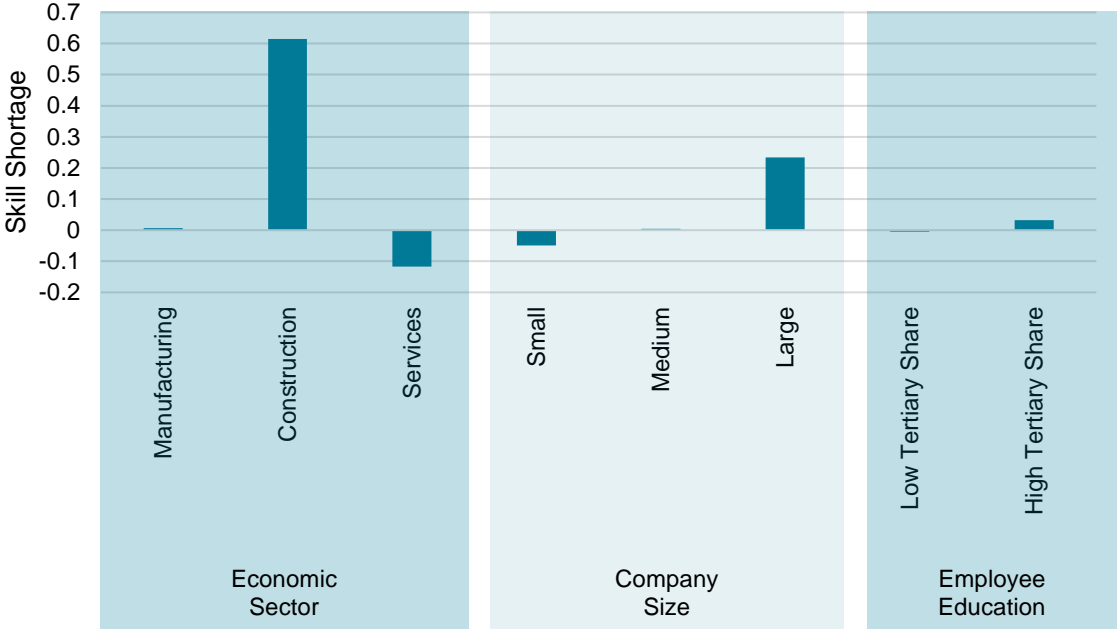
Notes: The figure displays to what extent newly hired employees fulfil the needs of the company in terms of average hard skills (blue, 1-5) and average soft skills (dark pink, 1-5). N~16, 21 and 113 for manufacturing, construction and services. N~117, 14, and 20 for small, medium and large companies. N~75 and 67 for low and high tertiary share.

In order to summarize these different indicators of skills shortage, Figure 10 displays the results of a principal component analysis that aggregates the different indicators in a single value. The results suggest that skills shortage is particularly high in the construction sector and only slightly lower in the services sector than in manufacturing. Furthermore, large companies suffer more from skills shortage than small or medium companies. Finally, skill shortage is higher for companies where many employees have tertiary education.

In all categories, skills shortage affects companies' ability to grow, skilled positions are harder to fill than unskilled positions, and workers' skill levels are not what companies consider skilled—especially in hard skills. All of these findings support the larger finding that there is a shortage of skills in Colorado relative to the demand of companies. The one standout category

is the construction industry sector, which consistently reports the biggest problems with growth, the most trouble filling skilled positions, and the lowest skill level among new employees.

Figure 10: Summary of Skills Shortage



Notes: The figure displays an aggregate of the five skill shortage indicators based on the results from a principal component analysis shown in Table A2 in the Appendix II. The aggregate has a mean of zero and higher values indicate higher skill shortage. N=10, 15 and 78 for manufacturing, construction and services. N=77, 11, and 16 for small, medium and large companies. N=55 and 45 for low and high tertiary share.

Summary of skill shortage

Companies cannot find the skilled workers they need, so they spend long periods of time looking for workers and even longer periods getting new workers up to speed. Growth and productivity suffer as a result.

Clearly, skills shortage is a problem in Colorado. Companies cannot find the skilled workers they need, so they spend long periods of time looking for workers and even longer periods getting new workers up to speed. Growth and productivity suffer as a result. Neither workers nor companies have strong incentives to train due to short tenures, and the results of this underinvestment show in companies' dissatisfaction with workers' skill levels.

An important consideration for this section is that the skill levels reported by employers are for workers they have actually hired—the skill levels available on the labor market in general are almost certainly much lower. Workers who are unable to find skilled positions or training opportunities are not included here and the real lack of skills on the market is also obscured.

Given that a skills shortage exists, we need to consider why that is the case—and why it is such a problem for the construction industry. A skills shortage at its simplest is just demand outpacing supply. Either there are not enough workers to fill the positions companies have

open, or the workers who are available are not sufficiently skilled. A bit of both may be the case, but the low reported skill levels of new hires imply that workers' insufficient skills is at least a large part of the situation. Therefore, schools and companies are either producing the wrong kind of skills or not enough skills. For the construction industry, the mismatch of the skills needed and the skills available is especially pronounced.

According to companies, the most important skills are best learned in the workplace.

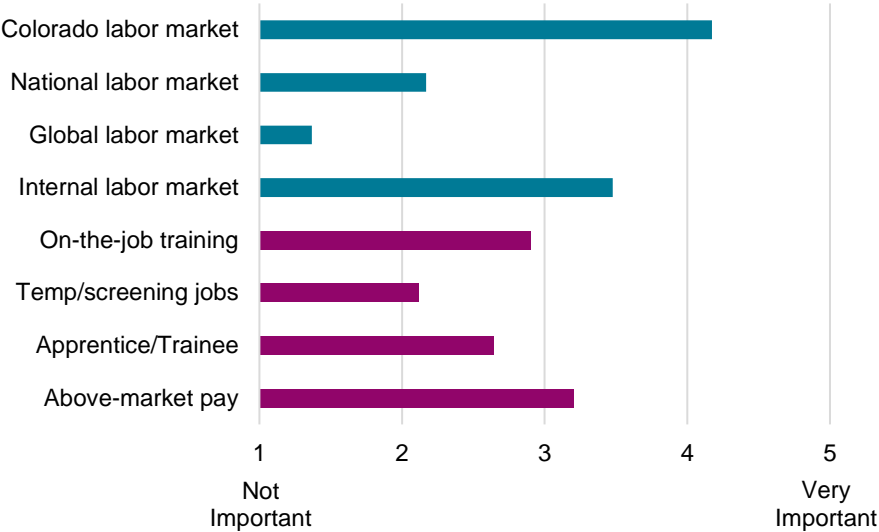
3.2 What is the current training landscape in Colorado?

How do companies find and recruit workers?

A skills shortage on the labor market means that companies are not finding the workers they need in the places they look, with the methods they use to attract good candidates. If we want to understand the basis of the skills shortage, the first thing we need to know is where companies are looking. This tells us the size of the labor market—whether it is the state of Colorado itself or a larger national or international market. We also need to make sure companies giving skilled workers from Colorado a reason to work for companies in the state, so we look at companies' strategies for attracting and developing talent.

Our first insights into the human resource strategies companies use to address skill shortage are in line with Figure 11, which shows where companies look for workers (in blue) and how they recruit or develop them (in dark pink). The results suggests that Colorado companies **recruit primarily from the Colorado labor market**, followed by promoting from within on their own internal labor markets. The national labor market plays a relatively minor role and the global labor market is largely unimportant. This means the labor market we are addressing is indeed the state-level Colorado labor market, and companies want skilled Coloradans first.

Figure 11: Relevance of human resource strategies



Notes: The figure displays the average relevance of several recruitment and training strategies in order to find the best qualified employees. N=237.

The human resource strategies that companies use to ensure they have access to skilled employees focus on both recruitment and skill development. Respondents report that **paying above-market pay** is their most important strategy, followed by **on-the job training**. Rather surprisingly, running an apprenticeship or traineeship program is nearly as important as on-the-job training. Hiring temporary employees for screening purposes is less important.

Colorado's employers want to find local and internal talent to fill their open positions, but often find themselves competing for qualified workers or turning reluctantly to training and candidates further afield. Colorado's companies are reticent to train as predicted, preferring to pay more for already-skilled workers than train in-house because of weak incentives to invest. However, they are at least eventually willing to train and providing training is one way companies can access skilled workers. Companies' emphasis on hiring from within implies that some training is happening on-the-job to prepare lower-level workers for promotion.

Within the larger labor market, new hires can come from a limited set of previous activities. At the entry level, **new hires most often come from other companies** (48%) or from the pool of unemployed people (22%). Recent college graduates (14%), and other sources (7%) are also commonly used. Hiring of past interns, trainees, or apprentices is a relatively small source of new entry-level hires at 3%, which is about the same rate as hiring directly from high school (4%). The military is the source of 2% of new entry-level hires.

How prevalent are internships, traineeships and apprenticeships?

Training is happening in Colorado's companies to produce the non-educational skills that exist. We need to know more about this training to understand where the skills shortage is coming from. To analyze current training activities, we distinguish three types of training: internships, traineeships, and apprenticeships, which we define as:

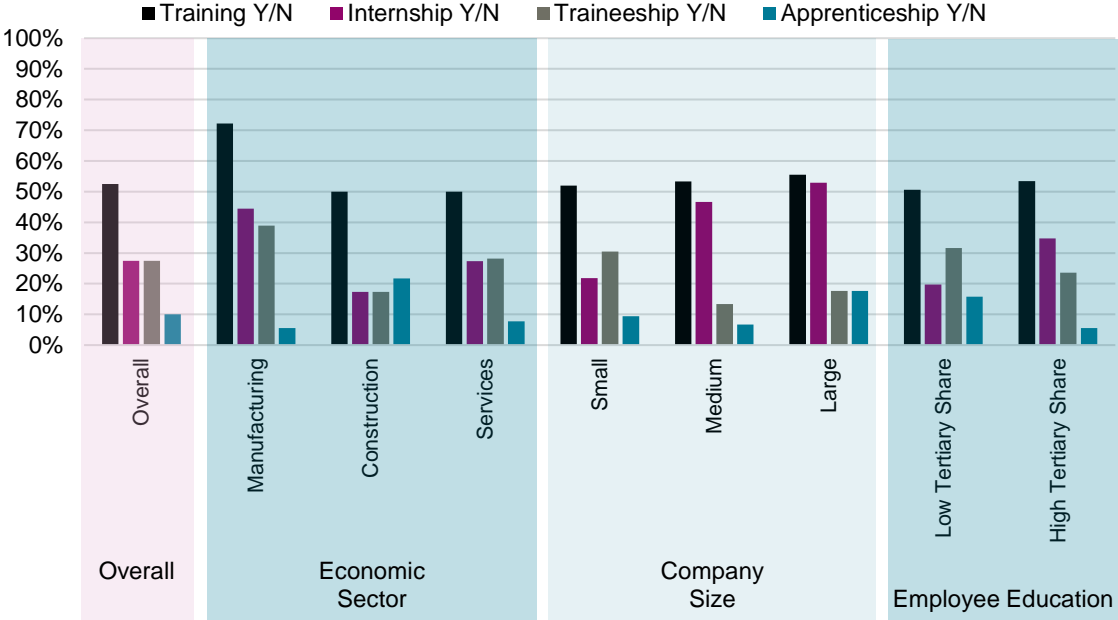
- **Internships** are short periods of work experience that do not end in any certification.
- **Traineeships** are "work practice" periods, and often trainees will continue working at the company after the training period. These usually do not end in certifications, though trainees might earn within-company certifications.
- **Apprenticeships** are set periods of education and training with clear pre-defined learning objectives. Apprenticeships always end in an industry, academic, or combined certification

Figure 12 displays the propensity of companies to provide these three types of training activities. The results suggest that **52% of companies train their employees** in some way through either internships, traineeships, or apprenticeships. **Internships and Traineeships are equally common in 28% of companies, while only 10% of companies offer apprenticeships.**

If we look at companies by category, there are a few interesting differences (see Table A4 in the appendix). At the sector level, more manufacturing companies provide internships (44%) and traineeships (39%) than the average company, though fewer provide apprenticeships (6%). Companies in the construction and service sectors have relatively similar training behavior, with the notable exception that a very large 22% of construction companies provide apprenticeship training. Companies of all sizes are surprisingly similar in terms of providing any type of training, but small companies are more likely to use traineeships while medium and large companies prefer internships. More large companies (18%) provide apprenticeships than the other sizes. Finally, though average training rates are similar between companies with few

(51%) and many (53%) tertiary-educated employees, the company categories differ on how they provide training. While companies with few tertiary-educated employees have relatively fewer internships, they provide more traineeships and apprenticeships.

Figure 12: Frequency of training activities



Notes: The figure displays the share of companies with interns (Internship Y/N), trainees (Traineeship Y/N), apprentices (Apprenticeship Y/N) and any of these three training participants (Training Y/N), respectively. N=162 (160) for overall sample of training and the training types in parentheses. N=18 (18), 24 (23) and 118 (117) for manufacturing, construction and services. N=129 (128), 15 (15), and 18 (17) for small, medium and large companies. N=77 (76) and 73 (72) for low and high tertiary share.

The three training types differ in terms of training intensity per company. While internship-hosting companies train about seven students on average, trainee-hosting companies only have 3.4 trainees on average. Furthermore, even though only 10% of companies provide apprenticeship training, each trains an average of 13.8 apprentices at a time. This finding—and the increased likelihood of larger companies hosting apprentices—suggests that providing apprenticeships requires companies to initially invest in program setup. This might include, for example, managing external bureaucracy, preparing supervisors as trainers, preparing training curricula, and adjusting production to integrate apprentices.

Why do some companies provide training and others do not?

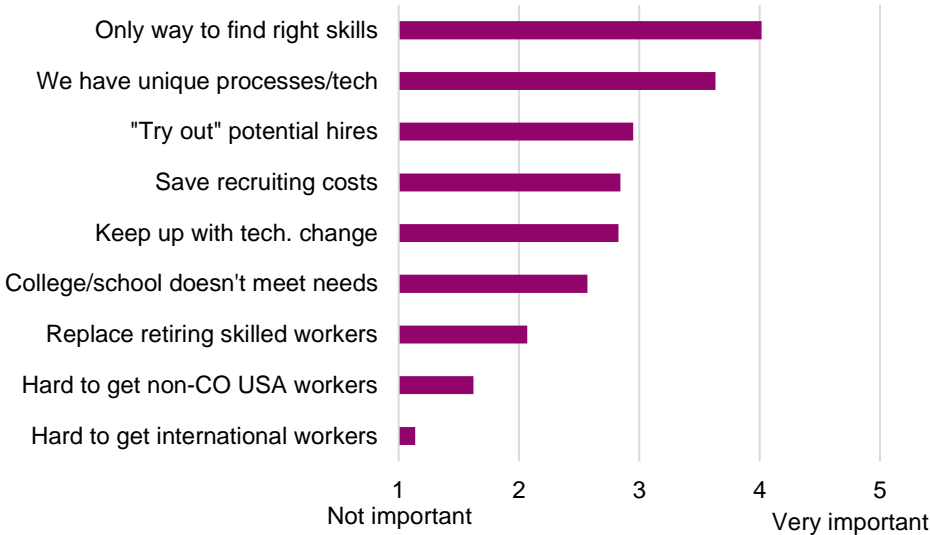
If training was the best way for all companies to acquire skilled workers, then all companies would train. However, this is not always the case. Missing knowledge, experience, and resources can prevent companies from initiating training programs, and characteristics of the company, its context, and its industry might make continuing a training program infeasible. To understand why only half of Colorado’s companies train despite the skills shortage, we need to know why companies do and do not train, and what enables and prevents them from training.

Figure 13 helps us understand the reasons why training companies choose to do so. By far the most important reasons responding companies cite for training are that it is the only way they can find the right skills (4.0), and that they use unique processes and technologies that employees could not learn elsewhere (3.6). The latter especially suggests that companies use training to convey company-specific knowledge in addition to addressing a general lack of sufficient skills on the labor market. This interpretation is consistent with the low reported importance of reasons that capture the difficulty of finding appropriate workers from college (2.6), from outside Colorado (1.6) or outside of the USA (1.1). Finally, trying out potential hires (2.9), saving recruiting costs (2.8) and keeping up with technological change (2.8) have medium importance.

When we look for differences across training program types, we find surprisingly little variation. This suggests that companies train interns, trainees and apprentices for similar reasons. The only exception is training to save recruiting costs, which matters more for companies that train apprentices. As discussed in detail below, this finding suggests that benefits arising after training represent an important component of apprenticeship training benefits.

Analyzing heterogeneity across sectors (see table A5 in the appendix) suggests that all sectors consider finding the right skills a similarly important reason. However, unique processes and technologies tend to be a more important reason in the manufacturing sector. Large companies use training less often because it's the only way to find right skills, while unique processes and technologies tend to be less relevant for small companies. Finally, unique processes and technologies matter less for companies with a high share of employees with tertiary education.

Figure 13: Reasons to train



Notes: The figure displays the relevance of various reasons why training companies provide internships, traineeships or apprenticeships to their employees on a 5-point Likert scale. N=56.

It is interesting—although not significant—to look at the relationship between companies' responses on their reasons to train and the skills they consider most important. Companies that consider training the “only way to find the right skills” are more likely to rate hard skills as important, but less likely to value soft skills. Therefore, the companies that are using training to meet skills needs are driven by their need for specific work process skills and not behavioral

and personality skills. At the same time, companies rate such soft skills as very important overall, so they might simply not realize they can be attained through training.

We also asked companies who train how problematic certain common challenges are for them, and asked those who do not train to rate the applicability of reasons they do not train. Figure 14 shows that the two groups rate the problems as similarly challenging overall, though non-training companies consider the barriers more difficult. Table A6 in the appendix displays the regression results for heterogeneity across sectors, company sizes and employee education.

Figure 14: Barriers to training



Notes: The figure displays the relevance of various barriers to provide internships, traineeships or apprenticeships to the employees on a 5-point Likert scale. Bars in dark pink and teal show the results for training and non-training companies, respectively. N=56 for training companies and N=69 for non-training companies.

Both training and non-training companies report that lacking time is an important barrier to providing training (3.2, 3.4). This finding holds across sector, company size and employee education. Furthermore, a lack of staff and size is also an important barrier to providing training. However, non-training companies (4.1) are much more concerned about company size than their training counterparts (3.1). Surprisingly, being too small and lacking staff matters similarly across sector, employee education level, and firm size, suggesting that the lack of staff is a consistent problem. Both training and non-training companies rate training costs as a major issue (2.8, 2.9). This is particularly true for manufacturing companies. These **issues with company size and training costs can be addressed by providing implementation support and designing programs that balance costs with benefits**. However, the first step in doing so needs to be creating an ecosystem that enables an efficient and effective support of companies in providing training to their employees.

The ability to find key skills among recent graduates and on the labor market in general is also an important reason not to train, particularly for non-training companies. Training companies score high in all indicators regarding skills shortage, which is consistent with the earlier analysis of skills shortage. Therefore, **even though companies in Colorado face a skills shortage on average, there are companies who can find what they need**. However, not all

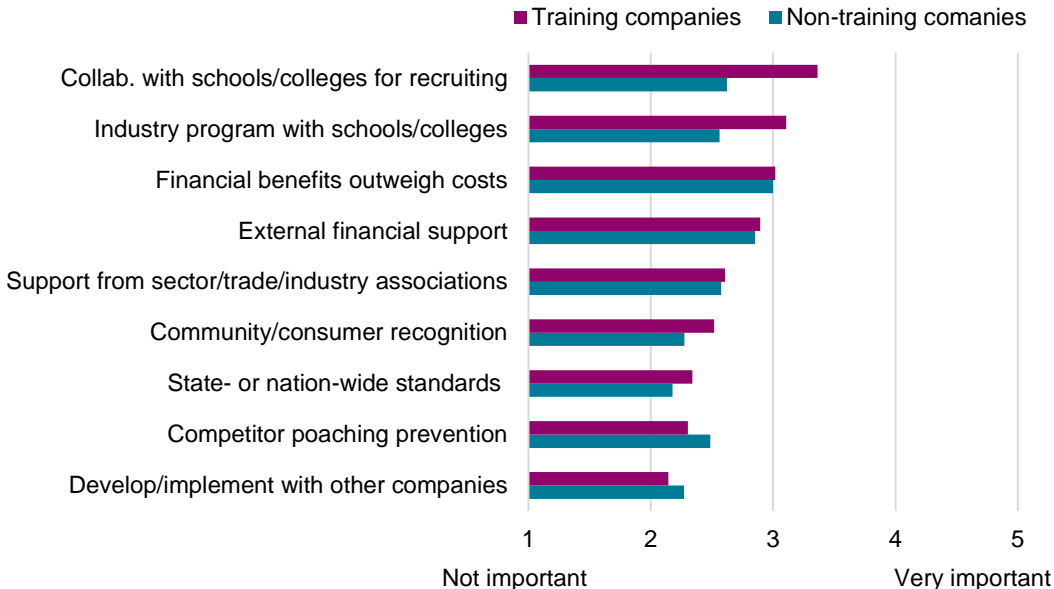
companies would benefit from new training programs. We recommend supporting companies who want to train without forcing companies who neither want nor need to train.

Given how often fear of poaching appears in discussions about training, its low importance is fairly surprising (it scores 2.1 and 1.9 as a barrier for training and non-training companies, respectively). However, this finding goes well with the finding that saving recruitment costs is a medium-important reason to train. This might be because current training activities are mainly company-specific skills are less valuable in other companies. Hence, **fear of poaching might become a more important barrier to implementing a training program with more general industry-wide skills**. Furthermore, fear of poaching is relatively high among companies in the construction sector, suggesting that it deserves more consideration in that context.

It is important to note that **Colorado appears to be well suited for the introduction of new training programs**. Not knowing how to train is not a major reason companies do not train, and neither are technological development or institutional issues like unions.

We also ask companies about encouraging factors that might help them create or expand training programs. Figure 15 shows how important respondents consider a number of factors. None of the reasons are especially important, though both training and non-training companies generally agree on their relative levels of importance. Neither group of responding companies is particularly enthusiastic about external support from industry associations (2.6, 2.6), recognition of their contributions to society (2.5, 2.3), official standards they can use to develop training programs (2.3, 2.2), or cooperation with other companies (2.1, 2.3). Interestingly, these results remain the same across sector, company size and employee education with the exception of poaching, which tends to be higher in the construction sector (see Table A7 in the appendix).

Figure 15: Factors that would help increase training



Notes: The figure displays the relevance of various training features to provide internships, traineeships or apprenticeships to the employees on a 5-point Likert scale. Bars in dark pink and teal show the results for training and non-training companies, respectively. N=56 for training companies and N=71 for non-training companies.

Training- and non-training companies are different in some respects. Training companies are cautiously enthusiastic about cooperation with educational institutions for recruitment (3.4) or industry-oriented programs (3.1). This is particularly true for internships and apprenticeships, but not for traineeships. Programs where the financial benefits outweigh the costs are also very attractive for both training and non-training companies (3.0, 3.0). Non-training companies are especially enthusiastic about training models that include external financial support (2.9), particularly for internships. These findings highlight the relevance of balancing the features of a training program in a way that incentivizes companies to provide training places from a business point of view.

What drives the costs of training in general?

When training costs more than it benefits, companies rationally choose not to offer training. Our findings thus far indicate that is at least partially the case in Colorado: though there is a skills shortage, only about half of companies in our sample train. The rest find what they need on the labor market or settle for lower skills and lower productivity. This section discusses the characteristics of Colorado training programs and their cost drivers in more detail. We can use this as to have an evidence-based discussion of companies' incentives to train.

We will base this discussion on a model of training costs and benefits developed using the Swiss system (Wolter et al., 2006). Training costs and benefits can be divided into those accrued during training and those after (Blatter et al., 2016). Post-training costs and benefits are important in imperfect labor markets—especially those with high rigidity and friction (see, e.g., Wolter & Ryan, 2016). Colorado's labor market is very flexible, so the most important costs and benefits are those during training. Essentially, companies in Colorado cannot count on training participants staying after training if a better offer comes along, so they need to make sure their training programs make short-term financial sense. Hence, the following discussion will focus on costs and benefits that occur during training.

Figure 16 is a stylized model of the determinants that define benefits and costs over the course of the training period (Lerman, 2014). Before the training, future participants earn an unskilled wage. Within the program duration, training costs (grey line) are made up mostly of training participants' wages. Training costs also include the equipment, materials and trainers' time used for the training. The benefits of training (black line) are training participants' productivity at unskilled work and skilled work (see, e.g., Muehleemann & Wolter, 2014). Training companies also save recruiting costs for any training participants that stays on after training, but that is outside the training period discussed here. In order to illustrate the benefits of the program to the participants, the figure shows the post-training wage after the program, which is substantially higher than the unskilled wage.

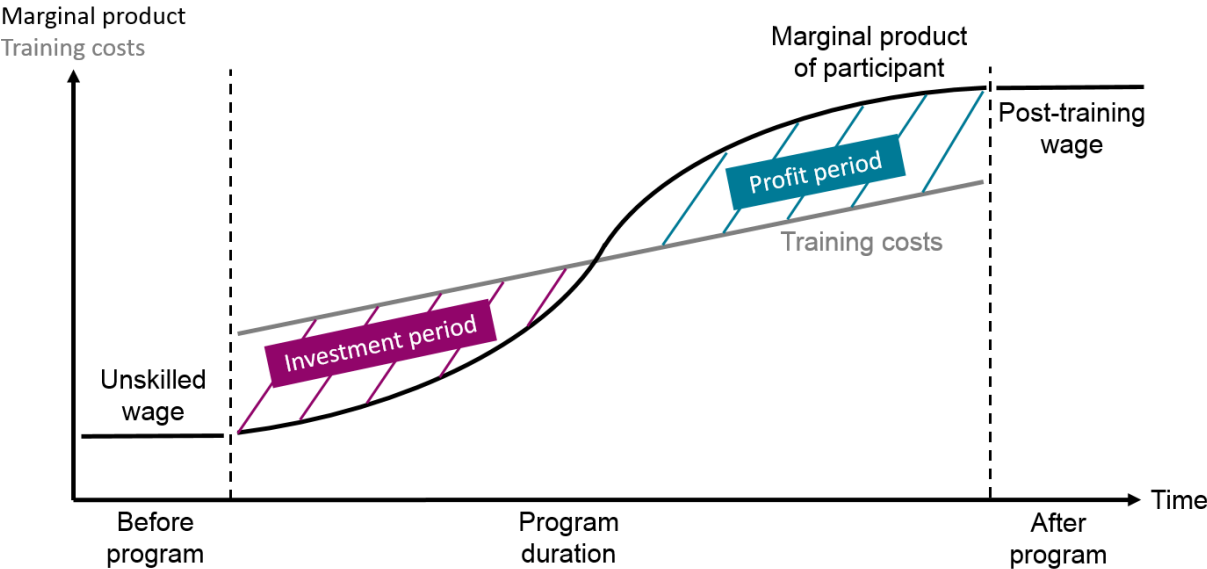
Initially, training is a net loss for companies as training participants are less productive than they are paid to be. Eventually, their skills improve and their productivity rises towards that of fully-skilled workers, but they continue to receive training participant wages—accepting lower wages during training is how training participants “pay” for formal training. Once productivity rises above their wage level and other costs, they begin generating a return for the company until, ideally, the company at least breaks even by the end of the training period.

If we imagine changing the parameters of training programs by moving and adjusting Figure 16, we can see how different program characteristics would affect the returns to training. Starting with costs, the grey line moves up and down as training participants' wages move. Increasing the wage (moving the grey line upwards) would eat into companies' returns and at

least require a longer training period—if not precluding a return entirely and requiring large returns after training. Moving the line down too far make the program very profitable for companies but risks exploitation of the training participants unless they can expect a large return for themselves after training. This is the case with programs that end with valuable certifications, like medical and law school where training participants invest significant time and money on the assumption they will reap returns later in life from lucrative careers.

Wages themselves are affected by the value of the program to training participants—lower wages are acceptable for more valuable credentials. Furthermore, the wage demanded by participants depends on their age. In Switzerland, participants start apprenticeships at the age of 15 and 16. Since they usually live with their parents, have no family and generally have low living expenditures, they can agree to a relatively low wage.

Figure 16: Stylized model of benefits and costs during the training period



Notes: The figure displays a stylized model of the development of training costs and benefits over the course of the training program. Training costs increase due to the assumption that participant wages increase over time. Benefits in terms of the marginal product increase as the participant becomes more skilled and hence can be employed more productively. Since benefits increase faster than costs, the beginning of the program represents an investment period, which can be remedied in the profit period. Source: Own depiction based on Lerman (2014).

On the benefit side, we can consider training program quality (the slope of the black line) and initial skill levels (the height of the black line in the beginning). Companies with more effective training programs—due to higher investment or any other reason—can expect training participants’ skills to advance more quickly, making the black line steeper and returns greater. This enables the training program to be shorter or simply more profitable, and might be the case with short, high-intensity programs like coding “bootcamps.” Raising and lowering the skill level can happen because of training participants’ initial skill levels or the desired end level of skill. If training participants come into the program already very skilled, they can begin to generate returns almost immediately and the program can be very short. This is the case with college interns that stay only for a summer. If the incoming skill level is very low, the training

program will need to be longer, the wages lower, or the quality higher to ensure returns. This may be the case with some Registered Apprenticeships in construction or manufacturing.

Therefore, there are three key determinants of a training program's costs and benefits. Training **wages** are the largest part of training costs, though other program costs can also play substantial roles. Training participants' **productivity** determines most of the benefits, and is itself determined by how much time training participants spend on productive—especially skilled productive—work (Muehlemann and Wolter, 2014). Finally, since employee productivity increases over time, **program duration** is the third key determinant of net costs of training programs. Hence, the following part discusses these elements in the existing training programs.

What drives the benefits and costs of training in Colorado?

We can start our analysis of training in Colorado with wages. Training participant pay relative to fully skilled employees differs substantially between the three program types—internship, traineeship, and apprenticeship. Interns earn 34% of skilled workers' pay on average, while trainees earn 59% and apprentices 51% during training. This finding suggests that trainees and apprentices receive relatively high wages similar to their counterparts in Austria (40%-60%), Denmark (51%-54%) and Ireland (60%). Those wages are unlike the wages earned by German apprentices—only 25% to 45% of a skilled worker's wage—and those of Swiss apprentices, which are even lower (Ryan, 2000).

However, in all of these countries, apprenticeships usually start after lower secondary education. Hence, one explanation for the relatively high wages of Colorado's trainees and apprentices might be the average age of students. While interns are the youngest on average at 22 years of age, trainees (27 years) and apprentices (28 years) are both much older. Older students might require higher wages because they are more likely to have households and families to support, so they have much less flexibility to take low-paying jobs that might pay off later. The wages can also be higher relative to skilled workers if skilled workers' wages are generally low relative to marginal productivity.

Analyzing other components of training costs shows that **apprenticeships are the most expensive type of training for the companies**, costing on average \$17,250 yearly in wages, trainers' wages, machinery, tools, and related costs. Interns and trainees are less costly with yearly sums of \$11,734 for interns and \$11,180 for trainees.

To assess the benefits of providing training, we need to consider what participants are doing with their time. Participants in the three program types spend their time slightly differently. We differentiate four ways they can spend time while in the workplace:

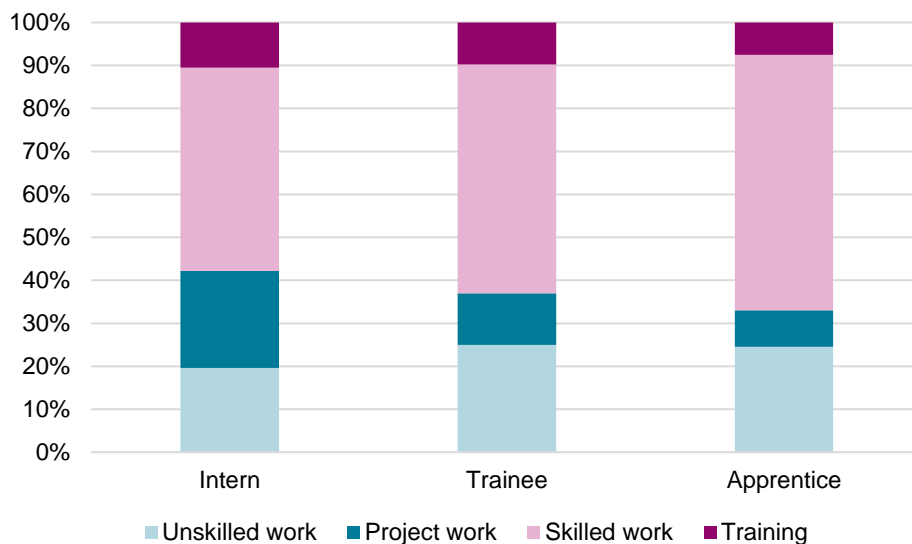
- **Training** can be in-house or external courses, training modules, unproductive practice, safety training, shadowing employees, background reading, learning procedures, etc. It is not productive.
- **Project work** can be productive, but is not part of a company's normal production process (i.e. reorganizing file cabinets, process improvement proposals, etc.).
- **Skilled work** is work that requires training, experience, and/or education (i.e. answering customer correspondence, operating production machinery, processing accounts payable, etc.).

- **Unskilled work** is work that can be done by anyone who has basic workplace skills with no or very little initial training (i.e. lifting and carrying, simple manual work, making copies, sweeping the floor, etc.).

Figure 17 displays the distribution of participants' time across these four activities. The results show a surprisingly similar picture across all three program types. Participants spend the most time on skilled work tasks, suggesting that the benefits of the program to the companies are substantial as these tasks are the most productive use of participants' time.

Interns do slightly less skilled work (47%) than trainees (53%) and apprentices (60%). Conversely, interns spend more time on project work (22%). The amount of unskilled work is similar at 20% for interns and 25% for trainees and apprentices. Training time is also similar, though slightly lower for apprentices (8%) compared to interns (11%) and trainees (10%).

Figure 17: Time allocation by program type.



Notes: The figure displays the share of time used for *unskilled work*, *project work*, *skilled work* and *unproductive learning and training time*, respectively. The low share of training suggests that the programs mainly convey company-specific skills. The high share of skilled work suggests that the benefits of the programs is relatively high. N=34, 36, 10 for interns, trainees and apprentices, respectively.

In order to put these numbers into perspective, it is important to bear in mind program duration: **internships are much shorter** than the other types at 6 months compared to traineeships' 12 months and apprenticeships' 33 months. Hence, the 8% of time apprentices spend in non-productive learning and training amount to nearly three months of full-time training, suggesting that apprentices acquire a substantial amount of skills during the program. When apprentices are performing skilled tasks, they are likely to be even more productive due to their higher skill levels, and will be spending even more time on the same due to their longer total time.

Another approach is to compare training programs to the onboarding process. During the introductory period, the average new hire in a skilled position spends 30% of their time training and only 70% on productive work. Since the average worker takes about three months to reach the same productivity level as an experienced worker—up to a year or more in 22% of

Colorado's companies—these are substantial training efforts. Companies are more experienced at offering training than they seem to think.

Colorado Training Leader: Mikron

Mikron Corporation Denver manufactures automation systems for industrial production. Established in 1983, it is part of the Mikron Group, based in Switzerland. We interviewed Denver General Manager Mike Gunner.

Mikron's fast growth from 50 to 150 employees in three years meant it struggled to find skilled employees who could assemble complex machines. Partly due to its Swiss parent company's experience, Mikron set up a high school-level **Apprenticeship Program** in Colorado. It connected with Pilatus and Intertech Plastics through the Colorado Advanced Manufacturing Alliance (CAMA) in 2014, and the three companies supported one another while Mikron developed its own program. Mikron used Department of Labor documents for apprenticeships as a starting point for standards, and developed value propositions for schools, teachers, parents, and training participants. The company partnered with the Cherry Creek School District to recruit its first batch of apprentices.

The first year was very successful. Mikron relied on the schools to recruit students, offering trial visits to technology teachers and relying on their insight to winnow the initial hundreds of applications down to the best-match candidates. Mikron interviewed 12 students and offered 10 of them a five-week internship in the summer before 12th grade. Interns worked part- and then full-time during the internship, experiencing the life of a Mikron employee. After the internships, seven students decided to go on to the full apprenticeship, and Mikron found itself with the difficult task of choosing only three for the 12th-grade apprenticeship. Apprentices divide their time between classes at school and workplace learning at Mikron, each one on a different schedule and paired with a mentor.

Mikron was initially concerned about potential behavioral issues during the first internships, so it brought in two teachers to help ease the transition to having 16- and 17-year-olds in the office. In reality, there were no problems at all with the students—quite the opposite. The interns and apprentices changed Mikron as a workplace, the way in Mikron's employees behave, and how they interact. This led to a lot more cooperation and thus had a very positive influence on company culture. Parents reported that the apprenticeship also changed family dynamics at home, with students so motivated and excited about their work that they started telling their parents about their days unprompted instead of going straight to the computer.

Mikron's challenge is extending the dual education and work apprenticeship to the college level, because there are no certifications or pathways that combine the two—yet. The vision is an industry-wide agreed-upon curriculum that includes both practical and theoretical knowledge, and through which students can take courses at community colleges, universities, and online to meet course requirements. The program would lead at least to an industry credential and community-college-granted associate's degree, with opportunities for further education and training.

How is training quality ensured?

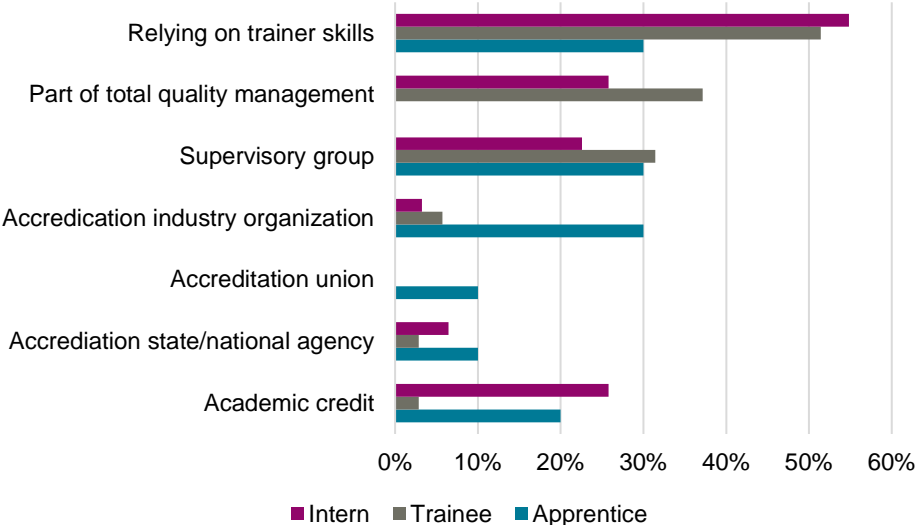
The previous section discusses the incentives of companies to train, but participants also need a reason to enter training programs. Individuals' incentives, in turn, affect the wages companies need to offer to attract good participants into their programs. Companies need good participants to ensure that their productivity is high and rising during training. Individuals need strong benefits either during training (high wages) or after (valuable, recognized certifications).

The high relative wages in all three programs suggest that Colorado's participants get strong immediate benefits during training. They can expect to spend about 10% of their time on training activities during all three program types. This relatively low training share raises the

question of how much skill participants can expect to gain from work experience. This form of skill acquisition depends on whether the work experience is structured in a way that optimizes learning. The results suggest that **interns are not likely to follow a curriculum** for their learning (26%) while some trainees (35%) do and most apprentices (55%) can expect curriculum-guided learning in the workplace. In addition to providing structure, curricula are also an external signal of what the participant has learned. Without them, the program may be less valuable for participants. This also matters for firms, because less able participants train in the program, thereby decreasing productivity of participants during the program duration.

Companies' quality control strategies for their training programs tell us a lot about the program's quality and value. Figure 18 shows the prevalence of various strategies by program type. All programs are likely to use group supervision of content and quality, and all rely most heavily on trainers—especially internships and traineeships. Internships are likely to be partnerships with educational institutions that provide academic credit, which can help ensure quality. They, like traineeships, are often part of companies' overall TQM or other quality management strategies. Apprenticeships have the most varied quality assurance strategies, with unions playing a role only for this type along with an unusually strong role for industry or sector organizations. Like interns, apprentices often earn academic credit.

Figure 18: Quality assurance methods by program type



Notes: The figure displays the share of companies using a particular quality assurance instrument to ensure quality of training *interns*, *trainees* and *apprentices*. N=31, 35, 10 for interns, trainees and apprentices, respectively.

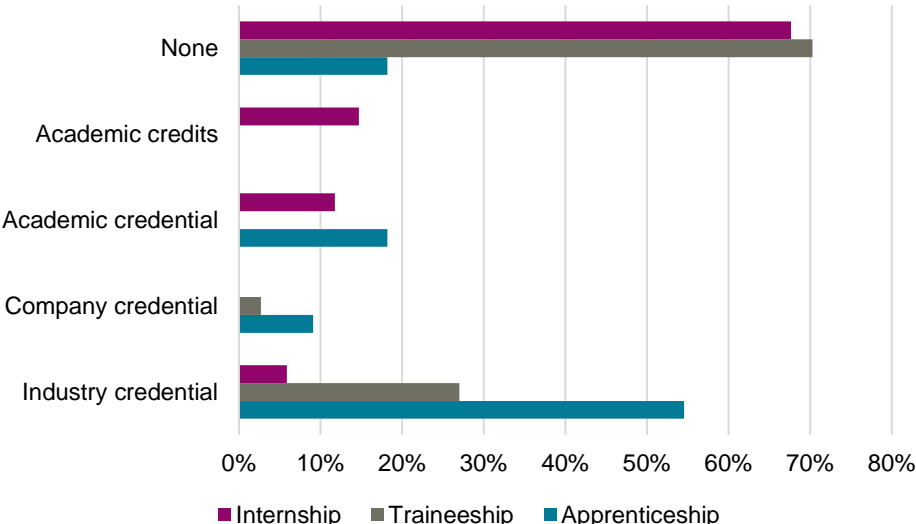
Since relying on trainer skills represents an important mean to ensure the quality of the training program, it is important to note that 54% of companies have a designated trainer to take care of the training participant. This share is higher for companies with trainees (71%) than for companies with apprentices (50%) and interns (45%). Among companies with designated trainers, 74% receive special preparation for that role. Furthermore, all companies with apprenticeship training have trained the trainers.

From the participant point of view, program value depends substantially on receiving a credential that signals their acquired skills to future employers. This is particularly important if turnover is high as is the case in Colorado, suggesting that participants need to be able to

signal future employers the skills acquired in the program. If the program itself does not yield a credential, it can still be part of a broader academic program that leads to a valuable degree. Interns are a good example of this phenomenon: although company and industry credentials are uncommon, 26% of interns combine academic education with work experience toward an eventual degree. Traineeships remain separated from academic education, but 18% of apprentices receive an academic credential related to their training.

Figure 19 shows that interns (68%) and trainees (70%) usually do not receive a credential, though some (27%) trainees earn industry credentials to signal their skills on the labor market. Credentials are the norm for apprenticeships, with only 18% of apprentices earning none. Among apprenticeship credentials, most (55%) are at the industry level, even more valuable than the company level. Company credentials play a relatively minor role (9%) for apprentices. If Colorado is to have a system where companies can train workers and offer well-recognized credentials, there need to be standards and recognition for program completion.

Figure 19: Program credentials by program type



Notes: The figure displays the share of *interns*, *trainees* and *apprentices* receiving academic credits or a credential from an academic institution, the company or an industry organization. N=31, 35, 10 for interns, trainees and apprentices, respectively.

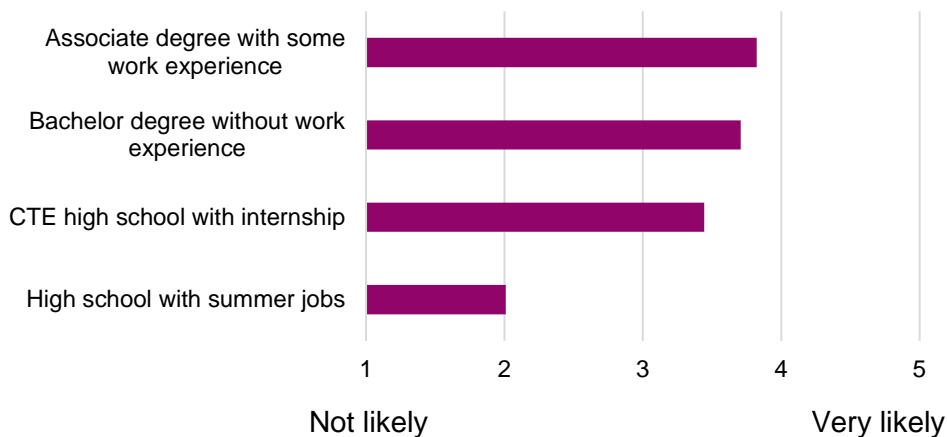
Training quality enables companies to attract the best participants, which starts a virtuous cycle of better-quality learners, better programs, and more valuable credentials that eventually leads to a more productive and skilled workforce. However, the quality of current training programs is often undefined in Colorado with so many programs lacking credentials. Prospective trainees are less likely to participate in programs that cannot offer reliable gains.

How valuable is training?

This study is not the place to causally identify the value of training in all its forms, but we did include a hypothetical experiment in the questionnaire. The experiment asked responding companies to say how likely they would be to hire a new employee with various backgrounds for a job opening of a skilled job as an IT technician assistant. It deals primarily with the trade-off among internships and various amounts of education and work experience. The hypothetical experiment gives respondents four alternatives that vary on the key dimensions while being sufficiently similar to be realistic.

The results in Figure 20 show that, in this mini-experiment, high school graduates who have only worked during summers are quite unlikely to be invited for an interview (2.0). Applicants with an associate degree and some work experience have the highest likelihood of an invitation (3.8). However, their advantage compared to applicants with a bachelor degree without work experience (3.7) remains very small. This illustrates the importance of work experience. Furthermore, graduates of high school CTE programs that include an internship reach a high value of 3.4, which is surprisingly close to the participants with a tertiary degree. This finding suggests that work experience gained through an internship is an important asset on the labor market.

Figure 20: Probability of candidate interview invitation



Notes: The figure displays the average probabilities that companies invite candidates with different background in terms of education and work experience for a job opening of a skilled job as an IT technician assistant. N=113.

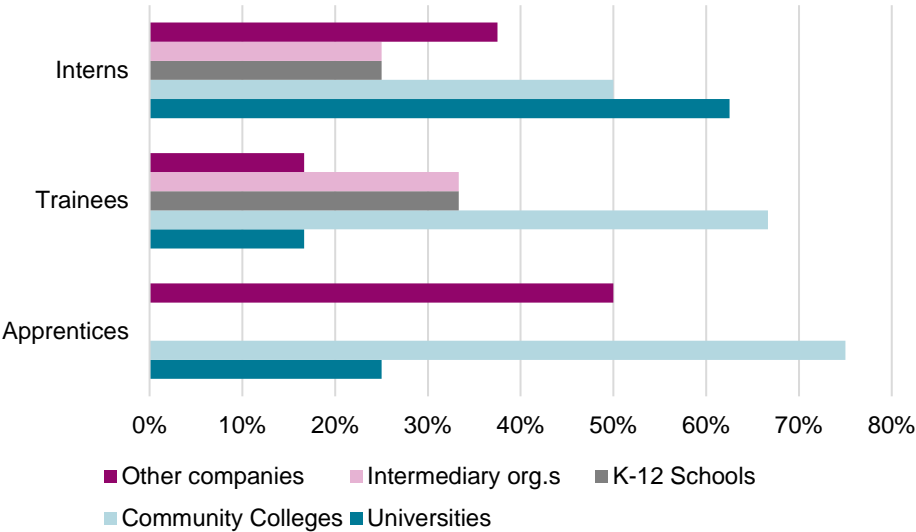
3.3 Cooperation for training

Training costs are not the only barrier Colorado companies say prevents them from training. Companies also cite low resources, staff, and small size as reasons they cannot train workers—the lack of resources is the most common barrier. Large training programs require different actors from the education and employment systems to work together along the whole educational process (curriculum design, application, feedback) in order to train participants optimally (Renold et al., 2016). This study analyzes cooperation from a systemic perspective, arguing that an optimal education system balances the power of the actors from the education and employment system in the educational process.

The present study takes a smaller perspective and defines training cooperation as a formal or informal agreement among companies, associations, or other organizations to train new workers together. This can include sharing resources, experience, curricula, or certifications.

Cooperation is not very common among companies that train in Colorado, with only 27% of all respondents reporting any cooperation. The most cooperative training type is apprenticeship (44% of companies cooperate) followed by internship (27%) and traineeship (19%). A good sign for Colorado is that there are companies who cooperate with one another. This is a very important requirement for establishing a state-wide apprenticeship program.

Figure 21: Frequency of training cooperation by training and partner types

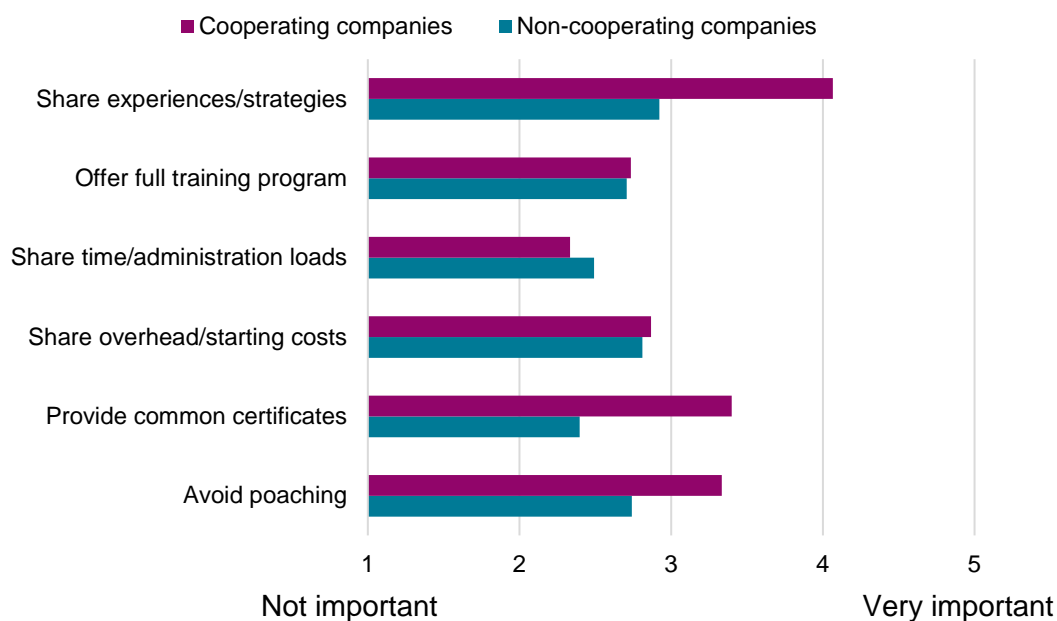


Notes: The figure displays the share of cooperating companies that cooperate with a particular type of cooperation partner in training interns, trainees or apprentices. N=8, 6, 4 for interns, trainees and apprentices, respectively.

Companies can cooperate with other companies, intermediary organizations like industry or sector associations, or education institutions like K-12 schools, community colleges, and universities. As shown in Figure 21, apprentice-training cooperate with community colleges and other companies often, and occasionally with four-year universities. Trainee-training companies cooperate the least, but do work with community colleges, intermediary organizations, and K-12 schools. Finally, intern-training companies are by far the most likely to cooperate with universities, and also work with community colleges and other companies.

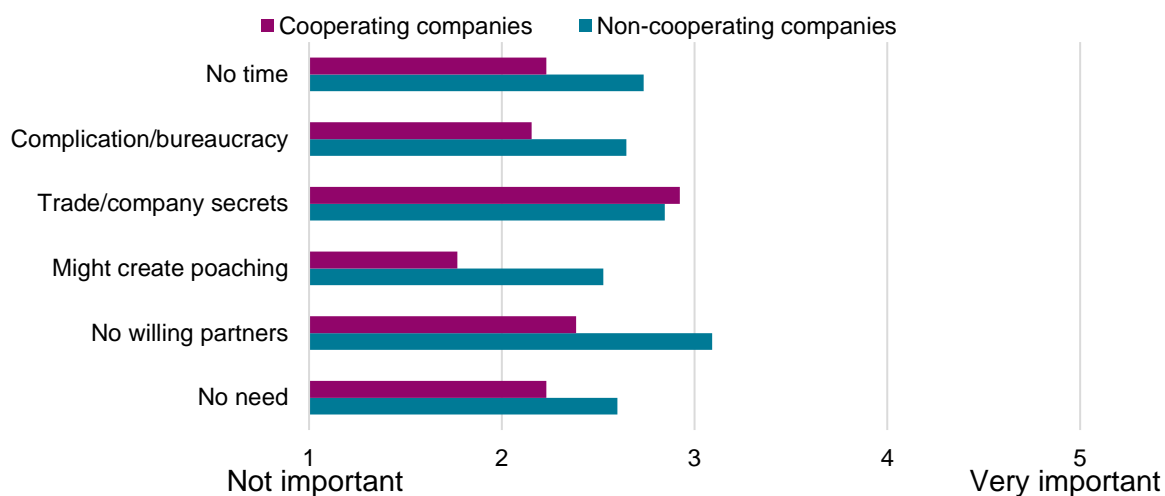
All companies—those who train and those who do not—reported what they perceive to be the main benefits of cooperating and the biggest challenges. Figures 22 and 23 show their responses. Cooperating companies consider sharing experiences and strategies the most important benefit by far. Furthermore, providing common certificates and avoiding poaching matter much more for cooperating companies than non-cooperators. Non-cooperating companies are generally unconvinced, finding no reason to cooperate important. Sharing experiences and strategies for training is relatively strong, and cooperation is slightly more appealing when companies can share administrative and overhead costs or avoid poaching.

Figure 22: Importance of reasons for cooperation



Notes: The figure displays the average relevance of several reasons to cooperate in training provision for cooperating companies and non-cooperating companies. N=15 and 116 for cooperating and non-cooperating companies, respectively.

Figure 23: Importance of barriers to cooperation



Notes: The figure displays the average relevance of several barriers to cooperate in training provision for cooperating companies and non-cooperating companies. N=13 and 110 for cooperating and non-cooperating companies, respectively.

Though reasons to cooperate are generally not strong, respondents find surveyed reasons to avoid cooperation weak as well. Cooperating companies worry about trade and company secrets, but other potential barriers are not important. Trade and company secrets also matter for non-cooperating companies, though the absence of willing partners matters more. The remaining barriers are not important even for non-cooperators.

When companies cooperate in curriculum development for schools, colleges, or universities—usually for industry-related programs—they report that they feel empowered, claiming that their

influence on curriculum content decisions is closer to “high” than “medium” (4.7 on a seven-point scale where 4.0 is “medium” and 5.0 is “high”). Since companies find reasons to cooperate more compelling than reasons to pull back, and since they seem to have good experiences when they do cooperate, the problem may simply have to do with never having considered cooperation for training.

Cooperation among companies and between companies and educational institutions enables the major changes that can turn training into an attractive and efficient undertaking for trainees and companies. Colorado already has some degree of cooperation, and companies that do cooperate seem to enjoy the process. If cooperation can be more consistent, major improvements can be possible.

Colorado Training Leader: FirstBank

FirstBank is a Colorado-based retail bank with 2,500 employees working at its 120 locations. We interviewed Senior Vice President and Human Resources Director Christinne Johnson.

Founded in 1963, FirstBank has always had its **Management Training Program (MTP)** to develop management talent. Anyone who reaches the level of officer goes through the program, from assistant vice presidents to CEO. FirstBank recruits 4-year college graduates with degrees in business into the program. Candidates should be highly motivated and willing to learn. For the past six years, FirstBank’s HR team includes a dedicated recruiter who cooperates with college and university business schools throughout Colorado.

The six-month program sends cohorts of 10 to 15 trainees through classroom and hands-on learning. Trainees are together in the classroom and alone for practical training in their assigned branch locations. At the branch, trainees work with a mentor to learn all aspects of FirstBank management and operations. Trainees work as tellers, open new accounts, experience customer service, and more. The program is based on a workplace training schedule in which trainees stay two weeks in each area, then spend the last half of their training dedicated to underwriting and lending. At the end of six months, the bank promotes successful trainees to Banking Officer and they typically manage a FirstBank facility.

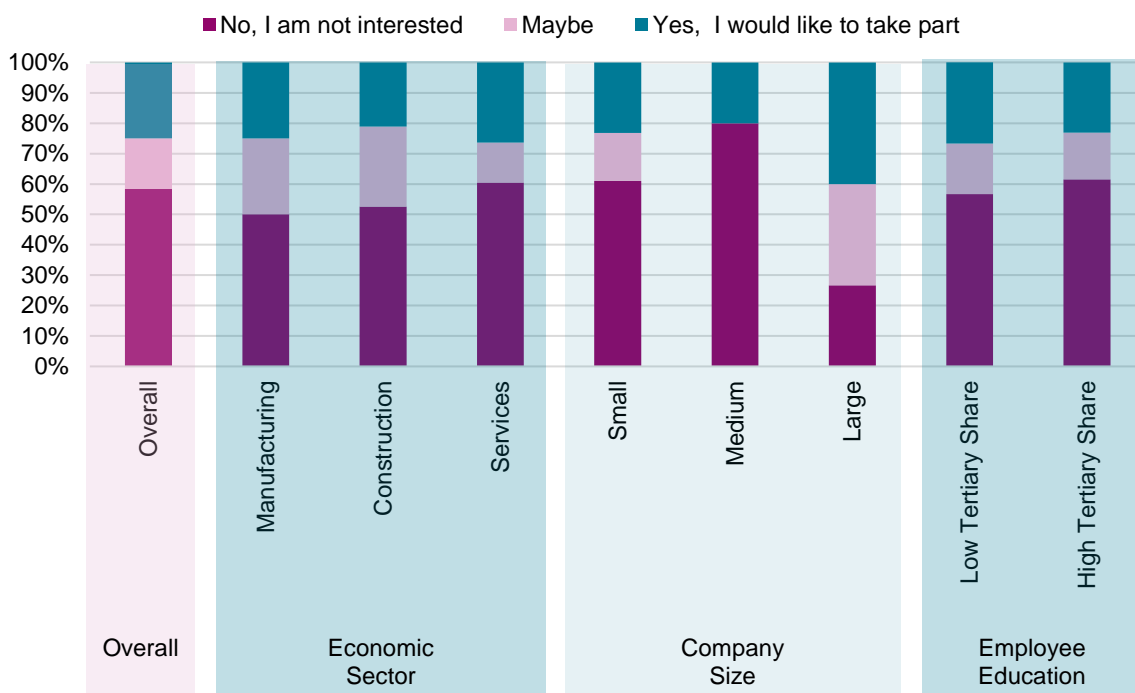
Five years ago, FirstBank introduced an **Internship Program (IP)** for college students that works as a feeder for the MTP. Students start as early as the summer before their first year of college to as late as the summer before graduating. The IP is a paid, full-time summer position, in which students work shoulder-to-shoulder with permanent FirstBank employees. Interns work in different contexts every summer until graduation as an introduction to the MTP. IP interns get a head start on the MTP, and FirstBank gets a head start on recruiting. The company considers the program a success as both a recruiting toll and a way of screening potential candidates.

In the future, FirstBank plans to add more soft skills to the curriculum, and more leadership development components earlier on. They are also considering a partnership with CareerWise Colorado on bringing in trainees even earlier. From FirstBank’s point of view, the most realistic opportunities are in opening up their training to non-management career paths and creating explicit access points to the IP and MTP programs from non-management roles like tellers and call centers.

3.4 Participating in a new program

Consistent with the finding that many companies face a skill shortage, Figure 24 shows that 42% of responding companies are interested in participating in a new apprenticeship initiative to tackle the problem of skilled worker shortage in Colorado while giving Colorado youth a better chance for the future. Interest is strong, the above-mentioned 42% is made up of 25% who are interested in taking part outright, plus 17% who are interested under certain conditions. Furthermore, larger companies are more interested in participating (73%) than medium (20%) and small companies (39%). Finally, interest varies little between companies with low and high share of employees with tertiary education.

Figure 24: Interest in participating in a new training program



Notes: The figure displays the share of companies who are not interested, conditionally interested or generally interested in participating in a new training program. N=120 for overall sample. N=8, 19 and 91 for manufacturing, construction and services. N=95, 10, and 15 for small, medium and large companies. N=60 and 52 for low and high tertiary share.

Overall, this is good news. There are a number of companies who are interested and willing to take part in a new training initiative in Colorado. Given that 80% of the state’s companies report the lack of skilled workers is holding back growth, it makes sense that there would be demand for new programs from the company point of view.

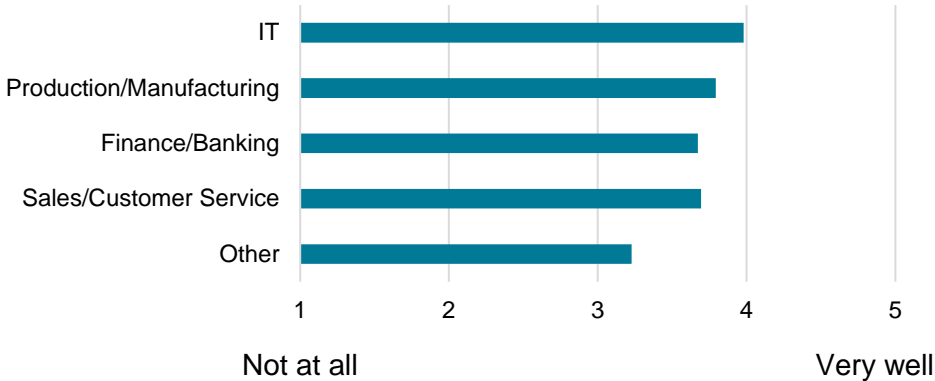
What are the best industries/job categories for a new training program?

A new program would need to help close the skills gap while overcoming or avoiding companies’ concerns about training and cooperation. One way to assess such relevance and

feasibility is to make sure the program addresses the right kind of skills. We asked companies to rate four industry sectors to get a general sense of what skills they consider reasonable to train.

Results, shown in Figure 25, indicate that all of the options and a number of others make sense for new training. The IT sector was the most popular, followed by manufacturing, finance and banking, sales and customer service, then a number of alternative options. Four respondents specified construction as a suitable alternative industry, and construction-sector respondents in general selected “other” as an option most often. While most of these industries and job categories are similarly suited across sectors, company size and employee education, manufacturing companies tend to want new training programs in production/manufacturing, though they also tend to consider IT training programs appealing (see Table A9 in the appendix). Furthermore, production/manufacturing as well as finance/banking are less appealing for small companies. Overall, these results imply that companies are interested in new training programs in these and other sectors.

Figure 25: Does it make sense to create apprenticeship programs in these industries, job categories?



Notes: The figure displays to what extent different industries and job categories fit with an apprenticeship training program. N=101 except for Other, which has N=22.

What do companies want in a new training program?

At this point, we know that companies train when it makes financial sense—they have to in order to get the skills they need, or they can earn a return on training. Responding companies value training programs where they can earn a return on training investments, and are wary of potential complications that cost time and, eventually, money for them. The key determinants of financial returns to training for companies are training participants’ wages, training participants’ productivity and how they spend their time, and program duration. This section deals with companies’ stated preferences on those features and others that affect the appeal of the program to potential trainees. We asked employers to rate how unappealing or appealing various features of a new training program would be to them. Figure 26 shows the outcomes, teal for features more attractive than neutral and dark pink for features less attractive than

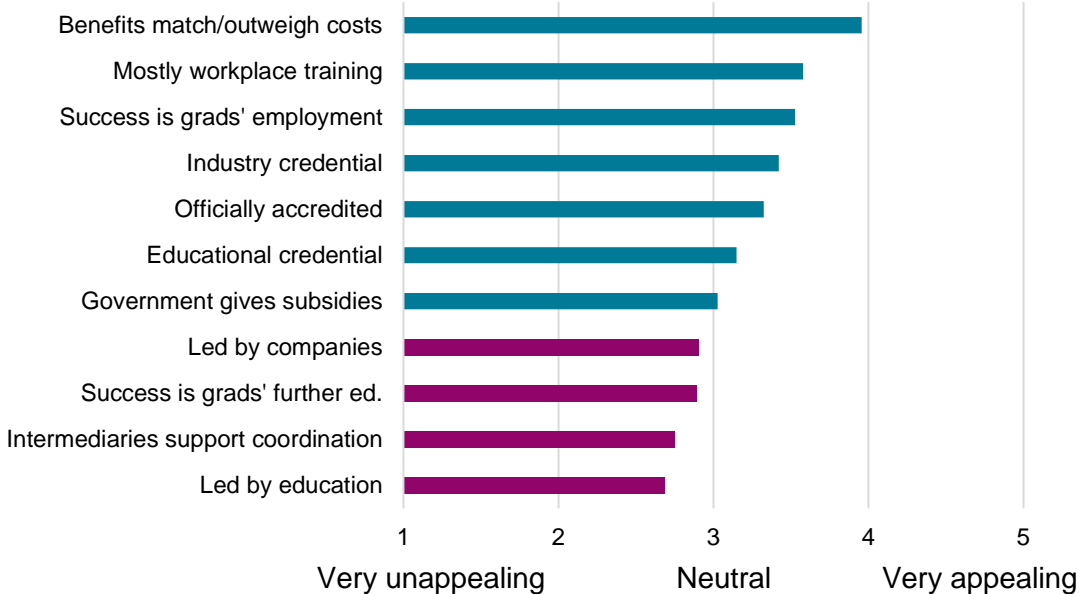
neutral. Table A8 in the appendix displays the regression results regarding the heterogeneity of these effects across company categories.

The most appealing feature a new training program could have would be if it made financial sense: training programs where the benefits of training in terms of productive work by training participants and saved recruiting costs equal or exceed the costs of training are the most exciting to employers. The balance of benefits and costs also appears several times as a condition for companies to join the new program. Analyzing heterogeneity of this feature reveals that construction companies consider this feature more appealing. Furthermore, the relevance of this feature is lower for small companies. Finally, it represents a particularly important feature for companies with a high share of employees with tertiary education.

Training participant wages are affected by their age: younger participants are more able to accept low training wages as “payment” for work and training, but older training participants are more constrained by financial responsibilities and will not accept such terms. Therefore, it is interesting to see that 25% of companies consider an ideal training program to start at the age of 15 to 16 years, which is similar to the starting ages in Germany and Switzerland. 45% of companies believe that the training program should start after high school at age of about 18. Another 26% believe the program should start after college, and only 4% of respondents think should start even later. Apparently only this last group considers the current average traineeship and apprenticeship age of 27 and 28 ideal. The companies that want training to start in the teen years can most reasonably expect to achieve their goal of earning returns on training.

Where and how training participants spend their time determines much of their opportunity to contribute productive work and generate benefits for the company. Employers seem to understand this, preferring programs where training participants spend most of their time in the workplace instead of at school or in training centers. While this feature matters similarly across sectors and employee education level, its’ relevance increases with firm size.

Figure 26: Appeal of new training program features



Notes: The figure displays how appealing various features of a new training program are. N=114.

Program duration is also a key determinant of training cost-benefit balance: shorter programs have less time for training participants' productivity to make up for initial costs, while longer programs have plenty. When we asked how long the ideal program should be, 22% of respondents chose less than three months. Half (50%) prefer programs between 6 months and a year. Two years is ideal to 19% of respondents, and 9% think programs should be even longer. Hence, respondents consider programs that resemble existing traineeships (11 months) ideal more than existing apprenticeships (33 months). An exception is the construction sector, where more respondents consider a three-year apprenticeship ideal (22%). Large companies also prefer longer durations, with 31% preferring programs lasting more than two years. Depending on training participants' starting skills, program quality, and training participant wages, the preference for short programs may be a problem if companies want financially beneficial training programs.

The most appealing feature of a new training program is that it makes financial and business sense by paying for itself.

The **less-attractive features of a potential new training program** are those that seem like they might create bureaucracy or administrative load. Education-led training programs are the least popular across sectors and company sizes, though companies with many college-educated employees consider the feature more attractive. Furthermore, intermediary organizations' coordination support with schools and other stakeholders also matters little, though construction companies, medium and large companies, and companies with more highly educated employees consider this feature more appealing. Similarly, company leadership is only barely more popular than education leadership, but is less relevant for small companies. This implies that respondents are more wary of extra administrative work than education, particularly small companies and companies with relatively low education level.

Even though this survey is focused on the company point of view, we can consider **the features that would make training programs attractive to individuals**. In order to accept lower wages, training participants need to be sure their training is going to generate returns for them later on the labor market or at work through higher wages. Companies report that they want program success to be measured by graduates' employment and success on the labor market, rather than their pursuit of further education. This implies that companies want to keep their trained workers, but also indicates that they want training to help training participants succeed. Companies also respond favorably to credentialing and accreditation, which both raise the value of training for training participants by making their skills portable. Companies are willing to provide training that gives value to the training participant, which in turn supports their own motivation to earn returns from training. Valuable training attracts higher-quality training participants, enables them to accept lower wages, and improves productivity faster.

The features regarding credentialing and accreditation is less important for manufacturing companies than for companies in the construction or services sector. Furthermore, small companies consider these features less relevant than medium or large companies. Similarly, measuring the success of the program by the success on the labor market or pursuit of further education matters less in the manufacturing sector, for small companies, and for companies with fewer tertiary-educated employees.

Government subsidies for training are a slightly separate issue from companies' own costs and benefits and those of training participants. Subsidies are usually intended to encourage non-training companies to start training by increasing their returns to training. However, Muehleman and Wolter (2014) point out that subsidies usually end up increasing returns for already-training companies without being sufficient to bring new companies into the program—

they are wasted money. Even worse, companies come to rely on training subsidies and it is nearly impossible to remove them once implemented. Though they are concerned about bureaucracy and costs of cooperation, Colorado's companies are essentially neutral but not opposed to training subsidies from government. While the appeal of subsidies increases with company size and employee education level, it remains similar across sectors. Subsidizing cooperation, intermediary organizations, and system capacity—but not companies directly—can encourage training without undermining it.

4. Conclusions

Study Purpose:

This report is intended not just to describe skills shortage and training in Colorado, it should also help the state develop stronger training programs especially at the upper-secondary (late high school) level. This section explores what employers find attractive and aversive about training programs, and what their ideals are.

4.1 Discussion

Training—in the form of internships, apprenticeships, and traineeships—is happening in Colorado. However, it is not a large source of new hires and does not seem to be fully meeting companies' needs. Training is not the first choice of a company looking for new skilled workers, instead they most often turn to workers who have honed their skills at other companies. We find that the skills gap is a problem for companies in Colorado, either because there are not enough skilled workers or because their skills are inadequate. Companies are reluctant to train because of cost concerns, but many feel they have no choice because their skills and processes are unique.

Do Colorado companies face a skill shortage?

The training that already exists in Colorado is not sufficiently meeting the needs of the state's companies—especially those in the construction industry. With nearly 80% of companies reporting that a lack of skilled workers affects their growth, this is undeniable. Companies' recruiting strategies focus on finding already-skilled workers in Colorado over creating skilled workers through training, and new hires are much more likely to come from other companies and education programs than from training either externally or internally. Finding sufficiently skilled people is difficult, and skilled positions stay vacant for months. When new hires start, their skills are not up to the level required and they take the majority of a year to reach full productivity. In addition to affecting growth, lack of trained skills affects the companies' productivity and Colorado's economy.

What types of training exist in Colorado, and how common are they?

About half of responding companies train, which is likely to be an overestimate of real training rates because training companies are probably more likely to complete this survey. Short, cheap internships and traineeships are offered by about half of all training companies each, and longer more costly apprenticeships are offered by less than a fifth of training companies. Apprentices earn by far the closest wages to those of skilled workers, but do a higher share of

skilled work thanks to their program's emphasis on certifications, curricula, educational cooperation, and broader-based quality assurance.

What are the major challenges and opportunities to training in Colorado?

Companies report that the lack of time, money, and personnel are the biggest barriers to training, but aside from the last there is little difference between companies that do not train and those who do despite the challenges. The companies that train report it is the only way for them to find the right skills or appropriately skilled workers for unique internal processes, while companies that do not train are unclear on potential reasons why training might be helpful. Both groups agree that a training model where the returns to training exceed their investments would encourage them to expand, though only already-training companies are enthusiastic about cooperating with schools or colleges to expand training.

Colorado companies report that workplaces are the best place to learn nearly every skill they need—indeed, the most important skills are the ones where the workplace has the greatest advantage. The soft and 21st-century skills that enable workers to function in the workplace have to be learned at work, and even the hard skills and methods of specific occupations are better taught outside the classroom. Companies know training is the best way to resolve the skills gap, they just need to act.

Do companies in Colorado cooperate in providing training?

Cooperation in general is not well understood, and companies are generally skeptical of the potential gains to be reaped from engaging with other companies, intermediary organizations, or schools. There is cautious optimism for the potential to share best practices or administrative loads and offer more well-rounded training programs, but concerns about time investments and complicated bureaucracy are also present. Companies that do cooperate with schools in terms of curriculum development are very rare. However, those who do cooperate feel empowered in the process and not steamrolled by bureaucracy. The low rate of cooperation in providing training is especially important for cost-neutral or benefit-generating programs, because these require a supportive ecosystem to develop the program and help individual companies implement it efficiently.

How strong is the demand for improved training programs in Colorado?

Finally, companies do appear to be interested in new training programs, especially in the field of IT. Manufacturing, finance, customer service, and other sectors are also promising. If a new program is created, companies prefer young training participants just out of high school. However they express preferences for relatively short training programs, which is less ideal.

What are the key features that Colorado's companies want from new training programs?

The most attractive programs generate returns that outweigh their costs while providing value to trainees. Lots of **time spent at the workplace** is the most important characteristic of a new program for companies, followed by **relative pay** and then **length of training**. These are the variables that affect the return on training investments—more time at work means more productive training participants, lower wages help training participants “pay” for training costs, and longer training periods make for more workplace time and more highly skilled training participants.

Credentials, quality, and sufficient training wages are the main concerns of the worker. Creating a clear **syllabus** behind the training is necessary because it ensures that the training content is sufficiently general to incentivize its participants to invest. Similarly, training that offers a recognizable **credential** is beneficial to workers and employers. Balancing those with the incentives of companies requires an ecosystem that ensures all partners work together.

Many responding companies report that the skills they need are **company-specific**: unique processes or technology mean they cannot be learned anywhere else. That might indicate that many companies in Colorado are in fact unique, but it could also reflect a misconception that is common in countries where on-the-job training led by single companies dominates. While few jobs are truly identical across companies—even in the same industry—Lazear (2009) frames workers' skill sets as bundles of individual skills, utilized by different jobs in different combinations and amounts. Using this perspective, it is easy to understand how workers can recombine skills from previous jobs to fit new ones, despite not having trained for that specific job. This is supported by the high turnover in Colorado's labor market—workers would not move so often if they had to go back to the bottom every time they changed companies.

When companies consider all skills company-specific, education and training are non-transferable and hence unattractive for training participants. We can see this attitude in companies' low regard for hiring workers straight out of education and their unwillingness to cooperate with educational institutions in some cases. If education is—or is considered—all knowledge and no skills, companies have to assume school is not useful to them. Indeed, companies believe that most hard and soft skills are better learned at work than in school.

Overall, Colorado is dealing with a skills shortage that costs its companies, workers, and economy productivity and growth. Only half of Colorado's companies currently offer training, and the more in-depth and long-lasting apprenticeship programs are the least common. Increased training has to be at least a major part of resolving the state's skill shortage, and companies themselves agree the workplace is the right location to learn most of the skills they need.

4.2 Recommendations

Recommendations

- 1. Create a platform for dialogue among companies, educators and administrators to address the findings in this report**
- 2. Establish industry-level or occupational training programs that combine classroom education with workplace training**
- 3. Design programs so that benefits exceed costs for companies**
 - d) Balance costs from participants' wages with benefits from participants' productivity and program length
 - e) Support companies and intermediaries as they set up training programs
 - f) Minimize financial subsidization to companies
- 4. Ensure the quality of workplace training**
 - c) Emphasize curriculum-guided workplace training in all programs
 - d) Provide recognized credentials upon successful completion
- 1. Empower intermediary organizations to establish state-wide linkage between actors from the employment and education systems.**

There is space for new and expanded training programs in Colorado. Companies need skilled workers to grow and agree that workplaces are the right place to learn key skills. This section outlines our specific recommendations for new and expanded training programs in Colorado that meet the needs of employers, workers and the state economy.

Create a platform for dialogue among companies, educators and administrators to address the findings in this report

This report is most useful if it is used to ignite dialogue on training in Colorado. Companies who agree, disagree, or want to expand upon the findings of this report are encouraged to do so. Similarly, educators and administrators who want to challenge or push further on the recommendations we present should add their voices. Many companies find themselves in the situation of not being able to find enough skilled workers, being interested in new training programs, and being unsure where to start. Communication is the first step to resolving that situation in a way that benefits companies, individuals, and the state.

Establish industry-level or occupational training programs that combine classroom education with workplace training.

Workplace training is something survey respondents consistently emphasized in the most appealing and successful training programs, and it is a critical feature of cost-benefit-balanced programs. Training in the workplace—instead of a school or training center—lets companies minimize costs by using what they already have: the right equipment and skilled worker-trainers who use the relevant skills every day. It also helps companies earn maximum benefits from training because training participants can work on unskilled, semi-skilled, or skilled tasks as practical training that is simultaneously productive for the company.

Workplace training is also good for training participants. It puts them in real work environments so they can be sure their skills are the right ones and that the job is one they are comfortable doing. Workplaces are the best places to learn nearly all skills according to companies, so the opportunity to learn is maximized. Finally, training participants who are tired of classrooms can learn in a new environment while earning at least some wages.

The classroom education part of training programs connects them with the education system as well as the labor market. Including formal education in transferrable and occupation-relevant content like biology for medical technicians or engineering for advanced manufacturing workers makes trainees better at their future jobs while giving them access to further education should they choose to pursue tertiary degrees. Access to further education makes training more attractive and brings in better-quality trainees, which improves productivity and makes the program more profitable for companies.

For all these reasons and more, reducing skills shortage in Colorado requires training programs that combine classroom education with workplace training. Isolating education without workplace experience creates risks of mismatched or out-of-date content, low practical skills, inefficient use of resources, and new employees who realize too late that they hate their

jobs. On-the-job training without education can be a dead-end path that is a second-rate option, and that yields only job-specific knowledge and no transferable skills. Colorado needs both.

Design programs so that benefits exceed costs for companies

Companies consistently—and quite rationally—prefer financially sustainable training models. Hence, in order to ensure the participation of companies in the training program, the training program needs to be designed so the benefits accruing during the program balance or even exceed the costs arising from the program.

There are many ways that cost-benefit-balanced training programs encourage and maintain training. One is that companies who have already earned back their investments can accept if some trained workers leave to their competitors, since the investment is already neutralized. In addition, such programs can be less costly to students and education systems since students pay for their training by accepting lower wages instead of debt, and education systems have no need to develop expensive training labs staffed by industry-experienced teachers. The best-equipment and -experienced trainers already exist in the companies that use them every day. Finally, such models encourage education-employment linkage, which improves efficient sharing of information and resources between educators and employers while making training maximally relevant, up-to-date, and helpful for the careers of graduates (Renold et al., 2016).

Balance costs from participants' wages with benefits from participants' productivity and program length

The main driver of training program costs are wages paid to participants. Costs also come from trainers' time and wages, plus the machinery, tools, and materials used in training. The benefits of training to companies are the productive contributions of participants, which depend on how much time trainees spend at work—on unskilled and skilled work—or in the classroom. The value of time spent at work, especially on skilled tasks, depends on trainees' productivity. Part of productivity is their initial ability level, which makes it important to recruit the best-possible trainees by offering them a program with benefits to their own careers. Trainees' productivity also increases over time, so longer programs enhance positive returns for companies.

Support companies and intermediaries as they set up training programs

Many companies consider a lack of size, time, and staff a key barrier to training their workforce. This can be resolved by supporting companies as they establish new training programs. Governments, foundations, and intermediaries can step in to offer support in the start-up phase of new programs, by providing curricula, materials, and support for coordinating with schools, industry-level organizations, and other companies.

As companies begin new training programs, they are more likely to need help with issues like training trainers, optimizing trainees' use of time, and meeting the demands of the curriculum. Sometimes, companies might even need to cooperate with one another to train every skill required by the curriculum. Challenges can arise on issues as simple as logistics. Defining or creating a body that can help support companies on these issues will help Colorado meet its workforce, economic, and social goals.

Minimize financial subsidization to companies

This might seem like it contradicts the previous recommendation, but they go hand in hand. Financial subsidies are appealing to policymakers and companies because they are a straightforward policy tool and a source of income. However, they create perverse incentives without commensurate payoffs when given directly to companies for training. Well-designed training programs are already at least cost-neutral for companies, so adding subsidies can waste money paying for something that is already paid for. Among companies who cannot make the costs and benefits balance out, the difference is usually so large that a reasonable subsidy would not change their training choices (Wolter et al., 2006). More importantly, it is very difficult to scale back subsidies after rollout, so they can endanger program sustainability.

The danger of directly subsidizing companies for training does not mean that there is no role for government support in training. Governments can help students with transportation or incentives for program completion. Support for system capacity is always welcome, especially for startup costs, coordination mechanisms among actors, curriculum development, and quality assurance. The education side of dual training programs is typically paid for by the government, as are preparatory services like career guidance for students still in school. Perhaps most importantly, the government can make sure there are no unnecessary regulatory or other barriers to training, cooperation, and other important activities.

Ensure the quality of workplace training

Companies provide training when it pays off for them. On the flip side, individuals choose to participate in training when there are net benefits for participants. Participants will pay for their training by accepting lower wages—a good alternative to accruing debt for education, but still a cost—so their investment must be repaid. Assurance of high-quality, recognized training they can use to further their careers is how participants are paid back. Quality also helps companies because high-quality training programs attract high-skill participants that are more productive—and therefore more profitable—during the program.

Emphasize curriculum-guided workplace training in all programs

The first tool for quality assurance is a curriculum. Training curricula for both the classroom and workplace parts of training to ensure that participants actually learn the skills they are promised. At the same time, they signal to potential future employers that the individual is skilled in specific ways. This improves the probably returns to training and gives a formal curriculum-driven training program an advantage over on-the-job or company-specific programs that rely on the name of the company for their signaling power. Curricula for workplace training are a cornerstone of attractive training programs.

Provide recognized credentials upon successful completion

When an individual finishes a training program and earns a credential, that signals specific skills to potential employers. Credentials need to be recognized by the education system so participants can pursue further education if they want, and need to be recognized by industry

so employers understand and use the signal in hiring choices. Recognition needs to be state-wide so that workers are free to move throughout the state of Colorado after training.

Credentials, education-system involvement, and accreditation all counterbalance the potential incentives of employers to exploit training participants with low-quality training and lots of unskilled work. They also give training participants a guaranteed transportable benefit from training. They guarantee to potential training participants and new employers that the program follows some curriculum and provides some level of skill. By guaranteeing training quality for training participants and therefore giving them a reason to accept lower wages during training, they further reinforce the cost-benefit balance of the program.

Empower intermediary organizations to state-wide establish linkage between actors from the employment and education systems

This recommendation is essentially a strategy for following the others laid out in this section. Intermediaries can start and facilitate dialogue among stakeholders on what should happen next in Colorado. They can help create new training programs that balance the incentives of companies and training participants. They can take on coordinating and start-up supporting roles with combined state, industry, and even philanthropically funding.

Functional training systems need a lot of coordination and linkage between actors from the education and employment systems, plus government, communities, and other stakeholders. Intermediary organizations play a key role in coordinating individual companies and establishing trust among companies, bringing education and employment actors together, and incorporating other key stakeholders in dialogue.

This report explores how Colorado's companies think about skills and training. It helps CareerWise and other leading institutions launch a dialogue and provides a platform for discussion with industry leaders so that they can determine what matters for training in Colorado.

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Appendix I: Funding



This work is made possible through a grant from CareerWise Colorado.

CareerWise coordinates apprenticeships among businesses, students, and educators that create opportunities for long-term impact. Today, the burden of educating the newest members of Colorado's workforce falls directly on our schools, and that is something that needs to change – it must be a joint effort.

CareerWise apprenticeships will break down financial barriers, create a highly skilled workforce that meets the complex demands of Colorado companies, and provide multiple options for students upon their successful completion of the program. A robust, business-led apprenticeship program will put Colorado schools, and businesses, and students on a path towards success. Visit <http://www.careerwisecolorado.org> to learn more.

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Appendix II: Authors



Ursula Renold is head of the research center for comparative education systems at the Swiss Federal Institute of Technology (ETH) in Zurich. In addition, she is Chairman of the University Board of the University of Applied Sciences and Arts, Northwestern Switzerland. She was a Visiting Fellow at the Harvard Graduate School of Education between September 2012 and March 2013. Prior to this, Renold was Director General of the Federal Office for Professional Education and Technology (OPET) until June 2012. In this position, she headed Switzerland's competence center for professional education, the universities of applied sciences, and led program innovation starting in 2005. Before becoming Director General, she was head of OPET's Vocational Education and Training Division and Director of the Swiss Federal Institute of Vocational Education and Training (teacher education). During her career, Renold has launched numerous key initiatives that have had great impact on the Vocational and Professional Education and Training system in Switzerland. She holds an honorary Professorship in Professional Education at the University of Applied Labor Studies in Mannheim (Germany).



Thomas Bolli is a postdoctoral researcher in the research center for comparative education systems at the Swiss Federal Institute of Technology (ETH) in Zurich. Before starting this position in April of 2013, he was awarded a Swiss National Science Foundation grant to visit the University of Lancaster as a postdoctoral researcher. He wrote his PhD thesis on the production and measurement of knowledge capital in the research center for innovation at the Swiss Federal Institute of Technology (ETH) in Zurich. Building on this, his research interests consist of the statistical analysis of knowledge, in particular applying microeconometrics to questions regarding the economics of education, research, and innovation.



Katherine Caves is a postdoctoral researcher in the research center for comparative education systems at the Swiss Federal Institute of Technology (ETH) in Zurich. She has a bachelor's degree from the University of California at Berkeley and earned her master's degree in the field of Education. Her PhD research was on the economics of education at the University of Zurich. Her research interests center around the economic, institutional, and infrastructure foundations of strong vocational education and training (VET) systems all over the world, especially what those foundations are in successful VET systems and how they can be developed in nascent VET systems. In addition to this project, she is currently working on identifying the success factors and barriers to labor market-oriented education systems reforms with the Center for the Economics and Management of Education and Training Systems (CEMETS).



Jutta Buergi is a research assistant and intern in the research center for comparative education systems at the Swiss Federal Institute of Technology (ETH) in Zurich. She has a university degree in sociology from the University of Chile, Santiago de Chile and received her master's degree in sociology and political science from the Faculty of Arts at the University of Zurich, Switzerland. Her research interests lie in sociology of education, vocational education and training, tertiary/higher education, education policy, as well as research policy and government support of research.

Appendix III: Complementary Tables

Table A1: Results regarding importance, new employees' ability and best learned

| | Skill importance | New employees' ability | Best learned |
|-----------------------------------|------------------|------------------------|--------------|
| Hard Skills | | | |
| Health & safety certifications | 3.19 | 2.45 | 2.33 |
| Advanced math skills | 3.26 | 3.05 | 1.44 |
| Handling unfamiliar situations | 4.19 | 3.09 | 2.73 |
| Job-related theoretical knowledge | 4.19 | 3.18 | 2.59 |
| Job-related practical skills | 4.41 | 3.24 | 2.90 |
| Problem solving skills | 4.43 | 3.34 | 2.48 |
| Soft Skills | | | |
| Resilience | 4.34 | 3.41 | 2.38 |
| Friendliness | 4.43 | 3.95 | 2.19 |
| Communication | 4.44 | 3.50 | 1.73 |
| Teamwork | 4.58 | 3.69 | 2.34 |
| Efficiency | 4.59 | 3.37 | 2.55 |
| Commitment | 4.69 | 3.68 | 2.36 |
| Motivation | 4.71 | 3.78 | 2.29 |
| Reliability | 4.87 | 3.81 | 2.36 |
| Trustworthiness | 4.89 | 4.06 | 2.21 |

Notes: The table displays the results regarding skill importance (How important are the following skills for your business on a scale from 1=low importance to 5=high importance?), new employees' ability (How well do typical new employees fulfill these skill requirements on a scale from 1=weak to 5=skilled) and best learned (Where do you think these skills can best be learned on a scale from 1=school, 2=don't know and 3=work). High values are shown in light blue, while low values are shown in light pink. Skills are ordered according to their importance within the categories hard and soft skills. For hard skills, N=189, 152 and 147 for skill importance, new employees' ability and best learned, respectively. For soft skills, N=171, 153 and 154 for skill importance, new employees' ability and best learned, respectively.

Table A2: Principal component analysis of skill shortage indicators

| Variable | Factor1 | Factor2 | Uniqueness |
|------------------------------|---------|---------|------------|
| Effect on company growth | 0.2213 | 0.1114 | 0.9386 |
| Vacancy duration skilled | 0.932 | -0.047 | 0.1291 |
| Vacancy duration non-skilled | 0.9232 | -0.136 | 0.1292 |
| Hard skills of new employees | -0.0832 | 0.9137 | 0.1582 |
| Soft skills of new employees | -0.1009 | 0.8949 | 0.1889 |

Notes: The table displays rotated factor loadings of a principal component analysis, summarizing the various skill shortage indicators in the first factor. N=104.

Table A3: Correlation of skill shortage indicators and firm characteristics

| | Vacancy length unskilled | Vacancy length skilled | Growth effect | New employees' hard skills | New employees' soft skills | Skills shortage summary |
|---|--------------------------|------------------------|---------------------|----------------------------|----------------------------|-------------------------|
| Company Size (Ref. cat.: Small companies) | | | | | | |
| Medium | -0.308 (2.161) | 2.586 (3.028) | 0.083 (0.274) | 0.308* (0.269) | 0.384** (0.260) | 0.036 (0.332) |
| Large | 2.662** (1.846) | 1.836 (2.613) | 0.392** (0.240) | -0.044 (0.229) | -0.377** (0.228) | 0.324* (0.302) |
| Economic Sector (Ref. cat.: Manufacturing) | | | | | | |
| Construction | 3.767*** (2.234) | 2.880 (3.306) | 0.756*** (0.297) | 0.122 (0.307) | -0.407** (0.290) | 0.723*** (0.419) |
| Services | -0.111 (1.845) | -1.978 (2.732) | 0.200 (0.244) | 0.294* (0.247) | -0.114 (0.242) | -0.157 (0.350) |
| Employee education (Ref. cat.: Low share tertiary education) | | | | | | |
| High share tertiary education | 0.317 (1.223) | 1.028 (1.702) | -0.008 (0.154) | 0.375*** (0.162) | 0.447*** (0.160) | 0.289** (0.223) |
| Constant | | | | | | |
| | 3.195*** (1.784) | 7.633*** (2.663) | 2.181*** (0.239) | 2.652*** (0.246) | 3.620*** (0.233) | -0.156 (0.348) |
| N | 175 | 190 | 206 | 140 | 139 | 99 |

Notes: The table displays coefficients of OLS estimations and standard errors in parentheses. *, **, and *** denote statistical significance at the 10%, 20% and 30% level, respectively. Small, medium and large refers companies with 1-49, 50-149 and more than 150 FTE employees, respectively. Low and high share tertiary education refers to companies with a share of employees with university education above or below the average, respectively.

Table A4: Correlation of training frequency and firm characteristics

| | Any type | Internship | Traineeship | Apprenticeship |
|---|---------------------|---------------------|----------------------|---------------------|
| Company Size (Ref. cat.: Small companies) | | | | |
| Medium | -0.040 (0.152) | 0.206** (0.146) | -0.158* (0.105) | -0.004 (0.084) |
| Large | 0.066 (0.136) | 0.345*** (0.136) | -0.079 (0.117) | 0.128** (0.110) |
| Economic Sector (Ref. cat.: Manufacturing) | | | | |
| Construction | -0.242** (0.155) | -0.221** (0.144) | -0.296*** (0.135) | 0.126** (0.093) |
| Services | -0.211** (0.124) | -0.124 (0.128) | -0.108 (0.131) | 0.047 (0.058) |
| Employee education (Ref. cat.: Low share tertiary education) | | | | |
| High share tertiary education | 0.037 (0.090) | 0.141*** (0.077) | -0.132*** (0.078) | -0.081** (0.054) |
| N | 148 | 146 | 146 | 146 |

Notes: The table displays marginal effects of Probit estimations and standard errors in parentheses. *, **, and *** denote statistical significance at the 10%, 20% and 30% level, respectively. Small, medium and large refers companies with 1-49, 50-149 and more than 150 FTE employees, respectively. Low and high share tertiary education refers to companies with a share of employees with university education above or below the average, respectively.

Table A5: Correlation of training reasons and firm characteristics

| | Only way to find right skills | We have unique processes/ technologies | Keep up with tech. change | Save recruiting costs | "Try out" potential hires | College/school doesn't meet needs | Replace retiring skilled workers | Hard to get international workers | Hard to get non-CO USA workers |
|--|-------------------------------|--|---------------------------|-----------------------|---------------------------|-----------------------------------|----------------------------------|-----------------------------------|--------------------------------|
| Company Size (Ref. cat.: Small companies) | | | | | | | | | |
| Medium | 0.043 (0.722) | 1.121** (0.856) | 1.974*** (0.856) | 1.990*** (0.863) | 0.822 (0.829) | 1.193** (0.882) | 1.724*** (0.862) | -0.171 (0.424) | 0.712 (0.810) |
| Large | -0.785** (0.565) | 0.598 (0.670) | -0.544 (0.669) | 0.582 (0.675) | -0.573 (0.648) | -0.905** (0.689) | 0.186 (0.674) | -0.213 (0.331) | 0.590 (0.633) |
| Economic Sector (Ref. cat.: Manufacturing) | | | | | | | | | |
| Construction | -0.004 (0.627) | -0.706 (0.744) | 0.597 (0.744) | 1.207** (0.750) | 0.039 (0.720) | 0.230 (0.766) | 1.252** (0.749) | 0.280 (0.368) | 0.956** (0.703) |
| Services | -0.307 (0.516) | -1.351*** (0.612) | 0.579 (0.612) | 0.303 (0.617) | -0.441 (0.593) | -0.346 (0.631) | 0.629 (0.617) | 0.158 (0.303) | 0.392 (0.579) |
| Employee education (Ref. cat.: Low share tertiary education) | | | | | | | | | |
| High share tertiary education | -0.609** (0.378) | 0.220 (0.448) | 0.228 (0.448) | 0.605** (0.452) | 0.022 (0.434) | 0.336 (0.462) | -0.206 (0.451) | 0.021 (0.222) | -0.251 (0.424) |
| Constant | | | | | | | | | |
| | 4.596*** (0.472) | 4.491*** (0.559) | 2.224*** (0.559) | 1.971*** (0.564) | 3.305*** (0.542) | 2.734*** (0.576) | 1.384*** (0.563) | 1.019*** (0.277) | 1.256*** (0.529) |
| N | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 |

Notes: The table displays coefficients of OLS estimations and standard errors in parentheses, where the dependent variable varies between 1 and 5. *, **, and *** denote statistical significance at the 10%, 20% and 30% level, respectively. Small, medium and large refers companies with 1-49, 50-149 and more than 150 FTE employees, respectively. Low and high share tertiary education refers to companies with a share of employees with university education above or below the average, respectively.

Table A6: Correlation of training barriers and firm characteristics

| | It's too expensive | We don't have enough time | We don't know how | We are afraid of poaching | We are too small/no staff | Education provides our skills | Can find skills on labor market | We have outsourced training | Trainees are too young | Technology changes too fast | Our union context prevents it |
|--|---------------------|---------------------------|-------------------|---------------------------|---------------------------|-------------------------------|---------------------------------|-----------------------------|------------------------|-----------------------------|-------------------------------|
| Company Size (Ref. cat.: Small companies) | | | | | | | | | | | |
| Medium | -0.155 (0.567) | -0.067 (0.556) | 0.188 (0.513) | 0.293 (0.479) | 0.539 (0.591) | 0.703* (0.566) | 0.324 (0.505) | 0.174 (0.331) | 0.231 (0.319) | 0.388* (0.309) | -0.198 (0.239) |
| Large | -0.282 (0.506) | -0.118 (0.496) | 0.029 (0.458) | 0.026 (0.428) | -0.457 (0.528) | 0.314 (0.506) | 0.181 (0.451) | 0.309* (0.296) | 0.300* (0.285) | -0.037 (0.276) | 0.200 (0.214) |
| Economic Sector (Ref. cat.: Manufacturing) | | | | | | | | | | | |
| Construction | -0.963** (0.603) | -0.473 (0.591) | 0.620* (0.545) | 0.897*** (0.510) | -0.565 (0.629) | -0.004 (0.603) | -0.070 (0.537) | -0.141 (0.352) | -0.271 (0.340) | -0.282 (0.329) | 0.551*** (0.255) |
| Services | -0.778** (0.521) | -0.358 (0.511) | -0.185 (0.472) | 0.048 (0.441) | -0.491 (0.544) | 0.401 (0.521) | 0.014 (0.464) | -0.017 (0.305) | -0.164 (0.294) | -0.356* (0.284) | 0.029 (0.220) |
| Employee education (Ref. cat.: Low share tertiary education) | | | | | | | | | | | |
| High share tertiary education | -0.320 (0.326) | 0.258 (0.320) | 0.172 (0.295) | 0.208 (0.278) | 0.129 (0.322) | 0.060 (0.304) | -0.505*** (0.280) | -0.199 (0.192) | -0.233* (0.186) | 0.218* (0.181) | -0.105 (0.141) |
| Constant | -0.076 (0.315) | 0.486** (0.309) | 0.262 (0.285) | 0.148 (0.266) | 0.387* (0.329) | 0.235 (0.315) | -0.524*** (0.281) | -0.099 (0.184) | -0.290** (0.178) | 0.242** (0.172) | -0.123 (0.133) |
| N | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 |

Notes: The table displays coefficients of OLS estimations and standard errors in parentheses, where the dependent variable varies between 1 and 5. *, **, and *** denote statistical significance at the 10%, 20% and 30% level, respectively. Small, medium and large refers companies with 1-49, 50-149 and more than 150 FTE employees, respectively. Low and high share tertiary education refers to companies with a share of employees with university education above or below the average, respectively.

Table A7: Correlation of firm characteristics and features facilitating training

| | Collab. with schools/colleges for recruiting | Industry program with schools/colleges | Financial benefits outweigh costs | Competitor poaching prevention | Develop/implementation with other companies | External financial support | Support from sector/trade/industry associations | State- or nation-wide standards | Community/consumer recognition |
|--|--|--|-----------------------------------|--------------------------------|---|----------------------------|---|---------------------------------|--------------------------------|
| Company Size (Ref. cat.: Small companies) | | | | | | | | | |
| Medium | 0.049 (0.603) | -0.085 (0.612) | 0.485 (0.586) | 0.611* (0.556) | -0.036 (0.503) | 0.283 (0.608) | 0.175 (0.561) | 0.078 (0.544) | -0.041 (0.507) |
| Large | 0.526 (0.538) | 0.360 (0.546) | 0.093 (0.523) | -0.111 (0.497) | 0.353 (0.449) | -0.246 (0.543) | 0.562* (0.501) | 0.484 (0.486) | 0.270 (0.453) |
| Economic Sector (Ref. cat.: Manufacturing) | | | | | | | | | |
| Construction | 0.077 (0.627) | -0.044 (0.636) | -0.038 (0.609) | 0.687* (0.579) | 0.327 (0.523) | -0.071 (0.632) | 0.409 (0.583) | 0.119 (0.566) | 0.302 (0.527) |
| Services | 0.243 (0.530) | 0.018 (0.538) | 0.041 (0.515) | -0.081 (0.489) | -0.052 (0.442) | 0.104 (0.534) | 0.341 (0.493) | -0.086 (0.479) | 0.432 (0.446) |
| Employee education (Ref. cat.: Low share tertiary education) | | | | | | | | | |
| High share tertiary education | 0.185 (0.343) | 0.180 (0.347) | -0.147 (0.339) | -0.006 (0.324) | 0.091 (0.289) | -0.100 (0.347) | -0.011 (0.321) | 0.167 (0.317) | -0.246 (0.280) |
| Constant | | | | | | | | | |
| | 0.275 (0.328) | 0.254 (0.333) | -0.005 (0.319) | 0.003 (0.303) | 0.185 (0.273) | 0.122 (0.330) | 0.164 (0.305) | 0.137 (0.296) | -0.024 (0.276) |
| N | 119 | 119 | 119 | 119 | 119 | 119 | 119 | 119 | 119 |

Notes: The table displays coefficients of OLS estimations and standard errors in parentheses, where the dependent variable varies between 1 and 5. *, **, and *** denote statistical significance at the 10%, 20% and 30% level, respectively. Small, medium and large refers companies with 1-49, 50-149 and more than 150 FTE employees, respectively. Low and high share tertiary education refers to companies with a share of employees with university education above or below the average, respectively.

Table A8: Correlation of firm characteristics and features facilitating interest in new training program

| | Workplace share | Cost/Benefit Balance+ | Companies Leadership | Education Leadership | Gov. Subsidies | Off. Accreditation | Ed. Credential | Industry Credential | JM Success Measure | Further Ed. Success Measure | Intermed. Organization |
|--|---------------------|-----------------------|----------------------|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-----------------------------|------------------------|
| Company Size (Ref. cat.: Small companies) | | | | | | | | | | | |
| Medium | 0.297 (0.503) | 0.759*** (0.446) | 0.869** (0.528) | 0.430 (0.555) | 1.114*** (0.585) | 0.616* (0.564) | 0.935*** (0.537) | 1.362*** (0.546) | 0.593* (0.512) | 1.108*** (0.453) | 0.966*** (0.514) |
| Large | 0.605** (0.380) | 0.443** (0.337) | 1.180*** (0.399) | 0.198 (0.419) | 1.011*** (0.442) | 0.988*** (0.426) | 0.974*** (0.406) | 0.912*** (0.412) | 0.974*** (0.387) | 0.835*** (0.342) | 0.143 (0.389) |
| Economic Sector (Ref. cat.: Manufacturing) | | | | | | | | | | | |
| Construction | 0.278 (0.524) | 0.506* (0.464) | -0.051 (0.551) | 0.244 (0.579) | 0.066 (0.609) | 1.151*** (0.587) | 0.630* (0.560) | 1.157*** (0.569) | 0.453 (0.534) | 0.709** (0.472) | 0.855** (0.536) |
| Services | 0.273 (0.467) | 0.128 (0.414) | 0.020 (0.490) | 0.251 (0.515) | 0.162 (0.543) | 0.678** (0.523) | 0.264 (0.499) | 0.697** (0.506) | 0.090 (0.475) | 0.656** (0.420) | 0.151 (0.477) |
| Employee education (Ref. cat.: Low share tertiary education) | | | | | | | | | | | |
| High share tertiary education | 0.019 (0.266) | 0.710*** (0.236) | 0.279 (0.280) | 0.473** (0.294) | 0.334* (0.310) | 0.617*** (0.299) | 0.704*** (0.285) | 0.504*** (0.289) | 0.608*** (0.271) | 0.628*** (0.240) | 0.921*** (0.273) |
| Constant | | | | | | | | | | | |
| | 3.220*** (0.460) | 3.327*** (0.408) | 2.566*** (0.483) | 2.249*** (0.508) | 2.512*** (0.535) | 2.193*** (0.515) | 2.344*** (0.491) | 2.295*** (0.499) | 2.953*** (0.468) | 1.837*** (0.414) | 2.010*** (0.471) |
| N | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 |

Notes: The table displays coefficients of OLS estimations and standard errors in parentheses, where the dependent variable varies between 1 and 5. *, **, and *** denote statistical significance at the 10%, 20% and 30% level, respectively. Small, medium and large refers companies with 1-49, 50-149 and more than 150 FTE employees, respectively. Low and high share tertiary education refers to companies with a share of employees with university education above or below the average, respectively.

Table A9: Correlation of firm characteristics and suitability of industries/job categories

| | IT | Production/Manuf cturing | Finance/Banking | Sales/Customer Service | Other |
|---|---------------------|-----------------------------|---------------------|---------------------------|-------------------|
| Company Size (Ref. cat.: Small companies) | | | | | |
| Medium | 0.316 (0.531) | 0.850** (0.515) | 0.135 (0.457) | 0.292 (0.530) | -1.354 (1.366) |
| Large | -0.450 (0.448) | 0.469* (0.434) | 0.719*** (0.386) | 0.020 (0.448) | 1.007 (1.618) |
| Economic Sector (Ref. cat.: Manufacturing) | | | | | |
| Construction | -0.400 (0.611) | -0.302 (0.592) | 0.419 (0.526) | 0.072 (0.610) | 2.000 (2.017) |
| Services | -0.607* (0.531) | -0.682** (0.515) | 0.034 (0.457) | -0.163 (0.531) | 0.722 (2.297) |
| Employee education (Ref. cat.: Low share tertiary education) | | | | | |
| High share tertiary education | 0.119 (0.327) | 0.303 (0.317) | 0.064 (0.282) | 0.226 (0.327) | 0.375 (0.824) |
| Constant | | | | | |
| | 4.447*** (0.519) | 4.028*** (0.503) | 3.485*** (0.446) | 3.618*** (0.518) | 1.993 (2.309) |
| N | 92 | 92 | 92 | 92 | 21 |

Notes: The table displays coefficients of OLS estimations and standard errors in parentheses, where the dependent variable varies between 1 and 5. *, **, and *** denote statistical significance at the 10%, 20% and 30% level, respectively. Small, medium and large refers companies with 1-49, 50-149 and more than 150 FTE employees, respectively. Low and high share tertiary education refers to companies with a share of employees with university education above or below the average, respectively.

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