Providing Vision and Leadership for the Future of the HVAC and Sheet Metal Industry

THE USE OF JUST-IN-TIME TRAINING IN CONSTRUCTION

NEW HORIZONS FOUNDATION
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THE USE OF JUST-IN-TIME TRAINING IN CONSTRUCTION

2014

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EXECUTIVE SUMMARY

Over the past few years, have your clients become more demanding? Have you asked your managers and field staff to do more with less support? Does your company have plenty of time available for highly structured classroom-based learning? Clients have become more demanding, and it isn't just a low price they want. They also expect quality and the capability to work with the latest systems, equipment, and industry standards. Just to make it tougher to meet owner demands, many contractors have cut overhead to the bone. There is not enough time to take your best field staff or key office personnel offline for a weeklong training program. Contractors work hard to find solutions for their customers, but they need some solutions themselves to help answer the growing demands of customers. The focus of this research is just-in-time training (JITT), a training solution that won't solve every problem but offers to help contractors and their workforce keep up with the changing demands of the marketplace as well as rapidly changing technologies and availability of skilled workers by reducing training time and retention for specific training needs.

One of the keys to using JITT is to deliver training just before the task or skill learned is needed on the job. This helps prevent the learner from forgetting what was taught. Likely, we can all identify with this problem—for example, learning all of the buttons on a new vehicle at a car dealership. Three weeks later, when we need to know how to turn off that blinking light or use the programmable buttons, we often don't remember what we were told at the dealership without a refresher.

For purposes of this study, we define JITT as:

Just-in-time is training rolled out, or launched, immediately prior to its usage. The advantage to implementing JITT is the shortened time between learning and application. When an employee needs to learn a new function or task, training sources can be delivered in a variety of ways shortly before a new skill or knowledge is needed.

Our definition of JITT training also covers on-the-job training in the traditional manner. This isn't the primary focus of our report, but it is a simple example of what is meant by JITT and similar training that has been in use for many years by other names. What we will demonstrate and discuss below leads to a more formal description and use of JITT from examples in interviews to examples offered by our survey respondents for this study. We also present a number of examples of JITT being used in other markets and industries. The term JITT is new, but by other names, it is a growing approach to providing training in a world where new technologies and ideas are changing rapidly.

In addition to examples of experiences with JITT, we discuss some of the potential obstacles to using JITT. One of the largest potential problems is formalizing the process and planning for the necessary training rather than looking at JITT as a last-minute solution to needed training. That approach happens, but it would not be considered the best and most effective use of JITT. The other potential challenges include getting buy-in from internal stakeholders and other outside sources to support JITT efforts. From our research, we believe this is possible, but it will take a high level of coordination and cooperation.

However, companies will not always need a lot of outside help to develop some forms of JITT for their workers in the office or in the field.

Sometimes, proactively identifying training needs ahead of the job is not possible. In these situations, just-in-time training may or may not be the best option. In most cases, this may mean the company needs to assess potential needs earlier, even before they get certain types of jobs. It could also potentially mean not taking a job the company is not technically staffed to handle.

One of the many reasons for the need for JITT is the rate of new technology being introduced to construction, such as new welding procedures mandated by new materials or new chillers requiring different installation procedures. Such procedures need to be recognized early on in the project, or more desirably, when the project is estimated and bid.

Our study, especially our survey, revealed many potential needs for training in the industry, and much of that is specialized and possibly company-specific due to markets and available staff. Many of these needs will or can be addressed by the use of a properly structured JITT approach. Some will not fit the model. Ultimately, the potential benefits of using JITT, including better productivity, less waste, better quality and a better-trained workforce, are manifold.

Our premise going into this project was that construction organizations could benefit from the use of more just-in-time-training in order to keep up with rapidly changing technology as well as ensure that there are enough properly trained personnel on the job. We assumed that this would be a new training concept for most organizations. As we will detail below, what we found was that many in the construction industry are already benefiting from some form of JITT, but it often is training by another name. Our first conclusion (and goal) is that this report will help clear up some questions about the use of JITT and help to define it better as an important delivery method for training in construction organizations. Our second conclusion, as depicted in Figure 1, is that JITT delivery use will grow in line with rapidly changing technology and be utilized at rates similar to the traditional fixed curriculum training delivery methods used today and, in many cases, supplant certain traditional approaches, which are unable to keep up with changing needs.

Whether your company is a small or large business, the general approach to JITT is the same. The decision process is scalable with the major difference being the number of projects that one has to plan for and the number of people required to perform the particular tasks. No matter the size of the organization, the consideration of personnel and skills required to do the job right while in the planning or even estimating phase of a project or potential project is important to ensure the company doesn't take on more than it can deliver and plans effectively for those projects it can accomplish.

In smaller companies, the staff and field personnel often must wear many hats. While that may means it is even harder to take the time to either lead a training session or get training, it is also often the case that these individuals need more training. The largest businesses may have staff dedicated to training. In this case, there are still challenges, because there are more people and projects to schedule, coordinate and track. Although the concept of JITT detailed below will at first seem to be adding yet another form, another process, and more work to already busy people—the concept, when done right, should help

to prevent problems down the line, like rework and otherwise less than satisfactory performance.

Many of the executives answering our survey for this report said they are content with the union apprenticeship programs and rely on the union to provide the needed trained workers. However, many in the industry are finding that training needs are changing faster than traditional training sources can keep up with. As one respondent noted, "When we are taught to do things just because that is the way they have always been done, we are not opening ourselves or our industry up to tomorrow's challenges."

The question isn't just whether or not the industry requires more skilled people and training to help those people with the changing skills needed for the job; rather, it is a matter of whose responsibility it is to see that this training is done. In almost every case, the skills needed are not conducive to self-study at home in the backyard, even for the most highly motivated students. However, it is just those motivated learners that the industry needs to attract. Unions and industry associations certainly play an important part in this role and will continue to do so; but more and more, the contractor needs to actively assure that the workforce keeps up with the needs of the market. In the following pages of this report, we will describe, analyze and make recommendations for what is expected to be a growing solution to many future training needs, that is, the use of just-in-time training (JITT or JIT). We think many more will adopt JITT and must do so in order to keep up with the changing times in a competitive industry.

In the following sections of the report, we will:

- Define just-in-time training and when to use it.
- Identify the need for JITT in the construction industry.
- Look at who is using JITT now with individual interview cases.
- Examine current and future training needs for HVAC/sheet metal contractors.
- Provide some successful uses of JITT for HVAC/sheet metal contractors from our survey.
- Look at future needs for training.
- Review the potential benefits of JITT.
- Discuss barriers and challenges to implementing JITT methods.
- Compare JITT to traditional training methods.
- Introduce a training model that includes JITT.
- Offer a checklist and form to use as tools to get started using JITT.

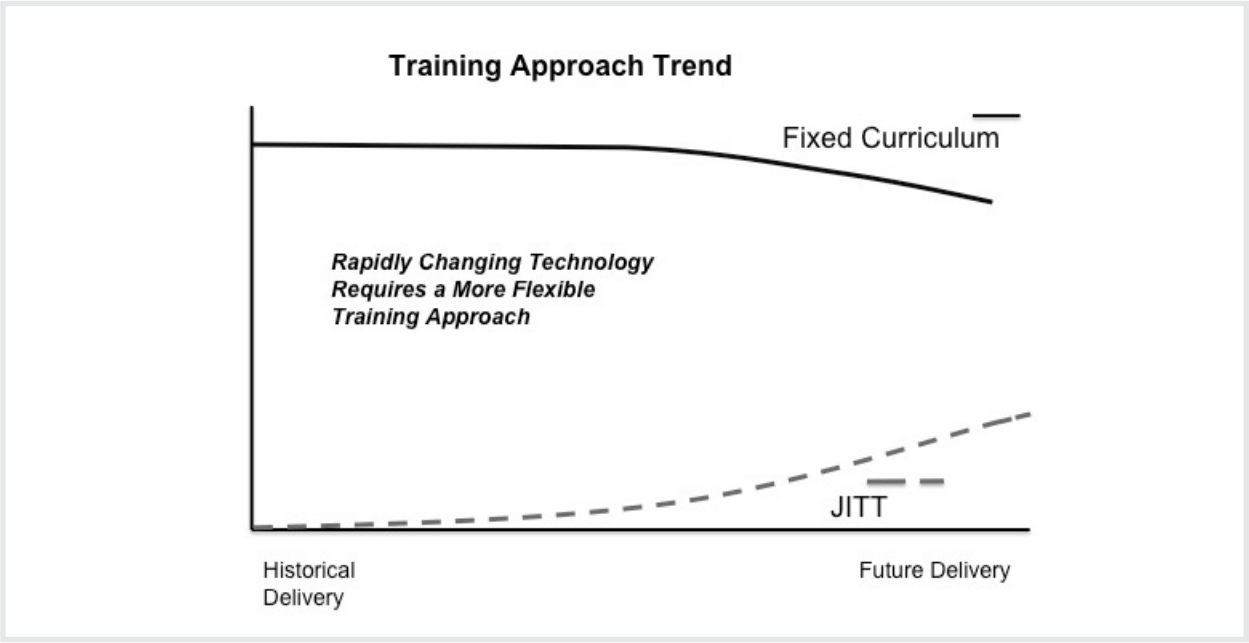
To summarize our findings and analysis below,

- There is a definite need for JITT delivery methods in the office and the field, in order to keep up with the changing workforce and customer needs.
- Many companies are using something like JITT now, but often by another name.
- JITT needs better definition, process suggestions, and examples to be utilized more effectively.
- Like traditional training methods, JITT requires good planning and early recognition of need in order to be effective.

JITT will consist of several delivery methods, but the expected trend is to use more online

computer-based modules. While there are a few good examples of this type of training now, it was not the method rated the highest by our survey respondents, and it will require much analysis of need and design to produce the necessary training programs.

Figure 1: Training Approach Trend



1 INTRODUCTION: DEFINING JUST-IN-TIME TRAINING AND WHEN TO USE IT

The focus of this report is Just-in-Time Training (JITT) as it is used or might be used in the construction industry. We describe that process and highlight many facts about the use of various training delivery methods, including JITT—however, the most important issues are the underlying reasons that the New Horizons Foundation commissioned this research and industry analysis. Two prior reports published by the New Horizons Foundation point toward the expectation that the industry will need to employ more learning techniques like JITT. The "Futures Study" (2012) specifically notes that HVAC/sheet metal contractors will need to "utilize just-in-time training techniques to quickly prepare new field staff to capture emerging opportunities." Other expected trends in that report support this conclusion, as it recommended that contractors "anticipate and adopt new processes and technologies to achieve competitive advantage." Another important expectation, demonstrated by some of the statistics from this research, is that the industry will need more skilled workers than will be available as the markets start to grow.

The second report published by the New Horizons Foundation that suggested the need for the current study of JITT was titled "Creating a Learning Environment" (2008). "The Construction Industry Institute (CII) defines a learning culture as one that is 'skilled at creating, acquiring, sharing and applying

knowledge. It embraces change and innovation at all levels for optimum performance and maximum competitive advantage.'" (RT 201 – CII 2005) For JITT to work in any organization, there must be a growing learning culture.

To help decide whether JITT is needed for a given project, we offer a checklist below for those considering the use of JITT. Although this list is specifically related to the field, the JITT checklist and process are equally applicable to meet the training needs of the office staff.

- What are the labor needs for the project you are bidding? Alternatively, for the type of projects and markets you are seeking to serve?
- Does the project require the installation of any equipment you are not familiar with or have not installed before?
- Do you have the right personnel, or enough personnel, with the right skills available to do the job?
- Are the personnel available the most competitive for the job?

If the answers are negative for any of the previous questions, can you find and train resources for the work in time to complete the project on schedule?

- What is the training problem that you are trying to solve?
- Who is your target audience, who needs to be trained?
- Which of the candidate's current knowledge, skills and abilities are required to solve the identified problem?
- What is the desired behavioral outcome?
- What learning constraints exist, and are they removable?
- What delivery options are you considering, and what resources are available for training?
- Who can serve as subject matter experts?
- What is the expected timeline for completion?
- When is the learner expected to utilize new knowledge, skills, or abilities?
- Is there any time available in the project or office schedule to include training?
- How is the training evaluated?

Many of these items are similar to more traditional training methods. If there are overall problems making greater use of JITT, it is likely due to companies not following the process, trying to take shortcuts, or not providing the proper training for poorly identified needs. To be truly effective, like most training programs, it must be understood that *JITT does not mean hurriedly putting together a training session at the last minute because a contractor just realized that the equipment that needs to be installed next week has never been seen before by those designated to install it. JITT is not a solution for procrastinators or poor planners*. To be effective, JITT often requires more planning and foresight than typical training. To aid in the planning process, we offer a sample "Project Staffing and Training Resource Requirements" form in Appendix 2. While many companies modify the form for their own processes, the intent is to include training resource requirements as part of the project planning process.

The concept of just-in-time training is a logical progression from the manufacturing concept of just-in-time manufacturing used to reduce

waste and improve quality. The goals are similar for just-in-time training. Those industries that currently use JITT can be characterized as businesses and organizations that work in areas where technology changes rapidly; for instance, health care workers and emergency responders, or software firms and the automotive industry.

JITT delivery is part of a continuous learning environment. In one form or another, it is not a new idea. The knowledge in professional fields is not frozen such that graduating from a college, trade school, or an apprenticeship program means the student has learned all he or she will need to know. With this type of learning, what individuals learn are the basics of the craft and how to learn more as needed throughout their careers. Otherwise, learning becomes less useful and less marketable as new problems and technologies surpass even what was learned a year ago. Anyone who says that construction doesn't change or doesn't need to change is not fully aware of industry and current trends. This is a criticism of the construction industry that is often heard, and it is one that must be overcome—not only to stay current with changing technology, but also to attract young, ambitious talent looking for interesting and rewarding careers.

JITT does not, or will not, replace traditional training delivery methods. Journeymen programs will still be required for craft workers. College degrees and technical school programs will still be required for office employees. It does, however, enhance both these programs and the learning of the individual, resulting in an individual who is more valuable to the employer. JITT training also helps fill the gap when there are not enough skilled workers available, especially when the training is for a particular task such as a technique that requires a special skill that is repeatedly used and can be learned via a short program.

Ultimately, JITT offers many advantages and potential benefits to those companies that can master it. On the one hand, it is just a new name for an old idea. As many of our survey respondents noted, "We have been doing on-the-job training for a long time." As part of our survey, respondents replied that 32% of field and office management and 41% of trade and craft workers now use some form of just-in-time training. We also found that around 16% weren't sure if they used JITT or not. Part of that problem is defining and understanding what JITT is.

Identifying the Need for JITT in the Construction Industry

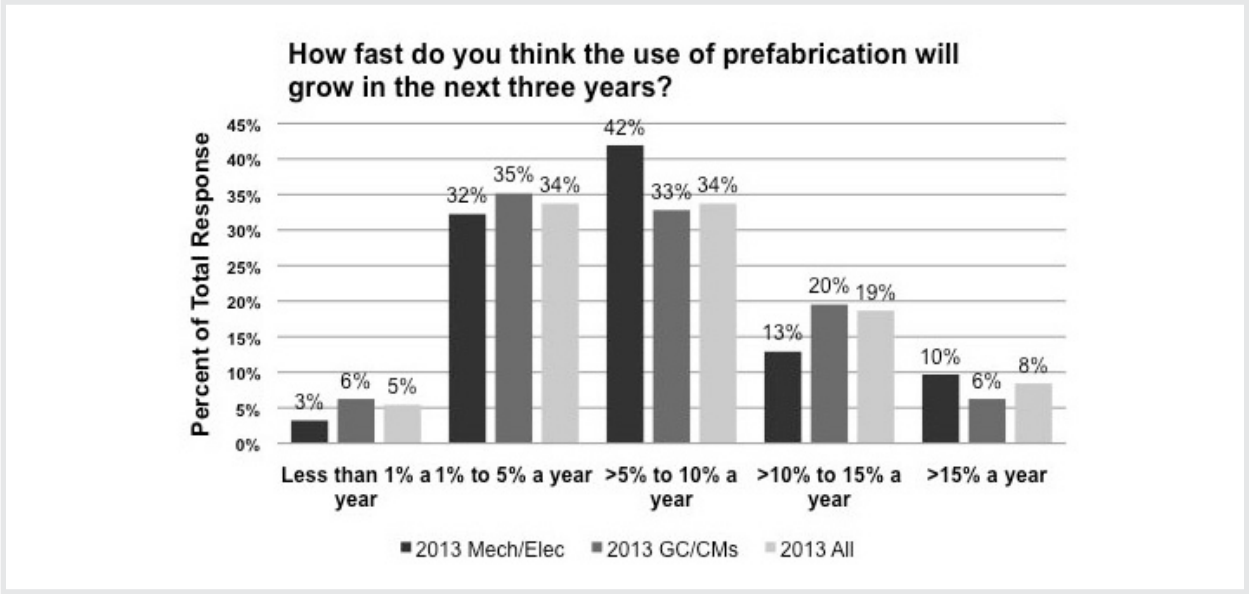
In our discussions with industry stakeholders, a number of needs and challenges facing the HVAC/sheet metal industry were noted as potential reasons that the industry will need to adopt a greater use of just-in-time training. Under "potential competition and threats," we listed:

1. Technology—equipment and materials
2. BIM (delivery systems)
3. Owner requirements
4. Labor shortage
5. Building systems
6. Regulations, safety, etc.
7. Modular construction of preassembled units, for instance, hospital rooms with all piping and wiring completed before they arrive at the job site
8. Increasing use of prefabricated assemblies

Technologies are changing faster than even the best journeymen's or estimator's program can adapt. There are new regulations and compliance needs not addressed in current

training that require additional training now. When we say "now," we increasingly refer to a situation where a company that just won a project finds that it doesn't have the skills or enough skilled personnel to complete the project without a crash course in some new process software, materials, or equipment. Without time to plan, the hurried decisions include training on the job as you go, setting up a training program on-site, or hoping someone inside or outside the industry is providing the needed training service just in time. For companies that cannot find those sources of training needed, there is the likelihood of poor workmanship, rework, and missed deadlines. Often that means turning to the existing training programs. Sometimes that is effective—and we will give a few examples below—other times, none of the traditional sources have the new equipment or materials available, to say nothing of having enough trainers available. In brief, the problem of keeping up to date with new technologies and materials is symptomatic of today's world. The pace of change continues to increase, and we all need to keep up with it to remain competitive.

Figure 2: How Fast Do You Think the Use of Prefabrication Will Grow in the Next Three Years?



(*From FMI Construction Prefabrication and Modularization 2013*)

While the country is officially out of recession, the Great Recession has left many marks that still affect business and career decisions. The owners (and banks) that pay for construction continue to have a buy-side edge in most markets. They expect more for a lower price; therefore, the contractor has to be more efficient to get work and make a profit.

Efficiency or productivity can come from many different areas of the construction process, including better methods, reduced waste and rework, and reduced cost of labor and materials.

One key example of changing delivery systems and technologies involves the increased use of prefabrication and modular construction.

According to a recent survey by FMI[1], for most respondents, the benefits of prefabrication include lower labor costs, better quality, safer working conditions, less training time for workers, less supervision per person, more people attracted to stable and consistent work close to home, and worker's ability to go to the same location every day. There are many other aspects to consider as the use of prefabrication and modularization is expected to continue to grow as a source of potential savings for HVAC/sheet metal contractors and a potential threat if other more traditional manufacturers enter this market space. Training delivered in a just-in-time format is often required for this application.

The huge layoffs in the construction industry since 2007 make it harder to attract new young people to apprenticeship programs in the near term. The idea that it takes four to five years to complete the program keeps some potential candidates from committing to a career in construction. That doesn't help the contractor that needs skilled labor right now. Also, there are many repetitive tasks that may not require a fully trained journeyman to accomplish and could be taught to less skilled individuals using training methods like JITT. This is one approach to solving skilled labor shortages that may be necessary in order to have a sufficient supply of labor as business improves.

Looking at labor needs from our survey response, it appears that many respondents are expecting to start rebuilding their backlogs in the coming year. For field labor, 69% of respondents expect to need more personnel in the next year. The need for shop workers is expected to increase by 47% for respondents, and 54% expect an increase in office staff and management in the coming year. The potential for more rapid growth may require faster "onboarding" of employees in the office, the shop, and the field. (See Appendix 1, Exhibit 5.)

JITT is one viable solution to train people for specific jobs in a much shorter time than traditional training. Another complication to potential training needs is the uncertainty of the market. While most believe we will see a more positive increase in construction in 2014, forecasting long in advance of the need is more difficult than in the past. This requires construction firms to be more nimble and strategic when considering their workforce needs.

Changing markets and technologies do not affect just the need for training in the field. It is just as important that office and management personnel keep up with the trends. As one respondent to our survey commented, regarding the challenges often requiring training intervention:

- **Office**: Dealing with online billing, purchasing, and other office tasks provided by third parties using web-based interfaces.
- **Project Management**: Using web-based project controls for submittals and scheduling, and extracting cost and productivity information from in-house accounting systems. Also, leveraging available software platforms to improve project control and profitability.

Even if you hire graduates fresh out of college or apprenticeship training, it is unlikely those individuals will know all that is needed to perform the tasks described above or a hundred other new skills required by changing technologies.

Estimating, scheduling, planning and record keeping all impact productivity and the bottom line. However, for office and management

[1] FMI Construction Prefabrication and Modularization 2013

personnel, we find there are often more training resources available, for instance, from software vendors installing new systems or management seminars and courses from outside parties. Nonetheless, as anyone who has attended seminars or training sessions on new software packages will tell you, the knowledge gained is often transitory unless it is used shortly after the training is completed.

Management and project planners have an important role in assuring that the right personnel and materials are in the right place at the right time. This is not only important every day to assure productivity improvements, but also will play—or currently plays—a critical role in implementing JITT programs. Part of that planning process must include knowing if the "right" personnel also have the right skills for a particular technology or task.

Ultimately, JITT offers many advantages and potential benefits to those companies that can embrace it. On one hand, it is just a new name for an old idea. Just-in-time training often means a senior person showing a new employee how to do something just as they need to know it. That is the core of what we mean by JITT. However, there is more to JITT than that, much more. For instance, from our survey of SMACNA contractors, 46% ranked "increased cost effectiveness of training investment" as a number one expected benefit from using JITT. "Skill upgrade for new/unique work" was ranked number one by 26%, and 24% ranked "improved quality of work" as a potential top benefit. This is more than just on-the-job training. True application of JITT requires planning and program management. It also requires that more contractors know and understand its benefits and how to take advantage of JITT to be more profitable and competitive.

In the following pages, we will further define this unique training and give some guidance as to how the HVAC/sheet metal industry might take greater advantage of this training delivery method. We will also discuss a few successes and some potential difficulties with the idea of JITT.

Who is Using JITT Now?

Delta College

One of the primary characteristics of JITT is that it is almost always very specific—designed for a certain task or skill needed for a specific job to be used right away. We interviewed Paul Sampson, project manager for training sales at Delta College in Michigan. The college often works with corporate clients to help train workers for various situations. The school's curriculum is broad and mostly involves traditional training methods for technical skills and office and management workers. However, it appears there is a growing need for JITT training, or what Delta College calls Fast Start. The concept was developed with Dow Chemical as a course for chemical process technologists and expanded to other areas partly due to demand from employees.[2] Other closed-enrollment programs delivered by Delta College include:

- Prehire training for a lithium-ion battery plant
- Dow Corning, post-hire on specific processes
- Advance manufacturing fast-start programs for:
  - Machine operators
  - CNC (15 hours)

[2] http://www.dow.com/michigan/contrib/csnews/just_in_time_training.htm

  - Robotics (3 days)
  - Safety
- Construction industry experience
  - Energy efficiency (green building)
  - Welding-certificate program (union and nonunion)

Sampson noted that there is more emphasis on training the less skilled workforce and trades; for instance, there is a dearth of qualified machinists right now. Often programs are partially funded by grant money to help train the local workforce to be able to do the jobs for local businesses and new businesses locating to the area.

Babcock Marine, UK

Babcock Marine is "the U.K.'s leading engineering support services organisation with revenue of over £3.2bn in 2013 and an order book of circa £12 billion." According to its website: "Defence, energy, telecommunications, transport and education are all sectors where Babcock can be found working diligently behind the scenes, delivering critical support. Services are underpinned by three core capabilities:

- Managing Assets and Infrastructure
- Delivering Projects and Programmes
- Integrating Engineering Expertise"

Often, JITT training is used when a company purchases new, high-tech, and complicated equipment. One example we came across was the special simulator program developed by Antycip Simulation, a subsidiary of ST Electronics (Training & Simulation Systems) Pte Ltd. and CMLAbs. The simulator was delivered to Babcock Marine after it had purchased a "Goliath crane." The simulator allows employees to work with the new, large crane in a safe environment without destroying anything, since the new operators make mistakes in early training.[3]

International Use of JITT: Indonesia Study

A report conducted in 2006 to support the argument "that well-trained construction site tradespeople have an important role in minimizing the amount of waste activities during the construction process leading to reduce company's productivity," found that:

> *Based on three case studies targeted at building construction in Indonesia, this paper states that a significant achievement in increasing a company's productivity has been attained by contracting companies that have conducted JIT training for their site tradespeople.*[4]

Few readers of this paper would argue with the premise of the Indonesian study. However, the key to the study was that Indonesian craft and trade workers are generally highly unskilled and untrained. Researchers for the study used PPC (percent plan completed) as the basis for measurement. According to the study:

> *PPC can be described as a percentage of the ratio of the number of completed assignments to the total number of*

[3] http://www.antycipsimulation.com/news/press-releases/babcock-marine-delivers-just-in-time-training-for-massive-1000t-goliath-crane

[4] "Investigation into the Relationship between Just-in-time (JIT) Training and Productivity in Building Construction in Indonesia," Sugiharto Alwi, Stephen Kajewski, School of Urban Development, Queensland University of Technology, Brisbane, Australia and Keith Hampson, CRC for Construction Innovation, Queensland University of Technology, Brisbane, Australia, 2006.

planned assignments in a week. The metric values of PPC can be ranged from zero to 100%, where the higher the value is, the better the performance of the project will be. The term "PPC" derives from The Last Planner System developed by Ballard (2000).

For the three companies studied, PPC increased by 80%.

JITT Case Study: Heating & Plumbing Engineers, Inc., Colorado Springs, Colorado

Katie Neufeld, Director of Business Services, and Jim Kennel, Training and Recruiting Manager

"Heating & Plumbing Engineers, Inc. is a full-service mechanical contractor serving Colorado. HPE specializes in building mechanical systems with the highest quality and reliability. HPE provides our customers with a proactive preconstruction approach, exceptional BIM services that include the use of Total Station in the field. In-house fabrication and prefabrication for plumbing, piping and sheet metal assemblies allow significantly shorter durations to install mechanical work and complete the overall construction on time. With the mantra of Honest. Performance. Every day. - HPE is a seamless part of any project, pioneering solutions with efficiency and expertise."[5]

JITT in Action

The following discussion took place with Katie Neufeld, director of business services, and Jim Kennel, training and recruiting manager, Heating & Plumbing Engineers, Inc. While not always called "JITT," the company has been using a formalized approach to JITT for some time now with good results.

Have you used JITT training or other training methods that generally fit the description of JITT?

Kennel: We have been doing this type of training for several years. I call it "site-specific" training. For example, we provide training as-needed on new installation methods or the use of new innovative materials. This training would take place on the project no more than a week prior to the actual installation of the new procedure or method. Think of it like reading a book on shooting pool. I wouldn't help me much if I read the book six months before I needed to play pool. But if I read it within a few days or a few minutes of needing it, I would be more likely to retain the information, apply it immediately and probably be able to make better practical application of the information.

How and when do you determine that you might need to use a JITT approach?

Kennel: We look at this early on in the planning phase of a project, when the job is being turned over from estimating to field operations. We determine upfront what new skills might be needed on that specific project and make a plan to deliver training in those areas at the appropriate time.

[5] http://www.hpeinc.com/

How is it working out?

Kennel: Works out well.

We also do foreman training that could be considered JITT. When we have people who are ready to take the step up to becoming foremen, we enroll them into a 20-hour course that will help them with various new skills they will need to perform their new job and give them insight from our "School of Hard Knocks" experiences that will help them avoid pitfalls and costly mistakes. Their promotion is an exciting milestone in their career, and this "just in time training" provides support and useful information at a time when their anxiety level is usually pretty high.

How has it been accepted?

Kennel: Our foremen are anxious for this training. They're excited not just about the fact that they have been considered for promotion, but they're happy to learn new skills that will help them on their new venture.

Neufeld: For the employees who have received JITT, we have received nothing but positive feedback. Our employees appreciate getting the training and immediately using it. It increases the comfort level of taking on a new task or a task that hasn't been performed recently. With respect to a new employee, it helps take the pressure off starting a new job and jump-starts their productivity.

Do you get the same level of acceptance with other "site-specific" training?

Kennel: Yes. And JITT also goes a long way towards protecting company liability. When training is received and put to good use immediately, fewer mistakes will be made and, therefore, fewer unfortunate incidents.

What about the unions?

Kennel: At Heating & Plumbing Engineers, Inc. we are union on the sheet-metal side and nonunion on the piping and plumbing side. We have high standards on both sides. I'm confident that the training that we provide across the board for our field operations personnel is second to none. We treat union and nonunion the same with no animosity. At HPE, we are one team with a common goal.

Neufeld: Besides what the union offers its members in terms of training and development, Heating & Plumbing Engineers, Inc. includes union employees with relevant Heating & Plumbing Engineers, Inc. training such as leadership and management training programs that we hold in-house (for example, we have internal foreman and superintendent training programs) or training that we send employees to from third-party sources (like FMI, SMACNA, AGC, etc.).

Can you give us some specific examples? Is this training different these days?

Kennel: Technology is advancing rapidly throughout the world. Training in our industry is much different today than it was just a few short years ago. For example, it hasn't been too long since copper with soldered or brazed joints was the primary way to go for domestic water piping and smaller hydronic lines on commercial projects in the plumbing and fitting trades. But now there are a lot of different choices of material and methods, such as CPVA, Aquatherm, and PEX. Each manufacturer has different installation methods that must be followed, i.e., glue, fusion weld, crimp joints, etc. So a decision has to be made early on as to what type of material will be used on a project. Then, at the point where HPE starts installing that specific product, it may be three months into the job; at that point, by staying in touch with the flow of the job, we can schedule the necessary installer certification for the manufacturer's product, so we would schedule the manufacturer's rep to provide training and certification at the most opportune time.

Are owners asking for this type of training? Is it a marketing advantage?

Kennel: It is a marketable advantage. And yes, I have seen specific training requirements for a specified product as a requirement on the specification. But we also do this to keep our liability down and avoid the unrecoverable costs of rework. We don't want people who are not properly trained out there installing our work.

For example, as most people in our industry now know, new legislation will take effect in a few months that has to do with the lead content of valve bodies on potable water systems. Old manufacturing methods used about 8% lead in the production of valves, so the castings were more malleable and easier to manufacture as well as easier to install. The new EPA standard dictates using less than 0.25% lead on valves used on potable water systems. This makes the product more difficult to work with. The castings are less malleable and more brittle, so the metal heats differently and make the soldering process more challenging. At HPE, we have been talking to different valve manufacturers' reps as well as flux and soldering manufacturers to determine the best practices for trouble-free joining of the new products. When we come to consensus, we will have training prepared for our workforce on what the best method is for applying the heat, the best solder to use, the best flux, etc., so that we can apply the proper training across the workforce at the proper time.

What about JITT in the office?

Neufeld: There are several areas in which we have JITT "in the office." For example, if we are using a team approach for interviewing, depending on the experience of the team, I will assemble the group beforehand and provide an hour-long training session on interviewing techniques.

For employees who are promoted to management-level positions, we create a 90-day jump-start plan, which includes spending time with:

1. Payroll (understanding how to use the timekeeping software and reports).
2. The office manager (learning how our internal documents are organized and how to navigate around our computer drives to find relevant documents.
3. The HR department will conduct a four-hour "Management @ HPE" training where we will review the employee handbook, policies, procedures and communicate the management training that they will be sent to within the first 90 days. They also will get a debriefing of their Hogan Personality Report and some coaching based on its results.

For new employees, depending on the position, we have 30-day on-boarding plans created that are tailored to each position.

Kennel: I used to schedule what we called OFTs, Opportunities for Training, which could be applied to office or field personnel. On a bimonthly basis, outside manufacturers or experts in their field would be brought in to keep our people up-to-date on many topics. We would schedule training on anything that applies to our industry in or out of the office. In the beginning, the training was well received with keen interest and good attendance. But, after a while, we began to see a noticeable drop in both interest and attendance even though the training and subject matter were still great. So I did some investigating and found that people were no longer attending because they weren't able to apply the training they were receiving to their current job activities. They felt as though attending the training sessions was a waste of their time, because, by the time they needed to draw on the details that they had been exposed to during training, their knowledge and retention were weak. So we quit scheduling OFTs. And that's when the idea came to me to try "site-specific training" with the intention of applying the training closer to the time that it would actually be utilized or applied.

What about the use of BIM?

Kennel: We have a CAD manager, Sean Lauck, who is very knowledgeable in this area and does a great job of BIM training both in-house and for others. HPE is well aware of the importance of staying current and on the cutting edge in this regard. Our CAD manager can provide a general overview of what BIM is all about in one session, but it takes quite a while for someone to become really proficient at it.

Do you measure the benefits of JITT?

Kennel: We do, beginning with our apprentice program. There are established goals that the apprentices have to achieve. Each level is a well-defined progression. Each apprentice is given a semi-annual review to include a merit-based pay raise related to his or her performance in the program. We look at each apprentice's grade, classroom attendance, foreman field rating, and the prompt completion of on-the-job training (OJT) work reports. If they have done well in all of these measures (21 total merit points possible), the apprentice would get the highest per semester raise appropriated. Anything less, and his or her pay will be based on actual merit points earned. For example, an apprentice with a C grade average, poor

attendance, a less than favorable foreman review, who doesn't turn in his OJT reports on time might earn only 10 of the 21 possible merit points and would get a smaller raise rather than the amount that was available.

We also track the progression of our new foremen after they've been through our foreman training program. Using our "Double Dozen Checklist," we periodically visit their jobsites and rate their performance on key factors taught during the foreman training class.

What about using less trained people?

Kennel: I would concede that there may be some use for unskilled laborers in our industry—material handlers, hand excavations, cleanup duty, to name a few.

But at HPE, everyone is a trained professional. We're proud of the fact that all of our field operations personnel are licensed in their respective trades. All of our welders, brazers and 6010 med gas installers are certified to perform their respective tasks. We will not entertain hiring anyone to work in our field ops group who is not licensed or certified for the job he is hired to do. The exception, of course, would be those hired into our apprenticeship program. They are registered with the state within 30 days of their date of hire as required and also registered with the U.S. Department of Labor, Office of Apprenticeship and Training as required by our Standards of Apprenticeship agreement.

Do you consider the program a success?

Kennel: Absolutely, very successful.

Is the Heating & Plumbing Engineers, Inc. approach an exception from other companies?

Kennel: I'm aware of a few others in the industry who do a respectable job of training, but there aren't many who invest as much time, energy and resources as we do at HPE.

We do not require our apprentices to sign a work agreement before teaching them a trade. There are no written or contractual consequences if they leave our employ after completing the training. I've been asked, "What if they take advantage of all that training and then leave the company as soon as they complete the program?" My response is, "What if we don't train them, and they stay?"

Neufeld: Yes, and our employees tell us so. Our culture is built upon values such as excellence, adaptability and pioneering solutions for our customers. We have to be committed to continuous learning and timely training (JITT) in order to be who we say we are. In fact, we are attracting the kinds of employees who expect to have training opportunities provided to them.

What would be the main barriers and challenges for using JITT?

Kennel: To be effective, training must be well organized, consistent and well timed (JITT), and there must be follow through to ensure that the trainee is indeed performing as trained. The quality of training is much more important than the quantity of training. In my opinion, superficial, insincere training may be worse than no training at all. So with JITT training, care should be taken to plan properly and avoid spur-of-the-moment exercises.

How much does your approach to JITT help in the competitive environment?

Neufeld: It has helped us in several ways:

1. Improved productivity—every time you train somebody just in time, he or she will be more productive and the quality of work is enhanced (which directly ties into our reputation as a company who is quality-driven).
2. Increased morale on the project—JITT increases the confidence and competence of the person performing the task which directly impacts the morale of the crew.
3. Helps to attract/retain employees—JITT allows a continuous skill improvement, and HPE wants to attract and retain the types of employees who want to continuously improve their skills and abilities.

Kennel: As training and recruiting manager at HPE, I agree with many others who are predicting a shortage of skilled craftsmen/tradesmen in the construction industry. It has already become more difficult to find qualified, knowledgeable tradesmen. I believe that those of us who have the means owe it to our industry to give back and provide or support training programs.

Companies with good training programs already in place will have a distinct advantage over those that do not, as they will be able to "grow their own" qualified tradesmen.

Interview: James Shoulders, Administrator, International Training Institute

Growing Recognition of the Need for More JITT by the International Training Institute

In an interview with James Shoulders, Administrator, ITI (International Training Institute), we found a growing recognition of the need for more JITT. ITI supports 160 Joint Apprenticeship Training Committees (JATC) across the country. Some offer training that could be classified as JITT now, and have tried other training programs in the past with mixed success.

Shoulders generally speaks of training programs offered or developed at the ITI headquarters level and pushed out to affiliate JATCs, which may offer all of those programs as well as others, depending on local needs. ITI's basic work includes:

- Technician training programs for the end user
  - Develop curricula
  - Teach instructors
  - Train Technicians
  - Test online for certification programs for different levels

Although not defined as just-in-time training, ITI has developed similar programs in the past, with mixed success, according to Shoulders:

Past attempts to use JITT include:

- Certified welding inspector program
- Non-code shop welders
  - Example: "*A contractor gets a job with certain specifications in the contract and finds it needs to get training and certification for their people as soon as possible. This is always reactive not proactive training. However, we have been working with this method for many years.*"

One type of training provided by ITI that has shown a growing need is training of craftspeople on the use of BIM. While not set as a formal JITT program, the need is often reactive, for example, when a company is going after work that requires training in the use of BIM and it needs to get training fast. ITI now has limited capacity for this growing need. According to Shoulders, what ITI is doing is working well—the trainer is always busy—but it would help if HVAC/sheet metal companies would recognize earlier that they have detailers that need this training, before the need becomes urgent. This is an example of an industry need that can be well served by just-in-time training.

Currently, there are a number of ITI programs, including instructor-led classes and Fire Life Safety courses, that fit the JITT model. According to Shoulders, the Fire Life Safety course has been successful as delivered in an online format. This is subject matter that more readily lends itself to online, self-paced training. "Most people learning this material already have a good amount of knowledge, so they learn better this way. There are two levels, Fire Life Safety 1 and 2. These are NEMI (National Energy Management Institute)-certified and working very well. BIM is more difficult to do online. With the training we have done in the area of BIM, we find that we must be ready to train smaller groups than normal, ranging anywhere from two to 19 people."

Shoulders expects an increasing demand for some types of JITT; however, much of this demand must be recognized at the local level. One of the main drivers for more JITT and

a better-trained workforce in general is that often a contractor cannot even bid the job if it does not have the skilled people available. Shoulders says there is a need to empower and support the local JATCs in order to get ahead of the trend and changing technology instead of scrambling to play catch-up. Manufacturers rolling out new technologies are one source of support.

One area that could likely benefit from JITT is the service technician training. ITI participates in a service program task force that includes SMACNA, SMWIA and NEMI. Task force issues and goals include:

1. Educating current contractors
2. Expanding contractor participation
3. Securing support at the local level

Shoulders notes that service technician training is not JITT now. It is a multiyear process that may need more advanced training for those already in this field. He sees some possibilities for JITT in this area.

Resistance to JITT?

There are a number of points of possible resistance to the greater use of JITT. At the JATC level, it is hard to change what people have done for years. There is a need to plan better and not be so reactive, and the idea must be sold across the membership. Shoulders notes, "We're not always as nimble in a changing marketplace as we would like with new ideas. We need to be able to make changes faster."

There are several points of resistance or organizational challenges before broader support for JITT delivery methods is developed. Maybe the most important challenge mentioned by Shoulders is developing research and planning on a local basis. Then there are decisions to make as to who develops the modules or programs, and identifying funding sources for equipment or program materials. Shoulders provided several examples of current training needs that might help develop JITT:

- **Total Stations training**: Contractors want it, but locals need to get the equipment; often they are not prepared when the need arises. There is a need for a national structure of technologies ready to go with training delivered on demand.
- **Orbital welding training** has been a particular challenge, with a number of partial solutions in place: Machines have been purchased for local training centers, but still have some limited resources. Another problem is that the effort was not contractor-led. That is, the technology and training were pushed out, not pulled in. Ultimately, the training program didn't work out that well. The locals are autonomous.

- **Services training, a new effort for ITI**: The industry is trying to focus on service, which is a recognized and growing market need. Some locals have good training labs. However, it isn't a case of "build it and they will come." That doesn't always work. Ultimately, companies need to plan for the services industry in order to create an overall approach to services. The effort involves many players, which complicates finding solutions to the overriding question, how do we gain market share?

According to Shoulders, JITT has potential as part of regular apprenticeship programs. Some companies now try to be engaged with the apprentice training and get the apprentice to coordinate his learning in class with actual work on the job. This approach motivates students' interest when then can apply what they learn and see what it means in a real-world situation on the job. Another approach is to model the training after the current approach to apprenticeship training, but set it up in "blocks" so that each block of learning is coordinated with on-the-job needs. This could be set up like JITT. First, though, there needs to be an overall program plan; as an example, the St. Louis JATC service program uses "blocks" for specific training needs.

How do training and JITT training fit into the need to be more competitive?

Shoulders notes, "There is no easy mechanism to have the discussion needed to become more nimble to plan for and react to the changing needs of the marketplace. We do have a set of 'best practices' and that is what we need more of." To ignore the problem or put it off is to lose the competitive edge; for example, plasma cutters training in the past when the process was new:

- Needed JITT at the time
- Weren't interested in it at the local level and lost market share to competitors
- Received training from manufacturers
- Needed to stay up with the times and new technologies

Shop training provides another example. There is some resistance at the local level, but someone will have to do it, considering the move to greater prefabrication and modularization use. Training in the use of press brakes, for example, has met with resistance at the local level and at training facilities due to the need to purchase equipment. It would be best if suppliers of equipment and new materials would provide the equipment needed for training.

"Manufacturers do help with modular equipment as part of their marketing programs. We need to do more partnering with manufacturers," according to Shoulders. "First, we need to formalize what ITI is already doing; then we need research on what it needs to gain a competitive edge, and companies don't always want to share their 'secrets.'"

Other JITT Applications

For the most part, in the construction industry, we found that JITT was a voluntary approach to training used by those who either planned ahead for labor and skill needs for the type of work the company was involved in, or by those landing a big project. Like a beginner angler, a company may find it has caught a big fish and doesn't know what to do next. However, we came across at least one example where an owner was specifying the possible use of JITT in its "Construction Manual" as a prerequisite for winning work:[6]

> **Just-in-Time Training**
>
> *Some contract special provisions provide for "just-in-time training," which is joint training with industry and construction staff. This training should include all contractor and Caltrans staff who are directly involved in the construction operation. The objective of this training is to introduce new practices, improve workmanship, improve quality, and provide current and timely training to the people actually performing the work.*

If the old rule that "fads" that start in California move east is true, more owners, at least in the public sector, may start to specify JITT as part of the contract.

Another sector where JITT is becoming a necessity is health care, especially in the area of emergency response, according to Advanced Practice Centers, National Association of County and City Health Officials. One example was the response to the H1N1 flu outbreak in 2009, where many volunteer practitioners needed to be trained just-in-time to deliver vaccinations. Many of the volunteers were professionals who hadn't worked in health care for some time or worked in other areas of health care and needed some training on how to perform vaccinations on a large scale.

Overall, we can see that JITT training delivery methods, whether called JITT or by other names, are a growing addition to the overall learning process in many industries.

Current and Future Training Needs for HVAC/Sheet Metal Contractors

In a continuous learning environment, JITT should be just another arrow in the quiver of training methods. For many of the respondents to our survey, the term was new, but 41% said they were using some form of JITT now for trade and craft workers, and 32% were using the process for field and/office management staff. Some may be learning about JITT for the first time in this report, as one respondent noted:

> *I haven't really discussed it [JITT] with anyone else. I really have just defined our program as JIT through this survey. Up until now, I really only thought of the JIT theory as it pertains to purchasing and inventory.*

Whether hearing about JITT for the first time from our survey and report or having used some form of JITT for some time, it is clear from our survey that there are a number of training needs not served by the regular methods now. The top item in number of mentions is training in the use of BIM. As James Shoulders, ITI, noted, it is a growing area of need and may be larger than some have thought. Overall, industry training needs range from the very basic use of computers, communications, and new office systems to the highly technical green building standards

[6] California Department of Transportation, Construction Manual, November, Section 1-307, 2012.

(LEED), high-efficiency HVAC equipment and sophisticated temperature controls/operating systems. (See comments from survey below.) For instance, there were several mentions of needing more training on the technical aspects of industrial work. Overall, though, the need is often driven by technology, as one observer noted: "Technology is changing so fast that traditional training methods lag behind in years."

Successful Use of JITT for HVAC/Sheet Metal Contractors

When we asked our survey respondents to provide some examples of where JITT had been used successfully, we received comments that paralleled those areas where others respondents indicated there needs to be more JIT training in the future. As noted earlier, not all of these training situations may have been thought of as formal JITT at the time—some obviously were—but there are sufficient successes to suggest the potential growth of this training delivery method as being high in the future. One respondent noted that, on a hospital project that required Lean practices, participating in JITT was a requirement of all subcontractors on the job. Most all of these successes appear to have been key to successful completion of a project and profitability. (See selected comments below from our survey.)

Comments and examples of where JITT has been used successfully for HVAC/ Sheet Metal companies:

- BIM and CADD training when implementing new software, safety and operator training provided by rental equipment vendors, installation and startup training for new equipment technologies.
- CAD, BIM, supervisor training, Trimble training, new shop and field tools equipment, Lean procedures, confined space, fall protection.
- Installation of variable refrigerant systems; we used JITT to train our service employees.
- Mostly office personnel, showing what is needed prior to a project and getting the task correct and done timely. This has also worked with shop laborers.
- New product implementation.
- Pre-task planning is JITT. The men in the shop or on the job review the tasks and best practices they have planned for that shift. When a new tool is introduced on a project, it usually includes some type of training.
- Train workers on unusual equipment where it is not cost-effective to train all employees at one time.
- Training in the use and the fabrication of rigid board ductwork. New systems and products in our industry.
- Utilized an outside training consultant for welding just prior to performing the project. It sharpened the skilled and brought up the less skilled quickly with a focus on the actual work to be performed. It was extremely successful.
- We built a medical clinic for a client that used Lean practices all the way through design, mock-ups and construction. We utilized more extensive prefabrication than we ever had before and saw good benefit. All the subcontractors had to participate as a condition of hire.
- We were able to train sheet metal workers with no TAB [testing, adjusting and balancing] experience to perform limited repetitive TAB tasks.

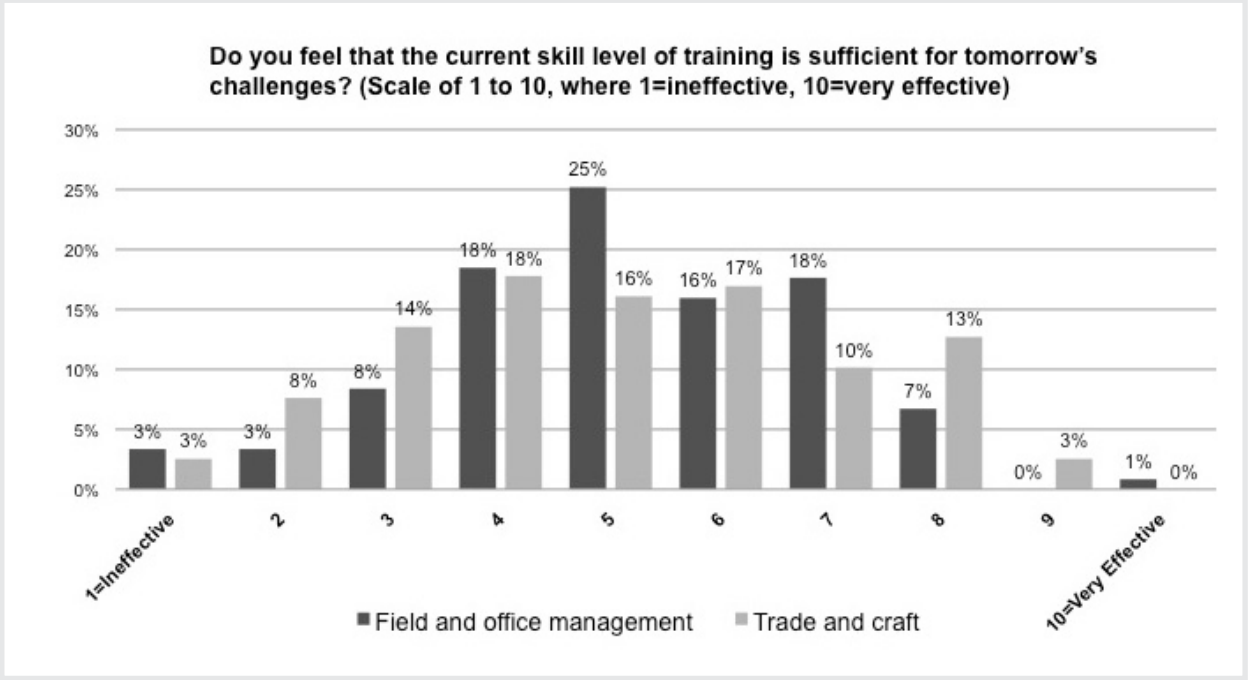
- We've used it [JITT] most successfully when training for work that is new to our people.
- When choosing someone to learn a new skill by identifying his or her strengths and weaknesses through past performance, you tend to get people who are more capable, confident and willing to learn a particular skill. This results in better buy-in from the employee, improved quality, less rework and better attitudes throughout the shop and office.

Looking at Future Needs for Training

In the near future, many training needs are predictable, given some research and planning. However, considering the rate of change in new technologies as well as the changing makeup of the labor force, it is more difficult to pin down what types of training will be needed and when. From the results of our survey for this report, we found that, when asked whether current levels of training were sufficient for tomorrow's challenges, only 25% of respondents felt skill levels for field and office management staff would be sufficient or "very effective." For trade and craft employees, the number was also 25%, and no one selected "very effective", or the top of the given scale.

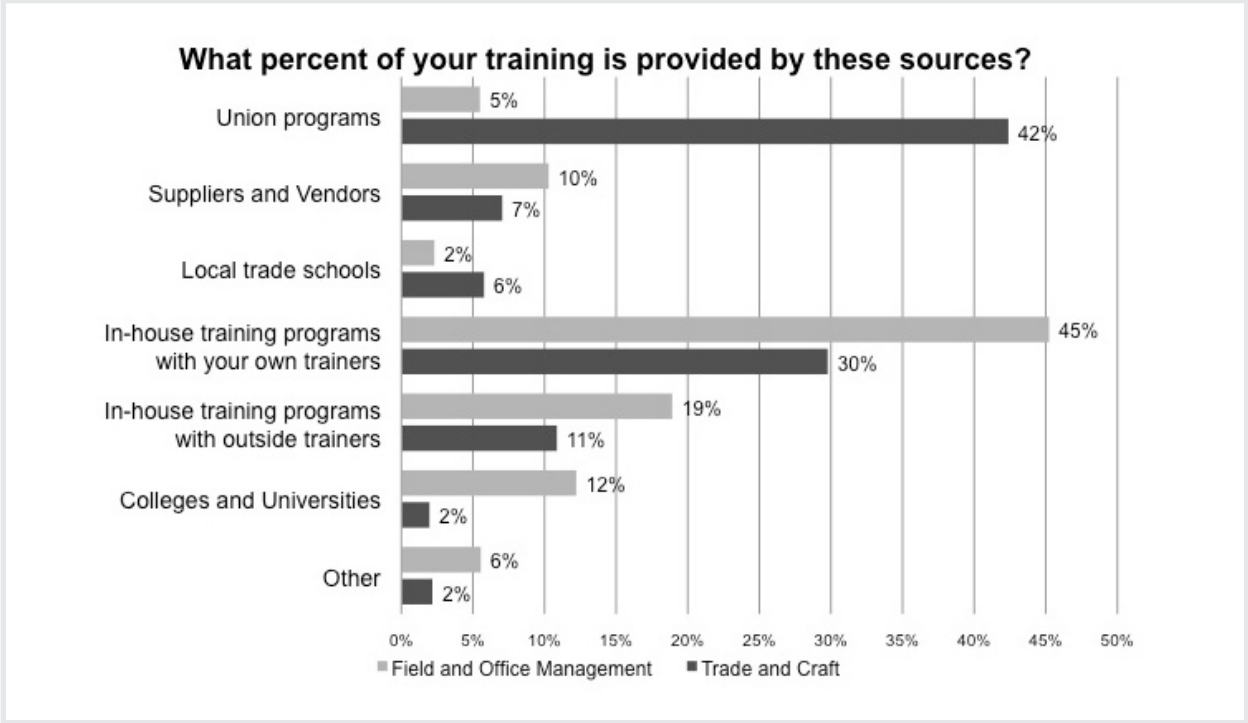
Currently, according to the results of our survey, 42% of training for trade and craft workers is provided by union programs, and 30% is provided by in-house training programs.

Figure 3: Do You Feel That the Current Skill Level of Traning is Sufficient for Tomorrow's Challenges?



Source: *FMI JITT survey, see Appendix 1 [Note: The graph above represents the limited scope of our survey of SMACNA members and selected others. It is not intended to represent the construction industry as a whole.]*

Figure 4: What Percent of Your Traning is Provided by These Sources?



Source*: FMI JITT survey, see Appendix 1*

For field and office management staff, 45% of the current training is provided by in-house programs by the company's own trainers, and 19% is provided in-house by outside trainers.

One of the most critical capabilities of a construction company, especially for trade contractors, is the ability to understand how to manage labor needs. Often, this is viewed on a broad scale, but labor force management is best accomplished when also managed on an individual level. The methods for determining individual training needs indicated by survey respondents varied widely. Most evaluations were done on an individual level; for instance, 21% said that managers identify training needs after observing job performance, 16% identified needs through performance appraisal discussions, and 16% used informal discussions with managers. Interestingly, 18% came from individual requests for training, a good sign that individuals want to learn and advance. All of these approaches to determining training needs can be effective, but depend on the skill level of those making the decisions. Ultimately, a more formal approach will be more effective, especially as we consider the needs for JITT in the mix.

When we asked about which employees were best-suited for a JITT approach, field workers top the list (19% of the total response) with project management a close second at 17%. However, all employee groups might be suited for JITT training under some circumstances.

Analyzing the research for this report, it is clear that JITT in various forms of delivery—from self-guided, computer-based learning modules to hands-on, instructor-guided training—will

play a critical role in providing the necessary training for the workforce in the coming years. However, to be truly effective, like most training programs or project management, *it must be understood that JITT does not mean hurriedly putting together a training session at the last minute because a contractor just realized that the equipment that needs to be installed next week has never been seen before by those designated to install it*. JITT is not a solution for procrastinators or poor planners. To be effective, JITT will need more planning and foresight than typical training does. The examples provided by Neufeld and Kennel of Heating & Plumbing Engineers, Inc. offered some good illustrations of advance preparation. The need for the training programs are recognized long in advance of the training program. In the next section, we will take a closer look at traditional training and compare it with a best-practice approach to determining the need for JITT.

Potential Benefits of JITT in Summary

We've looked at many potential benefits of using JITT above and found very few detractors overall. There are, of course, challenges to incorporating JITT into the overall continuous learning environment, and there will be challenges from others providing traditional training, we expect, but overall the biggest challenges will be learning how and when to deploy a JITT program and, especially for smaller companies, having the necessary staff or resources to plan in advance of the need for training. Many companies make their living doing fast jobs on an emergency basis or a quick turnaround project. It will be more difficult for those types of companies to utilize JITT, but smaller companies can certainly benefit from the process, particularly on new types of work.

From our survey, the top-five benefits expected from JITT in the future are:

1. Increased cost-effectiveness of training investment (46% gave it the highest ranking)
2. Skill upgrade for new and unique work (26% gave it the highest ranking)
3. Improved quality of work (24% gave it the highest ranking)
4. Improved productivity (18% gave it the highest ranking)
5. Competitive advantage (15% gave it the highest ranking)

If just a few of these benefits are realized, the use of JITT will more than pay for itself and keep the workforce sharper and more competitive on an ongoing basis.

Figure 5: Potential Benefits of JITT Survey Results

Please rank the top-five benefits you would expect from JITT if used in the future. (*1=highest benefit, 5=lowest benefit*):	Average Importance
Increased cost-effectiveness of training investment	2.4
Improved quality of work	2.5
Improved productivity	2.8
Skill upgrade for new/unique work	3.0
Lower cost of labor	3.2
Competitive advantage	3.2
Less rework	3.3
Increased morale on the project	3.3
Easier to find the needed workers for the project	3.7
Attract/retain employees	3.8

Source*: FMI JITT survey, see Appendix 1*

Traditional Training Delivery Compared to JITT: Survey Results and Model

Survey results confirm that everyone is implementing some form of training, the most successful of which seem to be structured, on-the-job and apprenticeship programs for trade and craft personnel. Instructor-led training (in-house or outsourced) also maintains effectiveness for both trade and craft and office personnel.

Figure 6: Traditional Traning Delivery Compared Survey Results

On a scale of 1 to 5, which training methods do you think are the most successful? (*1=Most successful, 5=Least Successful*)	Average Importance Field/ Office Mgt.	Average Importance Trade/Craft
Structured on-the-job training	2.0	2.0
Instructor-led, face to face, by outside trainers	2.3	2.4
Blended (combination of face-to-face and computer-based instruction)	2.6	2.7
Instructor-led, face to face, by internal trainers	2.7	2.7
Apprenticeship programs	2.9	2.1
Online, instructor-led	3.1	3.4
Online, self-paced, no instructor	3.3	3.6
Offline, self-paced, no instructor (books, videos, audiocassettes, etc.)	3.7	3.7
Other	3.8	3.9

Source*: FMI JITT survey, see Appendix 1*

Moreover, while budgets have been tight in recent years, it does not appear that the need for training will disappear anytime soon. Survey results indicate that the only thing likely to change concerning training is the delivery format. Right or wrong, more and more organizations anticipate the use of some sort of web-based or online learning to supplement current training delivery methods for all personnel.

One respondent stated:

> *There is an increasing need for ongoing training and upgrading as the demands of the industry and client expectations continue to increase. We need to have access to a catalog of training programs ready to use. "Marketing" would have to be done proactively with industry, clients, suppliers and vendors to identify new and emerging trends so that training is developed before the contractor is involved.*

This statement would suggest an increasing interest in JITT. Survey results suggest an increased usage of JITT, as most companies are already doing some degree of JITT. Thirty percent of those who do not now use JITT say

they would use it if it was better-defined and understood, while 68% responded "maybe." (*See Appendix 1, Exhibit 16*)

However, based on the survey results, it appears there are fewer companies using JITT than not. For either those who aren't using JITT or those who may not know what it is, it may be useful to see how other companies are using JITT. Survey respondents shared the following regarding applications for JITT:

- Any new procedures or products that are new to the industry or not covered under the apprenticeship program.
- Compliance training is a frequent example. As a California-based employer, there are legal decisions or legislature changes that impact processes or course of business. Usually the time between decision and training is less than two weeks.
- Field carpentry workers are shown how to do things on the job, which is about as just-in-time as you can get.
- If we are going to be installing a piece of equipment or a zoning system, for instance, we will study the specs and installation materials as well as speak with others in the industry about any hidden aspects that we may not be accounting for.
- If we are using a new product, we educate our tradesmen on how to install it properly.
- Implementing a new estimating program. Training would be given immediately prior to rollout of new system.
- New equipment or systems being introduced will generally provide formal training for primary operator(s) just prior to installation or at time of installation.
- Not every employee will do every job. With JITT we can identify candidates for particular tasks, based on prior performance and training, then start teaching them the new skills they'll need. Each individual is evaluated during training to make certain the new skill is a good fit for him or her. This way we are not training people to do things they will never do or aren't able to do or aren't comfortable doing.
- Our office personnel are trained in new software applications within weeks after its rollout. This allows some hands-on playing with the software to allow familiarity prior to training.
- Quite often, much of the training that is needed is due to skills or knowledge needed by an employee on a specific job. Therefore, when it is determined that there is a need, the employee(s) receive the required training.

Interestingly enough, of those who are currently implementing JITT, an overwhelming majority of survey respondents rated their success level at 5 or above on a 1 to 10 scale. Considering that these same respondents also believe that all positions would benefit from the use of JITT, it would seem that the only thing that needs to be addressed is the removal of any barriers that may be getting in the way of using JITT. (*See Appendix 1, Exhibit 15*)

Barriers and Challenges for Implementing JITT

We asked survey respondents, "What would be the main barriers and challenges for using JITT?" Here's what we learned:

- Analyzing who needs JITT and when they need it. Where do you go to find the training needed for the situation?

- Being proactive.
- Being too busy with business challenges to focus on the training when needed.
- Changing the current mindset. JITT requires a modified approach to shop fabrication, detailing and purchasing.
- Finding and arranging for the appropriate training, scheduling training time and possibly the cost of tailoring training to the specific needs.
- Having a proven curriculum in place. Utilizing JITT in lieu of current training programs.
- Having a training syllabus prepared before the demand (client, engineer, regulatory authority) requires it.
- Having the training tools and personnel available when the training needs to be done, without delay and without a high level of cost.
- Logistically, training field employees once they are on a job-site and ensuring the training occurs before the employee performs the work applicable to the type of work that will be done.
- Planning and facilitating the timing of the event, such that employees have enough time to obtain the skill sets prior to the execution of the work. This would apply to both contractors and manufacturers. Keeping it focused is the key.

One problem shared by each of these barriers or challenges is the need for planning, whether for a particular job and task or much earlier in the stage of anticipation and design of training methods and materials.

JITT Compared to Traditional Training Methods

Compared with "traditional" learning processes, the JITT approach is not significantly different. Simply put, JITT is the "Google" for training. When you have a question, you search Google (or other search engines); when you are about to perform a previously unknown task or assignment, you plug into a JITT training module. Said another way, JITT is almost like cable television boxes that offer on demand programming. The same thing could be said of YouTube. When you need training on a specific topic, process, procedure or material, JITT modules might be used the way one searches topics on YouTube now. In fact, use of YouTube-like videos is one approach to creating JITT modules.

Before we go any further, let's better understand the traditional approach to training.

The traditional training and development model consists of assessment, design, development, implementation, and evaluation. This approach is often referred to as the ADDIE model.

Figure 7: Training and Development Model: ADDIE

Training and Development Model: ADDIE

Strategic Objectives

At its core, the ADDIE model is rooted in strategic objectives. It is imperative that any training implemented, traditional or just-in-time, be designed to drive the strategic objectives of the organization. Training for the sake of training is nothing more than a checklist. Strategically focused training equals results.

Assessment or Analysis

This first step in the traditional training model is a systematic process of understanding training requirements. A problem is clarified; the learning goals and objectives are established; and the learning environment and learner's existing knowledge, skills and abilities are identified. However one plans to deliver training (traditional or just in time), this first step is crucial.

Ideally, analysis would be conducted on at least three different levels: organizational, individual, and work or task. Analysis may also include a performance analysis, content analysis, sustainability analysis and cost-benefit analysis. Much of these analyses may be supplemented with the use of surveys, interviews, and focus groups.

Organizational Analysis: An organizational analysis goes back to the strategic business needs or other reasons the training is desired. It asks the question, "What is the organization trying to accomplish?" Furthermore, it answers questions such as:

- Who decided that training should be conducted?

- Why is a training program seen as the recommended solution to this business problem?
- What are the delivery options?
- What is the expected timeline for project completion?
- What is the organization's history with regard to employee training and other management interventions?

Individual Analysis: An individual analysis focuses on potential participants and instructors involved in the process. It answers the questions:

- Who will receive the training?
- What are their current knowledge, skills, and abilities as they relate to the identified problem?
- What is their learning style?
- What learning constraints exist?
- Who will conduct the training?
- Do the employees have required skills?
- What is the desired behavioral outcome?
- Are there changes to policies, procedures, software, or equipment that require or necessitate training?
- When is the learner expected to utilize and perform new knowledge, skills or abilities?

Work or Task Analysis: This is an analysis of the job and the requirements for performing the work as well as the individual tasks being performed. Also known as a task analysis or job analysis, this analysis seeks to specify the main duties and skill level required. Analysis at this level helps ensure that the training, which is developed, will include relevant connections to the content of the current job. If this type of analysis is completed, it is helpful to have a job description in place.

Performance Analysis: Beyond an organizational, individual, and work and task analysis, a performance analysis asks if employees are performing up to the established standard. If performance is below expectations, it is important to ask if training would help to improve performance. If so, you must also ask what is the desired level of performance you are trying to achieve, and how will you measure performance before and after training has been delivered.

Content Analysis: Content analysis is often done once a problem has been identified and training is being designed. It often includes the analysis of documents, processes and procedures used on the job. It also answers questions about what knowledge or information is used as part of the job. The information can be gathered from manuals, documents, or subject matter experts. It is important that the content supporting the training does not conflict or contradict specific job requirements. It is equally important that some level of content be available to design and develop training. If no documentation is available, training may not be specific enough to meet the long-term needs of the job.

Training Suitability Analysis: Training is one of several solutions to solving a problem. However, it may not always be the best solution. It is important to determine if training will be effective in solving a specific business problem. In some cases, businesses may implement training only to find out that training merely placed a Band-Aid® on the original problem.

Figure 8: What Type of Performance Evaluations Do Your Employees Receive?

Source*: FMI JITT survey, see Appendix 1*

Cost-Benefit Analysis: Key stakeholders typically demand some form of cost-benefit analysis when giving the green light to proceed with any training investment. Traditionally, this is called Training Return on Investment (ROI). Effective training results in a return of value to the organization that is greater than the initial investment to produce or administer the training. That value can be in the form of increasing the bottom line or behavioral changes.

Once these analyses are complete, the results are collated to arrive at the objectives of the training program.

Currently, according to our survey results, 27% of performance evaluations of employees are informal, and 8% of respondents do not conduct performance evaluations of employees. However, it is encouraging to see that most companies have some sort of objective and formal means to evaluate employees. This is usually a fairer approach to evaluation and a better approach for planning training needs.

Design: The design phase addresses learning objectives, assessment instruments (ex. surveys), exercises, content, subject-matter experts, lesson planning and media selection. This phase includes:

1. Writing learning objectives that will meet the needs of the target audience.
2. Creating a detailed storyboard or prototype of the training to get an idea of look and feel.

3. Discussing program details, such as when and where the program will be delivered, the mode of delivery (PowerPoint presentation and lecture style, workshop, video, etc.), number of trainees at one time and length of program.

Development: The actual creation or production of the content and learning materials based on the design phase. Depending on the mode of delivery, this may also include the development of custom learning exercises and activities. Furthermore, this phase answers the following questions:

1. What responsibilities will each person have in the delivery of this program (trainer vs. subject-matter expert)?
2. Are there any additional stakeholders we need to include in our training discussions? What role will they play long term?

Implementation or Training Delivery: Materials are delivered and distributed to the target learning group. The implementation phase can uncover topics that require further development or re-design work.

1. As part of this phase, a train-the-trainer (TTT) program may also be included. A TTT program should include a full review of the course curriculum, learning outcomes, method of delivery and testing procedures.
2. Other items that may be included in this phase include test pilots, student registration and software (or hardware) installation.

In terms of delivery options, there are three basic options with a number of variations.

Figure 9: Training Delivery Options

Option	Advantages	Disadvantages	Best Use	Not Recommended for…
Instructor-Led Training (classroom)	■ Face to face ■ High-quality delivery ■ Immediate Q&A ■ Ability to leverage student questions during session	■ Costly: – Student and trainer expense – One-to-few training – Cost of being off the job and loss of productivity ■ Training often too soon or too late ■ Trainer must be knowledgeable of multiple applications	■ Multiple students of similar skill level ■ Training in single location ■ Observable performance ■ Interpersonal skills and feedback ■ Highly interactive knowledge sharing	■ Students of widely varying skill levels ■ Training for large system/ process rollout ■ Consistency across learner groups

Asynchronous Web-Based Internet/ Intranet Training	■ Can be delivered just-in-time ■ No travel costs ■ Self-paced learning ■ Remedial training at low or no cost (after initial investment) ■ Consistency ■ Possible increased retention ■ Easily distributed and updated training materials	■ Self-directed motivation can be problematic ■ Lack of classroom collaboration ■ May be viewed as "done on your own time"	■ Basic training ■ Students in multiple locations ■ As part of instructor-led training course (blended learning approach)	■ Observable interpersonal skills and feedback ■ Real-time knowledge sharing
Synchronous (real-time) Web-Based Internet/ Intranet Training	■ High-quality delivery ■ Immediate Q & A ■ Leverage student questions ■ Rapid, low-cost content	■ Cost per student higher than asynchronous training ■ Network connection needed	■ Basic training ■ Students in multiple locations ■ Highly interactive knowledge sharing ■ Hands-on application training	■ Students of widely varying skill levels ■ Observable interpersonal skills and feedback

Many survey respondents indicated that they believe online or web-based learning will increase over the next three to five years, especially if the industry requires certification or testing in order to perform the work. This type of delivery method can be very effective when used appropriately. Much like traditional instructor-led training, it still requires planning and scheduling. In addition, while it would appear as a less expensive option, any customized training designed for a company's specific business needs has the potential to be costly.

However, as industry organizations continue to develop more web-based training options, this is an approach that more companies could leverage as they address project training needs in the future. As one respondent stated, "The key is if the industry requires certification in order to have or keep your job. If the industry does not require certifications (i.e., turning out a journeymen after 10,000 hours—with no regard to passing an exit exam), then the motivation for training is greatly reduced."

Evaluation: The "last" phase of the model plays an important role in the beginning and at the end of the process, although some sort of evaluation is included at each stage of the ADDIE model. Evaluation objectives reflect many of the discoveries found in the Analysis phase, and a final program evaluation will often feed into the next round of the model. These discoveries include the objectives and expectations of the learner. There are various levels of evaluation. However, the basic questions that need to be answered during this phase are:

1. How will you know if the instructional objectives have been achieved?
2. Does the training solve the learner's problem(s)?
3. What evaluation measures will you employ?
    a. Trainee reaction (on-site course evaluations)
    b. Skills and knowledge mastery and retention (measured through the use of a quiz, test or certification)
    c. Observation of trainee's ability to easily transfer new knowledge, skills, abilities, behaviors or improvements in job performance
    d. Calculation of ROI (Return on Investment)

At this point in the ADDIE model, the cycle repeats itself to address the next round of strategic learning objectives within the business.

Just-in-Time Training Model

The JITT approach is not significantly different from the traditional ADDIE learning model. While it may be the latest buzzword in training literature, many companies have been using it for years by a variety of different names.

HPE Inc. is one example of a company that has been using a variation of JITT for many years. The company calls it "site-specific training." In the interview with FMI, (See sidebar 1), Heating & Plumbing Engineers shared with us that this approach is often used to train employees on new methods or on the use of installing new materials. Training is scheduled approximately a week earlier than the new procedure or method would need to be used.

In an ideal world, any type of training is planned long before it is needed. It is possible that more companies would employ JITT if they only knew how to adequately plan for necessary training to occur throughout the life cycle of a project.

As previously noted, Heating & Plumbing Engineers Inc. considers training as an early part of the planning phase for its projects. For example, when its team is moving from the bid phase to pre-construction, it is also considering what skill sets will be necessary from its team to deliver the project on time and on budget. Training can then be designed and developed to be delivered just before the skill is needed on the job. Furthermore, it can be scheduled on the master project schedule.

The key is to proactively identify training needs early to have materials ready on demand. This can certainly be done in the context of the traditional training model. What makes just-in-time training different is that JITT typically forces a response to the question, "When is the learner expected to utilize or perform new knowledge, skills or abilities?" with more urgency than the traditional learning model. In fact, this question often needs to be addressed before any other work that takes place. To help with planning, we have created a basic form to be used in pre-job planning to help plan training at the point of scheduling the labor needs for a project. The goals is to create an action item that is part of project planning as long in advance of the need as possible to assure the training requirements are matched with the right people and programs just before the need to use the skills arises. (*See Appendix 2*)

The basic steps shown above in the ADDIE training model are also present in the expanded model that includes JITT as an option. The biggest difference is the added timeline. If ASAP is truly "right away," then the best

approach to training one might hope for is that someone on the job knows enough about the problem to train on the job; otherwise, it is trial and error. When a three- to six-month timeline is available, there is time to decide on a delivery method for JITT training. With experience, it should be easier to make these decisions earlier in the planning cycle and adapt an approach that has been used before, like bringing in a subject-matter expert on a new piece of equipment to demonstrate installation techniques within a week of actual installation.

Sometimes, proactively identifying training needs ahead of the job isn't possible. In these situations, just-in-time training may or may not be the best option. In most cases, this may mean that the company needs to assess potential needs earlier, even before it gets certain types of jobs. It could also potentially mean not taking a job that it is not technically staffed for.

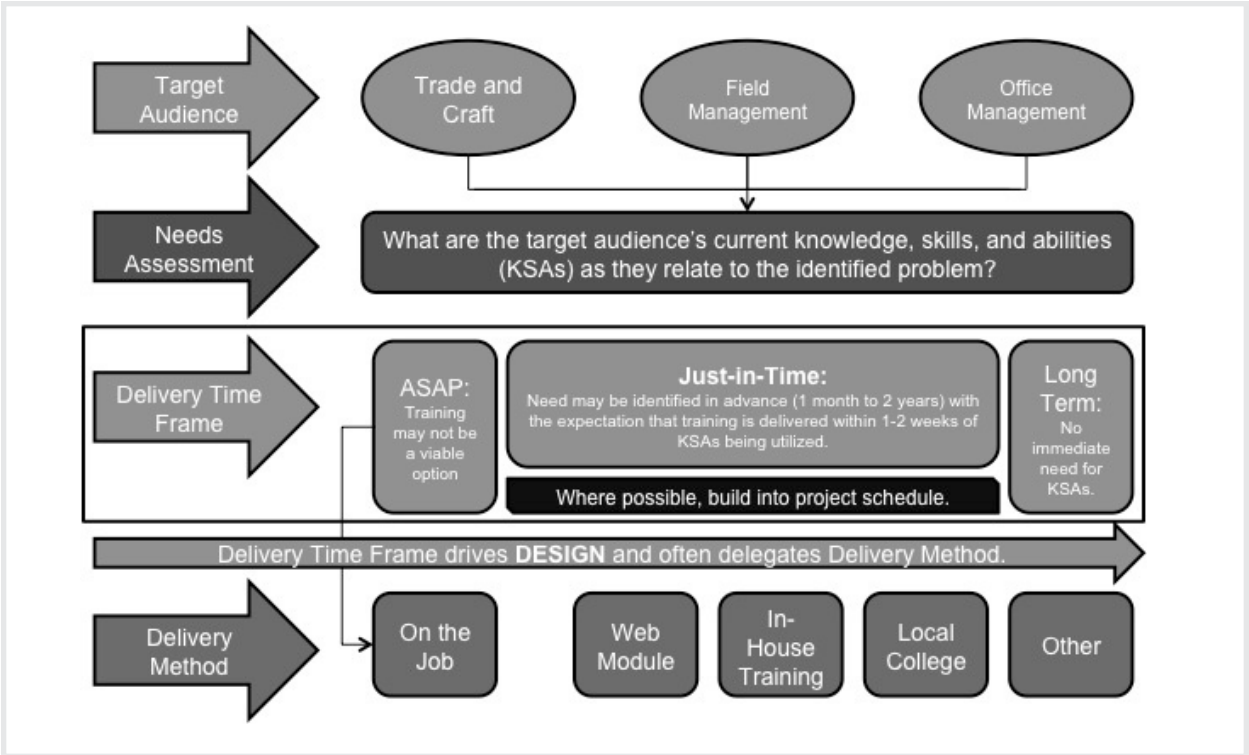
Applications for Just-in-Time Training

One of the many reasons for the need for JITT discussed below is the rate of new technology being introduced to construction, such as new welding procedures mandated by new materials or new chillers requiring different installation procedures. Such procedures need to be recognized early on in the project or, more desirably, when the project is estimated and bid.

Implementation

Based on our research, just-in-time training is certainly applicable and already in use within

Figure 10: Applications for Just-in-Time Training



the construction industry, even considering all of the potential obstacles. However, just as any project requires planning, so does training, and it starts with the assessment phase of the traditional training and development model.

So what's next? First, if you are considering more formal JIT training for your organization, you need to answer the following questions:

- What is the problem (equipment, codes, software, owner requirements, etc.)?
- Who is your target audience (who needs to be trained)?
- What are their current knowledge, skills and abilities as they relate to the identified problem?
- What is the desired behavioral outcome?
- What learning constraints exist, and are they removable?
- What delivery options are you considering, and what resources are available for training?
- Who can serve as subject-matter experts?
- What is the expected timeline for project completion?
- When is the learner expected to utilize and perform new knowledge, skills or abilities?
- Is there any time available in the project schedule to include training?

In order to answer these questions and be successful in your training efforts, you will need a bit of buy-in. Ideally, you would get buy-in from all parties involved, including contractors; your field and office staff; your current training organization (as needed); owners; and any certifying or regulating bodies, such as government or industry officials as well as your own employees. Training must then be built into the project schedule just as if it were any other work-related task.

A Review of the Challenges to be Faced, Potential Legal Issues, "Pitfalls to Avoid" and other Lessons Learned

We have discussed many of the potential challenges to using more JITT for HVAC/sheet metal companies. The first is simply informing leaders as to what JITT is and its possible benefits. The second is getting buy-in from all parties involved. It appears to us from our research that buy-in is generally not a problem in most cases; in fact, employees often want this type of training in order to do their jobs better and not feel inadequate for a task. Getting buy-in from top management may sometimes be more difficult. (First, there is always a question about time and money, so it must be demonstrated that JITT can save money and time, for instance, through less rework and higher quality, and, in some cases, the ability to do the job with less experienced resources versus journeymen.) So the overall problem or hurdle to cross before there is a significant change to using more JITT is a matter of collaboration among several parties and some of the various stakeholders with a shared understanding of the benefits from this flexible training model.

JITT won't replace all traditional training like the long-respected model of apprenticeship training. However, it should enhance traditional training models and possibly bring more skilled people into the construction industry where needs are expected to be greater in the future. Some of the future jobs may also not be traditional, however. For example, there is a trend in the industry to use more of a manufacturing model for construction involving prefabrication and modular construction. There may be points of resistance

in that trend too, but we see them being largely overcome in the next few years. The goal here is to stay up with emerging trends and technology--not fight them, but embrace them.

The only potential legal issues encountered in our study were related to certification for some construction procedures. These need to be identified and decisions made as to if and how this will be done and who will certify the workers learning these skills. JITT should not be designed to cut corners, but to help assure workers know how to complete tasks better, more safely and in a timely fashion.

As Jim Kennel, HPE, noted in our interview, "I have been asked what if they get all that training and leave the company in four years. My answer is, what if they didn't get all that training and stayed?" There is always the question of who will bear the costs of developing programs such as JITT modules, training materials or hands-on curricula needing special equipment. Essentially, each company will bear the costs; however, it must be approached as a long-term investment. What if that investment is not made and nothing changed? As noted in our introduction, there are existing competitors and potential competitors out there that are aggressively seeking this work.

Overall, we have found great receptivity to the idea of JITT. It just needs more examples of success and implementation guidelines to catch on in a way that it becomes more like normal procedure. If there is a major pitfall to avoid when using JITT, it is to think of it as "training lite" or training that needs little planning and can be set up at the last minute. JITT has to be as high-quality as any training, and it needs to be part of the field and office planning process.

2 CONCLUSION

In brief, our research found:

- There is a definite need for JITT delivery methods in the office and the field, in order to keep up with the changing workforce and customer needs.
- Many companies are using something like JITT now, but often by another name.
- JITT needs better definition and process suggestions and examples to be utilized more effectively.
- Like traditional training methods, JITT requires good planning and early recognition of need in order to be effective.
- JITT will consist of several delivery methods, but the expected trend is to use more online/computer-based modules.

The use of JITT is not only viable for the HVAC/sheet metal industry in the future; it is here now in some corners of the industry. While our definition of JITT necessarily includes more traditional on-the-job training, the more formal model discussed above will eventually lead to the greatest benefits. At first, this model may look a little bit daunting, especially to companies that don't have large HR departments and trainers on staff. However, most of the steps described above can be broken down and carried out by current office and field managers. In some cases, a company that takes on this planning procedure will find that it either shouldn't be taking some work or needs to train the field and office staff to better compete in new markets. Others will likely find that they can improve productivity, win more projects and become more competitive in the market.

We expect companies that use JITT will be able to attract and retain better employees. We have often seen that employees want to work for an employer that helps them learn more about their job and offers opportunities for growth. Those that get effective training will be more apt to stay than leave.

Like any new idea, the temptation is to wait for others to try it first. In this case, others are trying it first and succeeding. JITT is not for every situational training application, so it is a good idea to discuss and plan in order to roll it out in a few cases before using it for every need. However, that doesn't mean take another 10 years to work it out. The need is immediate in many cases. This is the "just-in-time" notice to make more use of JITT.

3 APPENDIX 1

Methodology

Discussions with the New Horizons Foundation Task Force for the JITT research project have been beneficial in helping to define the major issues around the JITT concept and in defining the scope of the project research and survey. Our research includes a secondary search for other uses of JITT as well as definitions. The information represented in this report is primarily the result of interviews with James Shoulders, Administrator, ITI International Training Institute; Katie Neufeld, Director of Business Services; and Jim Kennel, Training and Recruiting Manager for HPE Incorporated of Colorado Springs, Colorado. Paul Sampson, Project Manager for Training Sales at Delta College (http://corpserv.delta.edu 1961 Delta Road University Center, Mich.) was also interviewed concerning the use and popularity of JITT in other industry sectors. The primary statistics came from our survey of Sheet Metal and Contractors National Association members (SMACNA) as well as a small group of general contractors and other trade contractors. In total, we received 121 responses to our survey. The complete results of the survey are provided below. (***Note: The survey results are not meant to be representative of the entire construction industry, only the SMACNA membership's opinion and experience***.)

Graphic Results of Just-in-Time-Training Survey

The following graphs and tables represent the data from our survey. Some of the graphics are referred to directly in our report; others provided background information for our analysis of the use of JITT.

Exhibit 1: Primary Type of Work

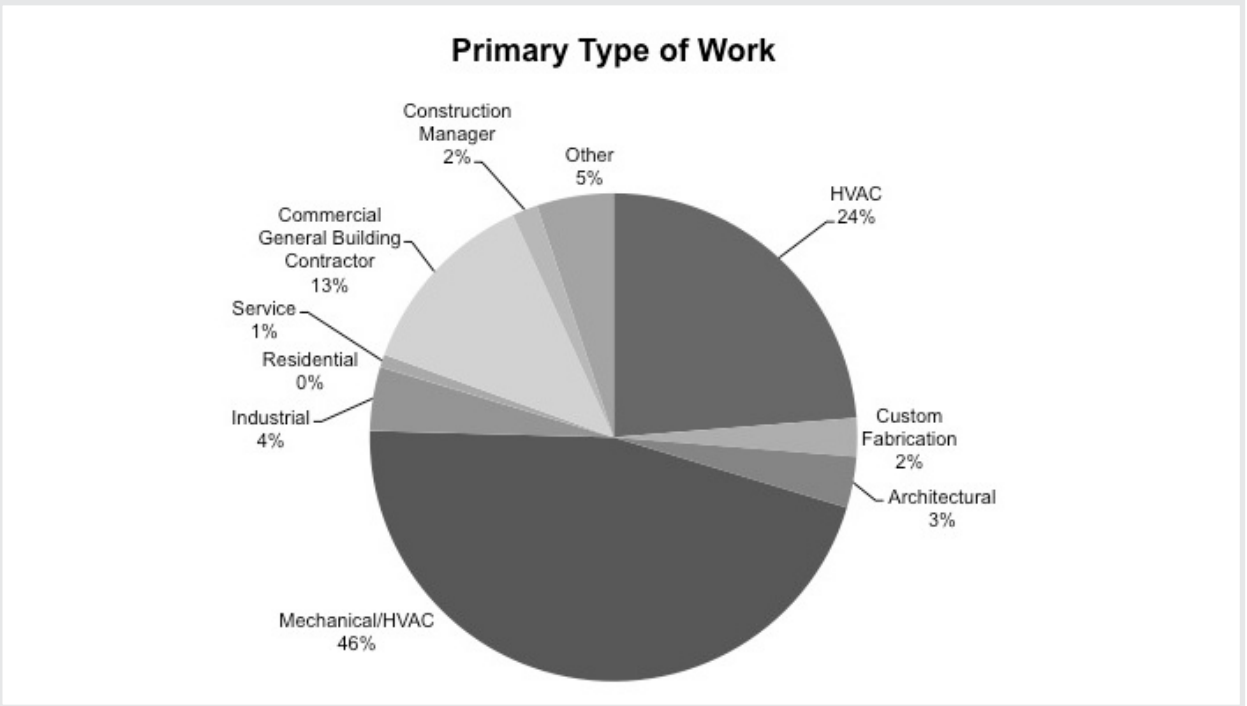


Exhibit 2: Primary Markets Presently Served

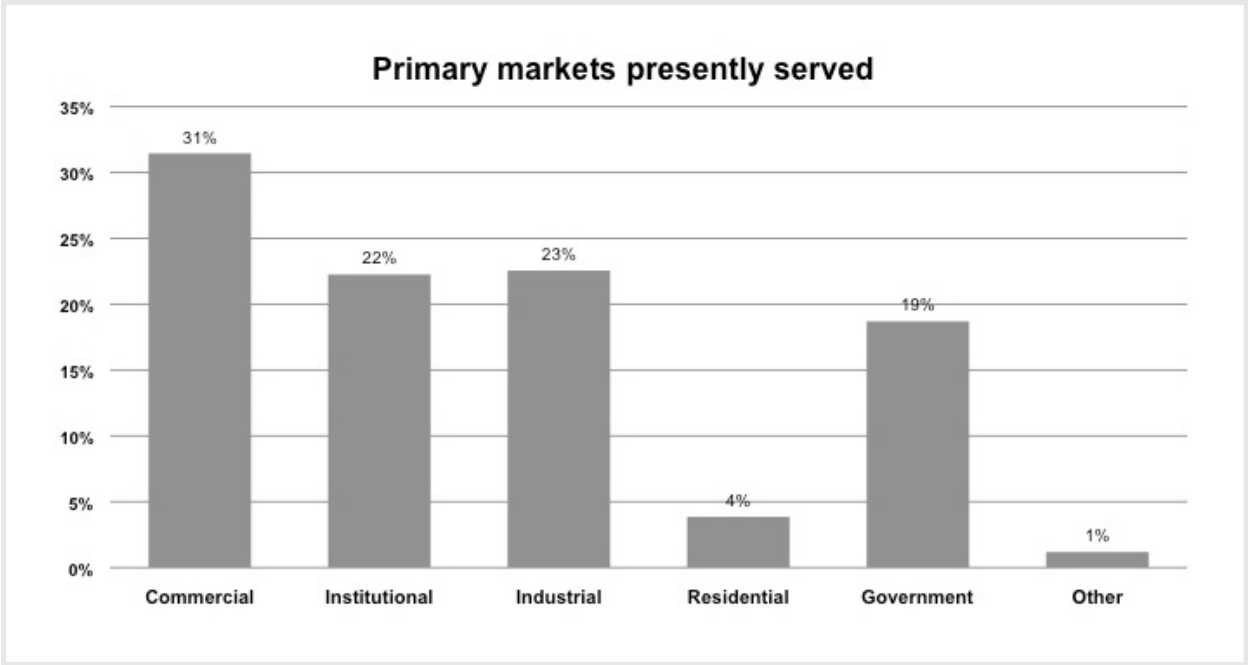


Exhibit 3: Is Your Company: Union, Nonunion, Both Union and Nonunion?

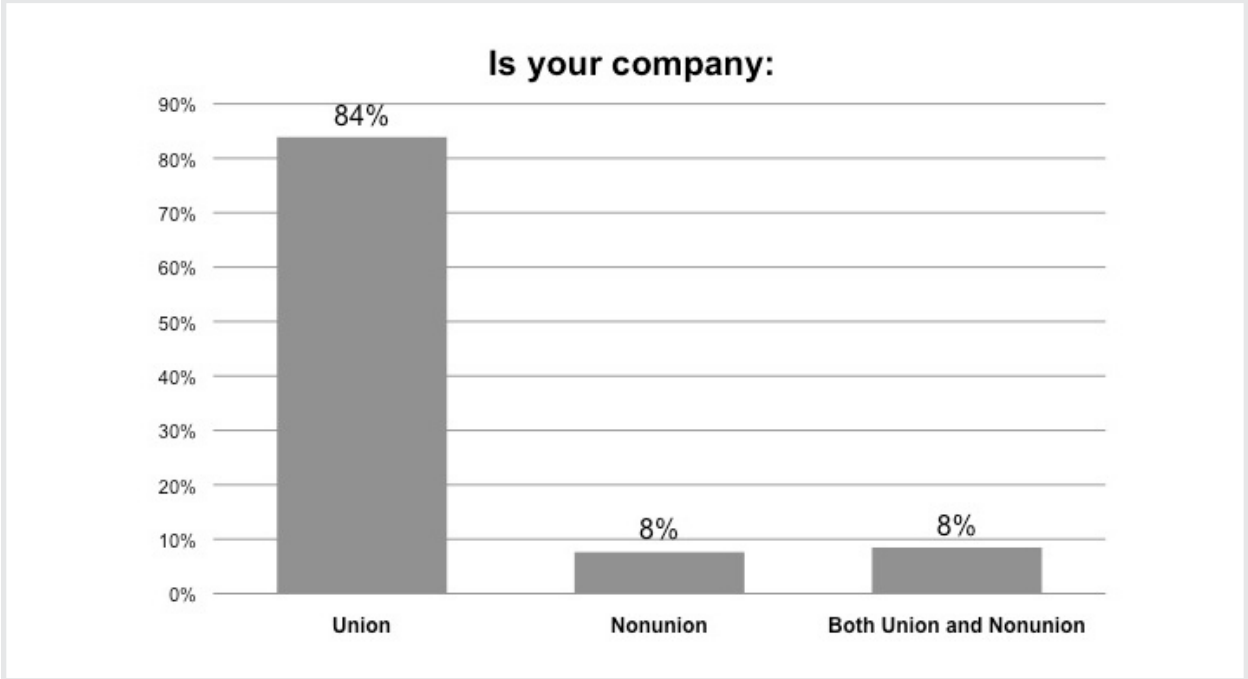


Exhibit 4: Size of the Organization in Annual Revenue

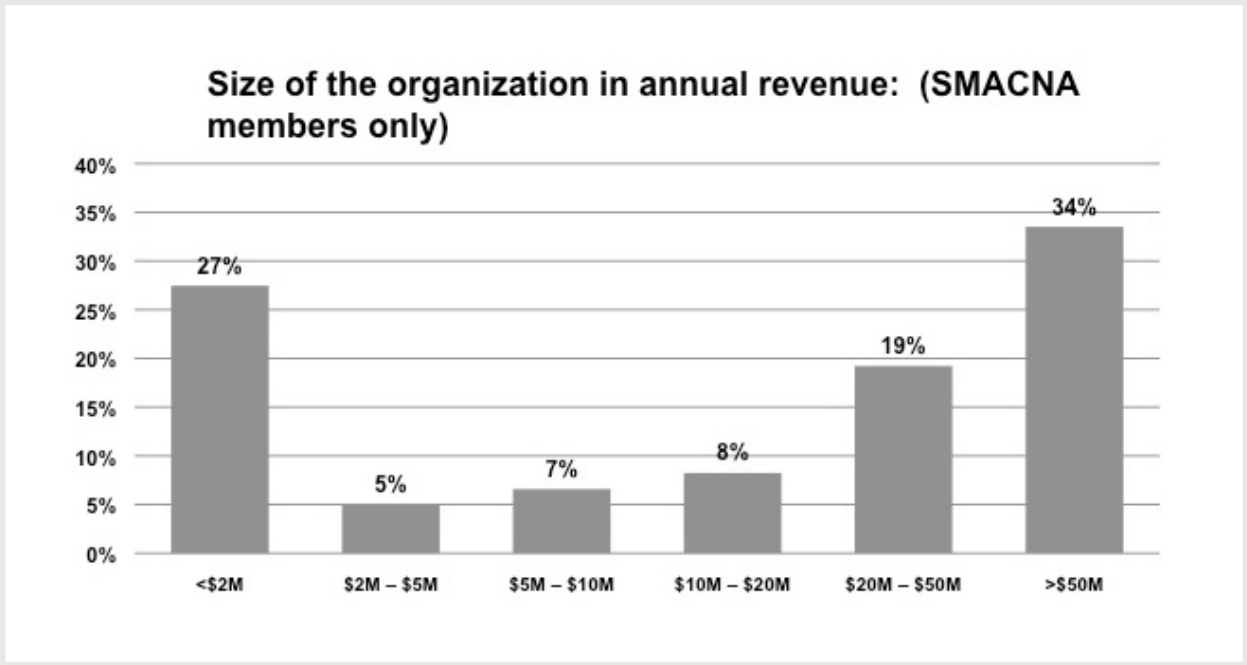


Exhibit 5: Within the Next Year, Will You Need More or Fewer Field, Shop, and Office Personnel?

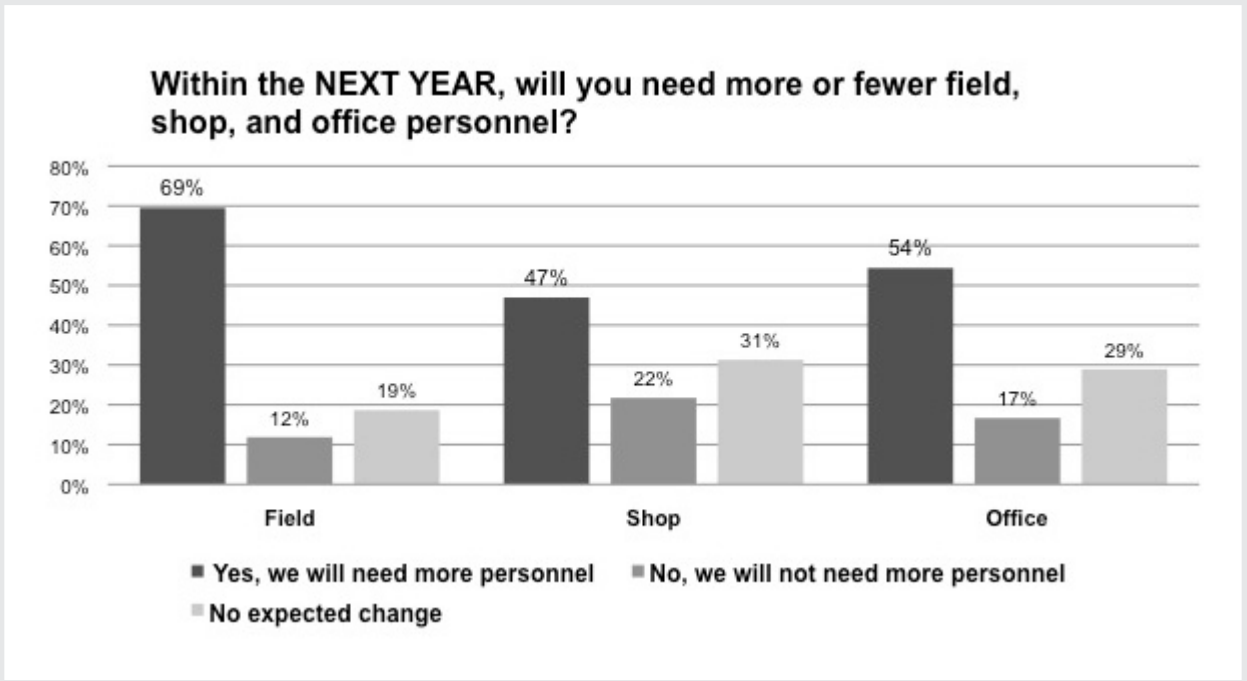


Exhibit 6: Most Successful Training Methods Survey Results

On a scale of 1 to 5, which training methods do you think are the most successful? (1= Most successful, 5= Least Successful)	Average Importance Field/ Office Mgt.	Average Importance Trade/Craft
Structured on-the-job training	2.0	2.0
Instructor-led, face to face, by outside trainers	2.3	2.4
Blended (combination of face-to-face and computer-based instruction)	2.6	2.7
Instructor-led, face to face, by internal trainers	2.7	2.7
Apprenticeship programs	2.9	2.1
Online, instructor-led	3.1	3.4
Online, self-paced, no instructor	3.3	3.6
Offline, self-paced, no instructor (books, videos, audiocassettes, etc.)	3.7	3.7
Other	3.8	3.9

Exhibit 7: For TRADE and CRAFT WORKERS, how do you expect these training delivery methods to change in the next three to five years?

(Please explain)

- Accelerated learning techniques. Potentially more specialty training—welding, medical gas, air balancing, shop fabrication. Lean.
- As an instructor at our JATC, I expect the curriculum to evolve just as our industry evolves. I do foresee more and more electronic training methods being available, of course.
- As electronics become more sophisticated, workers will have access to the knowledge base that currently is only available to the office worker. iPads (or similar devices) will replace the cellular phone and provide construction models and instant data access. All of the field personnel will need training in how to use the software and devices.
- Depending upon if the union and industry requires certification and testing, then we will see an increase in YouTube-type instruction and/or online, instructor-led or self-paced learning. The key is if the industry requires certification in order to have or keep your job. If the industry does not require certifications (i.e., turning out a journeyman after 10,000 hours—with no regard to passing an exit exam), then the motivation for training is greatly reduced.

- Do not anticipate much change in the next three to five years.
- Expanded instruction into energy management and LEED training. Use of computer for paperless projects.
- Expect more computer and online, self-paced training.
- Expect very little change in three to five years. The programs are slow on change. Trade programs need to embrace either instructor-led or no instructor online training.
- Gradual movement towards online, self-paced classes in place of classroom instruction.
- I believe that they will become more electronic, web-based. It cost us a bunch of money to assemble our workers due to high wage rates and work rules. If we can keep the training off the clock, that would be best.
- I believe the face-to-face or hands-on with instruction will continue to be the most effective for training. The trend may be more online for office staff, but not for trade workers.
- I can see going to some online training to help save costs. But obviously, the hands-on training can't be replaced.
- I could see a shift to online studies for technical aspects. The next generation adapts better to this form.
- I don't expect change other than increased safety training.
- I don't see the training delivery methods changing much or at all in the next five years. Our trade workers receive training through an apprenticeship program. I would like to see these programs upgraded to stay ahead of competition.
- I don't; apprenticeship programs are increasing.
- I expect more computer work as the job in the field gets more automated.
- I expect to see a lot of online, mobile training.
- I expect to see more personalized training with more specialized jobs.
- I think major changes in craft training are more than five years away.
- I think there will be more web-based training methods that will be available to the construction trades in general that will be helpful and more cost-effective.
- I would like to see a Craft Worker Training Program developed in our high schools. We need to do a better job of preparing these graduates to find a skilled profession when they enter the job market. The increased demand for craftsmen is going to make their wages competitive and offer a job with good pay.

- I'm afraid that the instruction will get less personal and more computerized.
- Increase productivity through technology.
- Instructor coming to our business and tailoring the safety to our specific functions.
- Internal training is required due to our specialized manufacturing techniques and equipment.
- Introduce online modules to mix with on-the-job and apprentice training. More emphasis on financial and scheduling.
- It will get more challenging to find workers, so the methods of training may need to also change.
- Local apprentice training program is enhancing the journeyman retraining program.
- More access to training tools and structured career path development. More use of mentoring and structured OJT.
- More and more training outside the apprenticeship. More internal training.
- More computer-based technical training.
- More computer interaction to deal with tablets and smartphones in the field.
- More focused training on specific skills or new technologies, delivered in seminar fashion, similar to short-duration, journeyperson upgrade training.
- More hardware/software-led training.
- More online (cloud based) training.[7] Video, shorter duration, with tailored topics/subjects.
- More soft-skill training provided by the company.
- More specific training. Only train the worker on what they will be doing not training to do everything in the whole craft.
- More task-oriented with less focus on codes, systems, big picture. More use of technology and more instruction on how to use technology in the field.
- More technological methods for delivering and more content involving technology and time management, efficiency.
- More technology used.
- More training of personnel in the actual costs of projects.
- More training. It was held back by downturn in work.

[7] Note: 16 other mentions of "more online training not shown."

- More use of electronic media. More flexible apprenticeship school hours.
- More vendor or expert-led training, face to face preferred.
- Need more of it, not enough workers interested in this industry.
- New generation appears to like online applications, fewer books and memorization.
- No change. Training is received through union.
- No expected change from current apprenticeship-based training.
- No, apprenticeship and on-the-job training of apprentices, and classroom journeyman upgrades are working well.
- None.
- Open-shop competition will challenge unions to step up their game.
- Possibly more online training, but I still see apprenticeship programs mostly unchanged in five years.
- Seems like all trainings will be computer-based or online trainings, and instructors will be non-existent.
- Some online, but still hands-on with personal instruction.
- The change will probably be toward online, self-directed, with support by teaching organization.
- The craft workers will start having to do more online learning.
- The integration of more technology into their craft.
- The same as they have been for the last three to five years.
- The traditional apprenticeship programs and OJT will continue to be the best method. Training will likely continue to be traditional classroom or lab instructions, combined with online computer learning.
- The use of technology in the workplace will change the way the field is trained.
- There is an increasing need for ongoing training and upgrading as the demands of the industry and client expectations continue to increase. We need to have access to a catalog of training programs ready to use. 'Marketing' would have to be done proactively with industry, clients, suppliers and vendors to identify new and emerging trends so that training is developed before the contractor is involved.
- There needs to be a focus on more technology-based training with computers, tablets, cloud-based systems, etc.

- There should be more in-house training provided by the contractors. A blend of in-house and outside trainers would be utilized.
- There will be more online training.
- There's a continued push to have trade and craft workers find some way to complete online training.
- To improve our training, we have recently created a new position titled safety and training leader. With increasing regulations and training requirements, we see this as the only way to keep up.
- Training program is being modified to better meet the current industry requirements.
- Union has taken a stronger initiative in training. Also will be doing more in-house training
- Use of online training to increase.
- We don't expect much change—training primarily comes through the union and specialized equipment training we provide to our employees.
- We have to adapt and become more flexible. Structured training seems to advance at the pace of the slowest learner.
- We need to continue to adapt training to the younger generation. In addition, we need to develop useful continuing education programs.
- We see a move to a program that will provide training in a consolidated fashion, two consecutive, 10-day sessions per year.
- We will have to train our people ourselves.
- Will need more outside one-on-one training.
- With the technology available, I would expect to see fewer brick and mortar classrooms and more virtual classrooms with an instructor part-time and then isolated hands-on training along with on-the-job training.
- With the use of notebooks and laptops, I believe training in the field of trade and craft employees via the Internet will become a more utilized option.
- Workers are specializing in a particular aspect of the installation.
- Yes, more computer work.
- Yes, the need for more business management skills for the trade crews is taking place.

Exhibit 8: For OFFICE/MANAGEMENT, how do you expect these training delivery methods to change in the next three to five years?

(Please explain)

- More computer work, less manual work.
- Becoming more technical, BIM, on-screen take-offs, Bluebeam and PDF markups, less paper but more documentation (electronic).
- Combination of YouTube and online with instructors, with a requirement by the industry for proof and certifications of a skillset.
- Continue with webinars.
- Even more web-based training.
- Expanded training in BIM, LEED and paperless projects.
- Expect more computer and online training.
- Expect online training to increase with a big reduction in off-site travel for training.
- Expect there will be more professional coaching and structured mentorships.
- Expect to use more online training.
- I believe that online courses and webinars will be the desired method of training.
- I don't agree with the evolution, but online training modules will become the norm. I feel they are less effective without instructor and peer review and feedback.
- I don't foresee changes to this area.
- I expect a return to more face-to-face training in groups. The discipline of consistency is becoming more and more crucial to sustained productivity.
- I expect the level of training and certification to rise as positions in management become more complex and more demanding.
- I expect them to remain the same.
- I see office and or management training trending towards online training such as webinars. One problem—being able to commit to training while you are at your desk with other distractions.
- I think the balance of classroom to online training will move from 50/50 to 30/70
- I think we'll see more use of "GoToMeeting" type technology and online interactive training.

- Increased computer usage and training.
- Increased productivity through technology.
- More aggressive movement towards online, no instructor, self-paced options.
- More balance between field, office, estimating, and project management so that staff has a broader perspective on the big picture. More engineering, contract, and business training as the industry is moving more toward LEED, Lean, IPD and design/build.
- More computer-based, self-paced learning modules.
- More electronic media.
- More electronic training with online, self-performed work.
- More extended off-site training.
- More group online, more multimodal training.
- More in-house training both by inside and outside resources.
- More legal and insurance items.
- More mentoring programs.
- More online training for basic.[8] Nothing beats structured OJT and quality in-house training.
- More online (cloud-based) training. Shorter duration, tailored topics/subjects, better follow-up validation of effectiveness, etc.
- More online, technical, codes.
- Combination of online and in-person.
- More outside training such as seminars.
- More small-group training classes with industry professionals and our own internal experts.
- More technology-driven training.
- No change expected. On-the-job training as well as classes by community college will remain the best method for us.
- No change. Education and training received through combination of self-study, classroom learning, and vendors and trade organizations.

[8] Note: A dozen "more online training" comments now shown.

- Nothing more beneficial than repetition and hands-on experience.
- Office workers will probably see more online training.
- Online training is gaining in popularity.
- Online training is on the rise and works for many HR and safety-type training, but hands-on experience, combined with live trainer, is needed for technological advances and policy and procedure needs.
- Our project managers will need access to an education and training syllabus that will allow for continual, graduated professional growth; professional designation would be an asset.
- Outside sources.
- Primarily OJT, coupled with seminars, online computer courses and continuing education at the community college or college level.
- Safety training online will expand and be effective. Training classes on-site will be the most effective as they are now!
- Each individual has to wear many hats. It is hard to take time out to attend training sessions. Management will expect folks to better themselves on their own time, not company time. Work rules are not as rigid for office staff as they are for union members.
- Seminars and one-on-one in office.
- The best way to learn is from acquiring the knowledge of someone experienced.
- The same as they have been for the last three to five years.
- The trend of computer and web-based training will continue.
- There needs to be a focus on more technology-based training with computers, tablets, cloud-based systems, etc.
- There will be more online training.
- They will be at their desk training online as well.
- Training through colleges.
- Training will be self-directed, with little to no support from organization.
- Virtual classrooms.
- We are training more, using webinars and video conferencing, than in the past. Less off-site training is taking place. This is the case with both internal and external customers.
- We are utilizing online training, and I see more of that being offered in the future.

- We see a shift to using SMACNA to provide training and less outsourcing.
- We utilize consultants more for office and management training.
- We will most likely expand online-based training opportunities.
- Webinar, likely due to costs.
- Yes, they will and are shifting towards more mobile, online, and blended learning solutions to reduce travel costs and time away from project sites. This learning is also available for just-in-time reference use on procedures.

Exhibit 9: What different types of work are you doing today that would require training that is not already being provided for your people in current training programs? (Selected comments roughly separated between office and field)

Office/management

- Understanding BIM. Understanding the requirements of commissioning and how to work with a commissioning agent.
- Architectural sheet metal.
- As technology continues to shape our industry, effective training is needed for the efficient implementation of these systems.
- Balancing needs to step up. Personal skills training. Business training.
- Basic computer. Lean. Finance.
- Building envelope test. Energy management.
- Business negotiator, customer relations, marketing, business development.
- CAD, Trimble, programming, industrial fabrication.
- Chiller, low-temp work.
- Codes, processes, procedures for industrial, process, and power and energy-type projects.
- Contractor-specific.
- I feel that we are lacking in training on every level. From administration to our tradespeople. As always, I know there's room for improvement, but I feel like the world (economy, technology, governmental regulations) is constantly changing. All these changes are hard to manage when you're a small, family-owned business.

- In the office, more computer-based job and financial tracking and technical savvy (i.e., paperwork) than legwork seems to be the trend.
- Leadership and management for trade. Computer skills.
- Lean operations. Better manpower projecting. Awareness of energy usage and tracking knowledge of ever-changing current building codes.
- More and more complicated software is being used in both office and field jobs, with little to no training on proper use of the software.
- Work in the office is always changing with new software programs, especially with CAD drafting.

Field work

- Current training programs are designed for building trades (HVAC) work. We do custom fabrication and heavy metal work using all types of materials that generally require welding, cleaning and polishing. We use computer-controlled laser and plasma cutters, punch presses, press brakes, welders, etc. The local training facility only has the new computerized welders and an old press brake, which they don't even give basic operational instructions on. In school, the apprentices rarely see material other than galvanized and heavier than 16 gauge. We have to teach people that there are many different types of material, that the material thickness varies between the types, and that there is a tolerance range within each gauge. We also have to teach people how to use micrometers, calipers and other measuring devices other than pull tapes. Since a great deal of our work is close tolerance (+/-.020' or better), we have to bend allowance calculations, which are more complicated than adding or subtracting a metal thickness. We use press brakes and power rolls for most all work; eventually, everyone is taught how to set up and run this equipment.
- Customer service training (our own employees being the customer). Evolving technologies (CAD, Total Station being a few).
- Documentation and effective communication skill sets.
- Downhill welding for Marcellus Shale.
- Exposure to the industrial side of our business seems to be lacking in the apprenticeship programs. Journeymen, overall, don't seem concerned with apprentices getting well-rounded exposure to all aspects of the trade.
- Having the craft worker be more business-oriented to be able to sell and manage small jobs along with install.
- Hospital and specialty-medical work and nuclear energy-type projects.
- I think training can be found for most anything that we might be doing. All the training doesn't necessarily need to come through the unions.

- Increasing safety regulations make everything more costly and difficult. Also increasing infection control requirements for healthcare work become more difficult to stay current with.
- It's not so much that the work is different, but how we communicate information that is changing.
- Mining, healthcare, design-build.
- More cross-training to allow versatility and competency in various disciplines of our business.
- More industrial and industrial maintenance.
- More integration with technology. Building and system controls.
- More service-oriented.
- More specialized welding procedures.
- Need more safety programs.
- Need training to teach field personnel to look for and find additional work opportunities that will increase our revenue as well as be a benefit to the customer.
- New building testing requirements, such as Building Enclosure Testing (BET), Infrared Testing, more Measurement and Verification testing that is related to energy use (i.e., metering of domestic water, chilled or heating water tenant usage, electrical metering per tenant, etc.)
- New technology along with CNC equipment. It is difficult to continuously attract workers.
- New types of HVAC equipment, for exampleVRF, new technologies being utilized in the field (iPads, iPhones, etc.).
- Nuclear (NQA-1
- Office: Dealing with online billing, purchasing and other office tasks provided by third parties using web-based interfaces. Project Management: Using web-based project controls forsubmittals and scheduling, and extracting cost and productivity info from in-house accounting systems. Also leveraging available software platforms to improve project control and profitability.
- One example is we are making great progress in the bioscience sector. This is driving sector-specific training for things like working in a vivarium.
- Organizational and IT.
- Paperless projects, use of systems such as Bluebeam.
- Production methods for prefabricated construction.

- Production skills aren't really taught in apprenticeship program. Apprenticeship is made up of approximately 20% shop labor and 80% field labor. So the training is tailored to field personnel.
- Servicing new units.
- Special project work and how to manage these projects.
- Technology is changing so fast that traditional training methods lag behind in years.
- Training for compliance with regulatory requirements, such as building code, NFPA and safety.
- Training in the use of new products in our industry.
- Union is lacking paperwork skills and scheduling. College graduates are lacking in people skills.
- Updated regulations, current industry topics.
- VRF and AutoCAD.
- We are a service-based company, so customer relations are of the utmost importance for us. I would like to implement a customer service training program to ensure our techs are interacting properly with our customers.
- We are a union contractor, and, as contractors, we have an association called the Mechanical Contractors Association. We brainstorm this and attack it that way.
- We are doing more versatility training. Jobs don't only do one thing. This will help us with agility in gaining and running different kinds of work, including smaller jobs.
- We are doing more with enterprise automation. Projects are more web-based for interaction and information. Field crews could be more IT-oriented.
- We are using a lot of new software and hardware (tablets, smartphones, laptops, etc.). Most of the training is OJT. We have a big difference in effective use of the tools based on the users' technical abilities.
- We need more machinist-type workers instead of fully-trained sheet metal workers. The equipment is getting more and more automated.

Exhibit 10: Do You Feel That the Current Skill Level of Training is Sufficient For Tomorrow's Challenges?

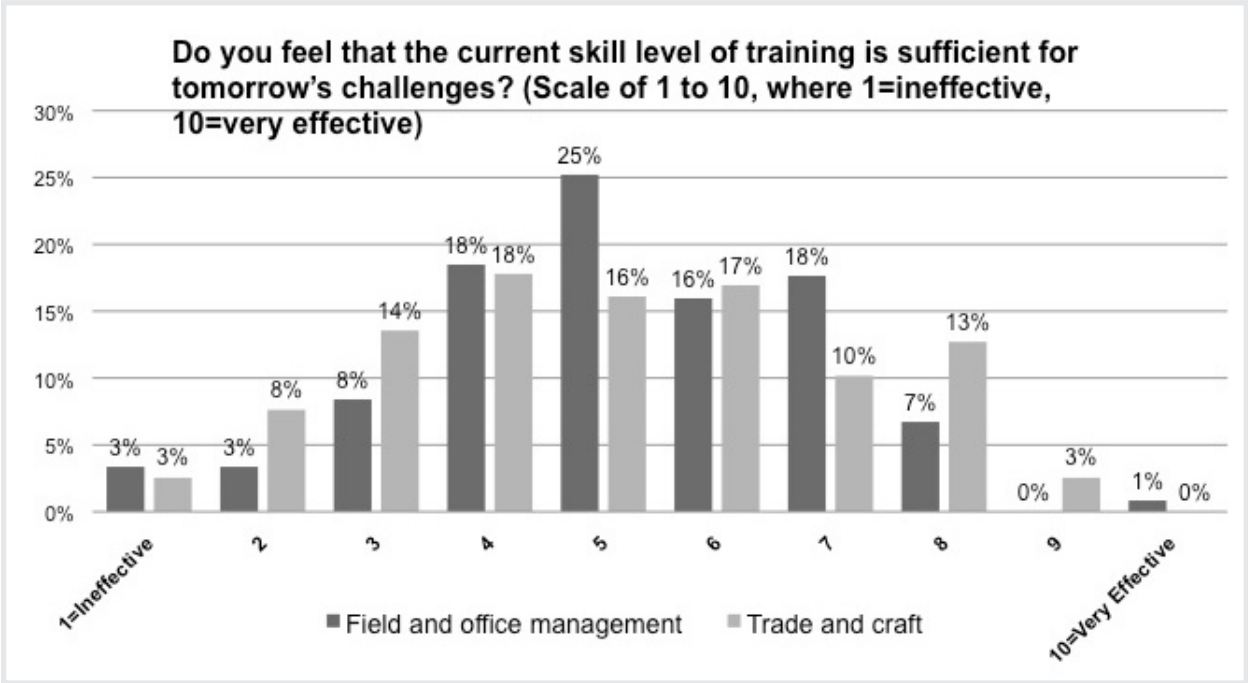


Exhibit 11: What Percent of Your Training is Provided by These Sources?

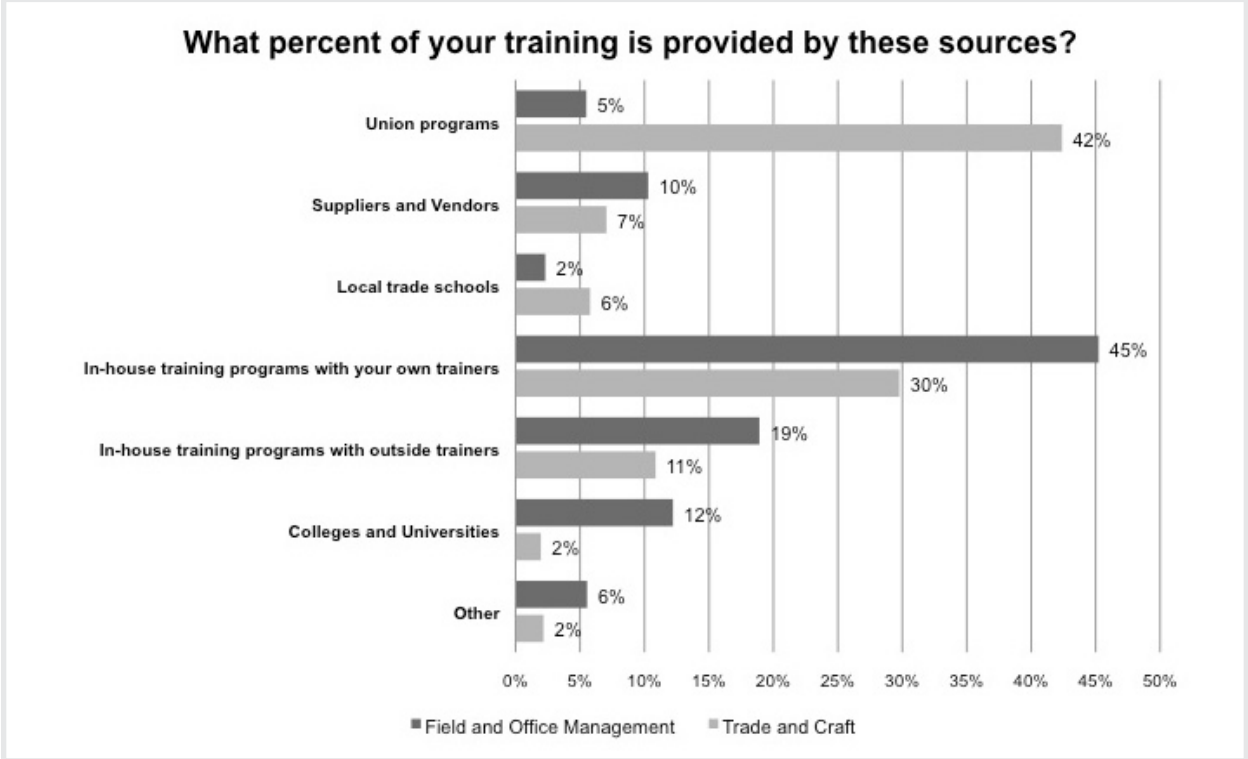


Exhibit 12: How Does Your Company Determine Individual Training and Development Needs?

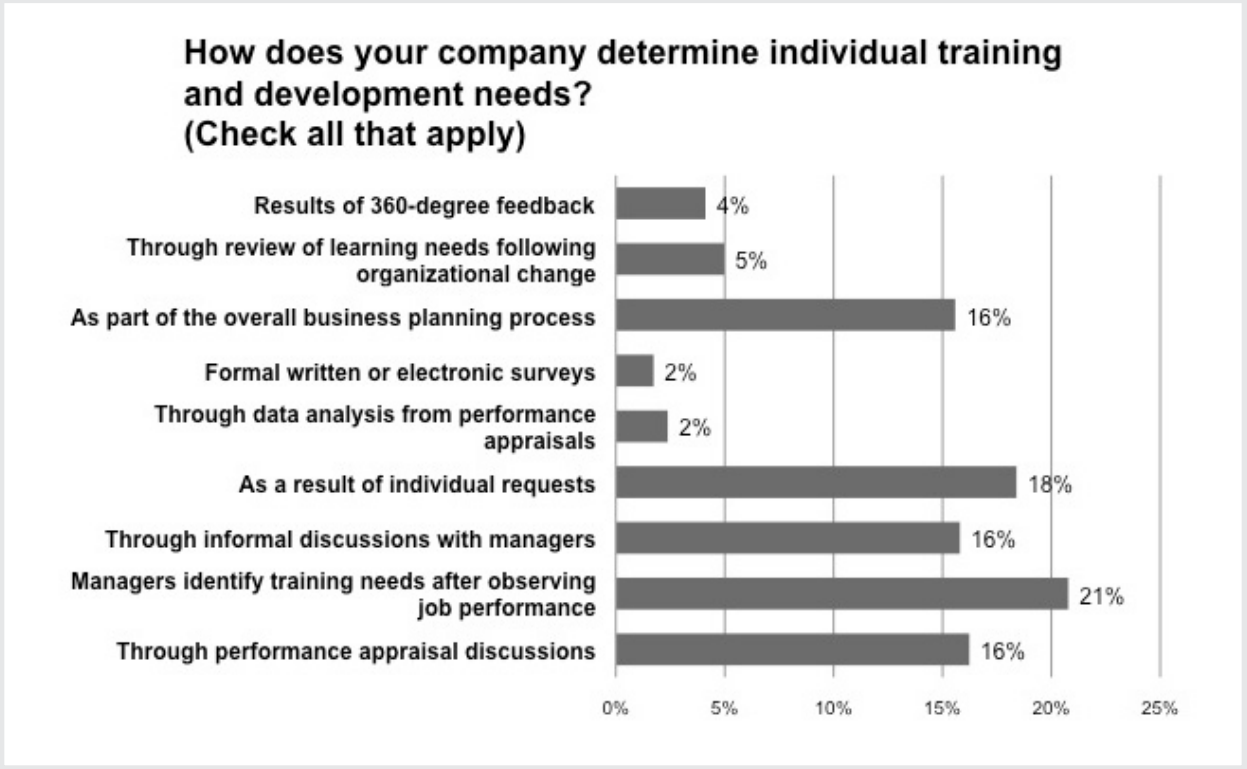


Exhibit 13: Do You Currently Use Just-in-time Training for Your Workforce?

Exhibit 14: If you currently use just-in-time training, please give brief example(s):

- A new type of product is being used on a project (i.e., Armstrong Pumps new "Intelligent Variable Speed Pumps"). We have to do JIT training for these types of systems and products since the design concept is new, the Control Contractors "Sequence of Operation" is new, etc.
- Any new procedures or products that are new to the industry or not covered under the apprenticeship program.
- Compliance training is a frequent example. As a California-based employer, there are legal decisions or legislature changes that impact processes or course of business. Usually the time between decision and training is less than two weeks.
- Fire Life Safety opportunities came up, and union trade school/NEMI/ITI got our workers trained and certified fast, so we could get them on the job.
- Field carpentry workers are shown how to do things on the job, which is about as just-in-time as you can get.
- For trade and craft usually related to a new product or material, and training typically provided on-site by supplier or equipment provider.
- I think a good portion of our training takes place because a need is recognized, for instance new tool training, lift training, new software training, and safety training resulting from an incident. If the skill is not used after the training, the skill is often lost, and retraining will be required. On the other hand, some basic training is required prior to starting in most positions.
- If we are going to be installing a piece of equipment or a zoning system for instance, we will study the specs and installation materials as well as speak with others in the industry about any hidden aspects that we may not be accounting for.
- If we are using a new product, we educate our tradesmen on how to install it properly.
- In the process of TAB, we often encounter new equipment, control system, or design.
- Installed new underground duct product. Received training from vendor immediately prior to installation.
- Job-required training.
- Med gas, welding, interviewing, new manager training.
- New brand of equipment, new software being implemented.
- New equipment or systems being introduced will generally provide formal training, for primary operator(s), just prior to installation or at time of installation. Training for other personnel will be provided as they are exposed to the equipment or process.

- New installations may need training for our crew from a vendor who is selling it for a project.
- New system to be installed, train engineers and tradespeople in design, installation, and maintenance of the system.
- Not every employee will do every job. With JIT we can identify candidates for particular tasks, based on prior performance and training, then start teaching them the new skills they'll need. Each individual is evaluated during training to make certain this is a good fit. This way we are not training people to do things they will never do, aren't able to do, or aren't comfortable doing.
- No formal training; employee is shown what to do if it is clear he or she does not know.
- Only for specialty work, new shop work.
- Our tradespersons get classroom training and practical hands-on training simultaneously through the apprenticeship program.
- Preplanning before the start of a new task or project as required concerning the prior training of that employee.
- Quite often, much of the training that is needed is due to skills or knowledge needed by an employee on a specific job. Therefore, when it is determined that there is a need, the employee(s) receive the required training.
- Safety training is given to employees when they encounter unforeseen circumstances they have not previously been trained in, aerial lifts, for example.
- Scissor-lift training for the field and new internal operations manual for the office.
- Specialty jobs that require immediate and specialized training.
- Tendency to train the employee when he or she is in the midst of an unfamiliar task or to expand knowledge base in a repetitive duty or roll.
- Trimble.
- Use of rigs or special equipment—we have supplier give a quick "how to use" training program.
- Using a specific tool, process,or safety application that impacts a specific project outcome.
- We depend on suppliers that can warehouse materials for us and manufacture only what we can use in the short term.
- We have an onboarding process where we provide training to new project engineers prior to their assignment to a project where they will be expected to utilize the tools such as project management software. With our trades, we have had vendors do aerial boom lift training prior to the use of the equipment to perform a specific task.

- We have provided training for new software rollouts to coincide with the installation of the product. Similarly, we have trained on processes (orbital welding, aluminum, HDPE fusion) just prior to beginning new projects.
- We have sent field employees to factory training immediately prior to a project beginning that utilizes a new system or product.
- Welding, specialized safety, quality control.
- When a need is required, that is usually when an individual is identified and trained.
- When a new product, device, or software is used, we obtain vendor training just prior to rolling it out.

Office (and mix of office and field examples)

- Any new employee will be shown by a supervisor before he or she is given a task to complete in order to learn the correct and fastest way to accomplish the task.
- CAD software.
- Compliance learning for new OSHA programs (GHS). Prolog training for online user tutorials available 24/7.
- Due to current economic conditions, money for training is only spent if absolutely necessary.
- Implementing a new estimating program. Training would be given immediately prior to rollout of new system. For trade and craft, learning how to install a new type of system. The training would be done immediately prior to the job starting.
- New program in computer—taught, learned, and utilized new piece of equipment—received training and then utilized it.
- Our office personnel are trained in new software applications within weeks after its rollout. This allows some hands-on playing with the software to allow familiarity prior to training.
- Prior to a presentation, may have a trainer help prepare for presentation.
- Training on project management software prior to implementation.
- We are incrementally testing and using proven Lean techniques such as Pull Planning and Last Planner. We have hired a Lean consultant to help us assess our tool and equipment yard. We are systematically assessing areas of our business, like accounting, risk management, etc., in order to seek efficiency improvements, under the guise of Lean improvements.
- We are internally developing new project management software on the Sharepoint platform. As we roll out a new part, for instance submittals, we have training that Friday.

- We have been training office and field on new computer software called Bluebeam and using it on two projects immediately.
- We have on-site training and courses we can take online to obtain the training before we start our work. The training is more general in nature, so it may or may not be site- or job-specific.

Exhibit 15: If You Do Use JITT, How Would You Evaluate Your Current Program's Success?

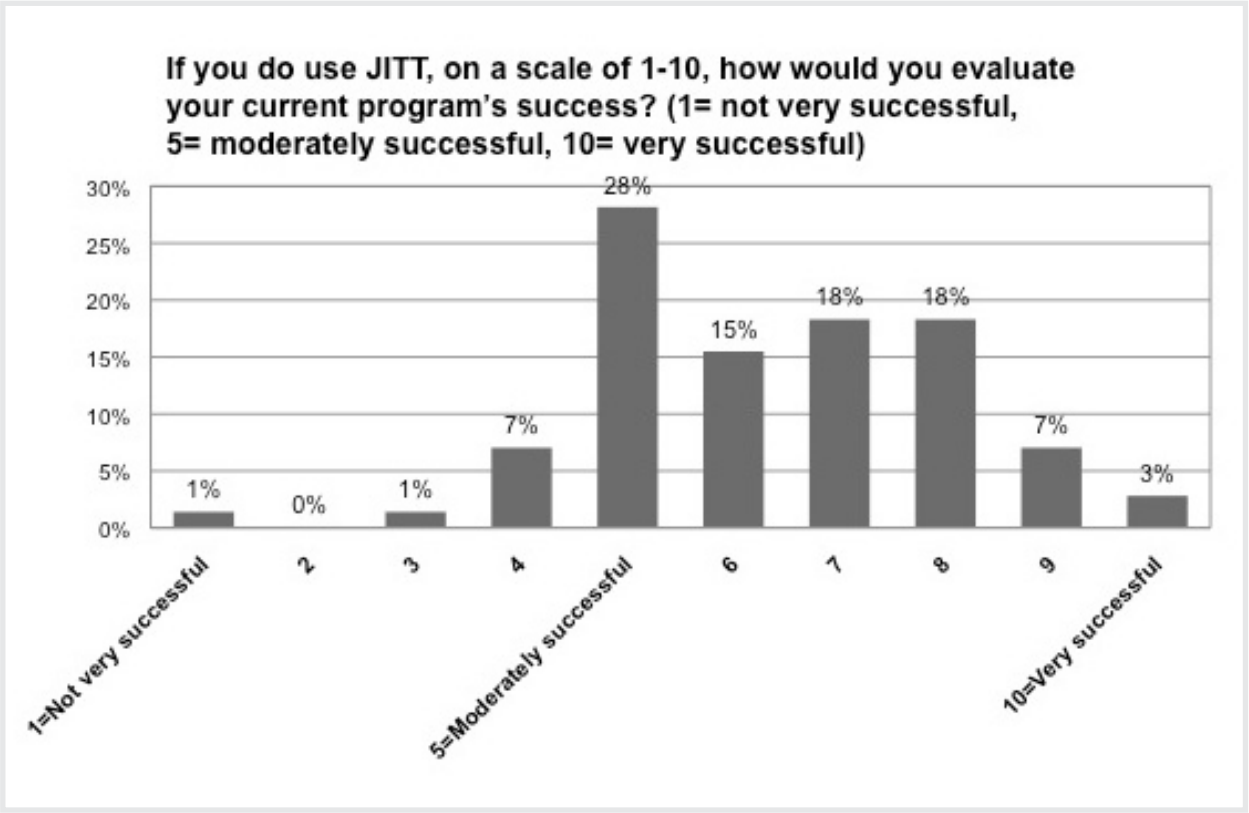


Exhibit 16: If You Do Not Use JITT, Would You Use It If the Process Were Better Defined?

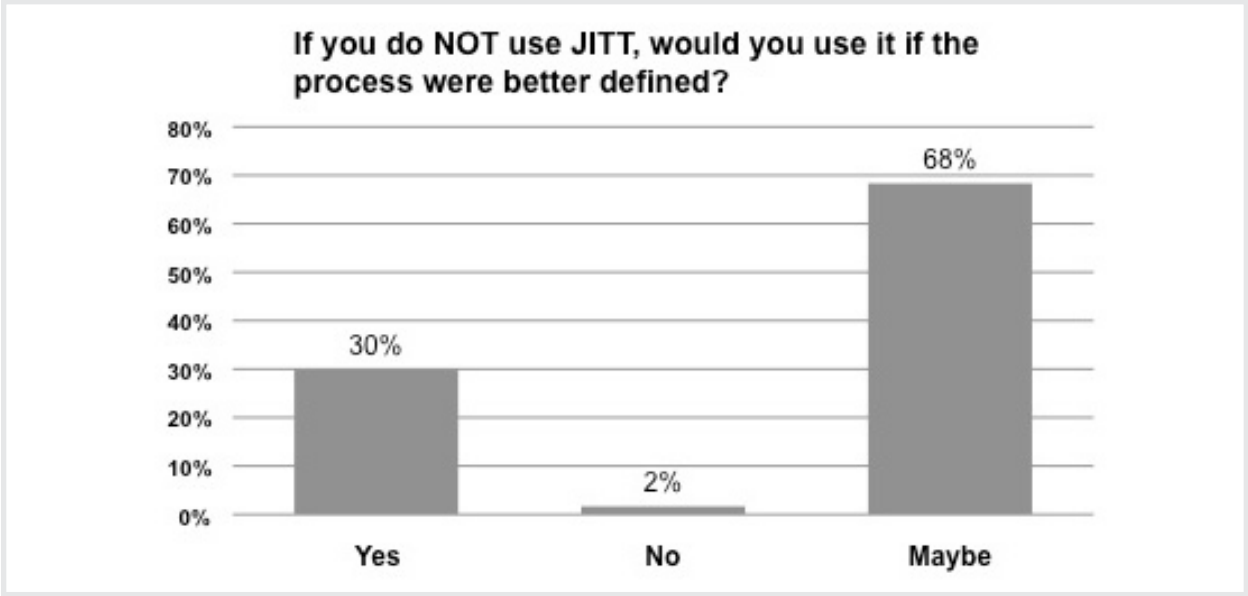


Exhibit 17: What Percent of Your Training is Provided by These Sources?

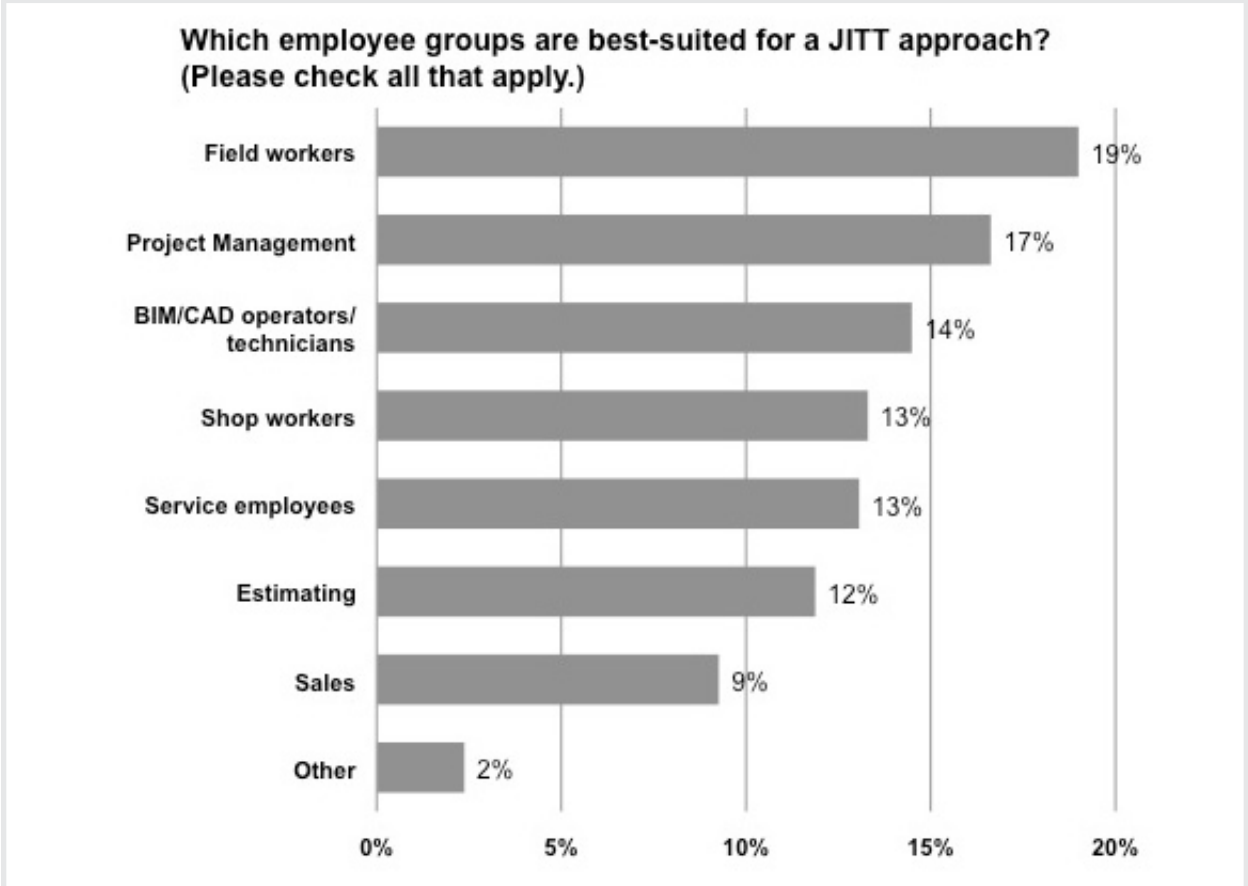


Exhibit 18: Do you know of any examples of other companies in the construction industry using JITT?

- Equipment rental businesses.
- I haven't really discussed it with anyone else. I really have just defined our program as JIT through this survey. Up until now, I really only thought of the JIT theory as it pertains to purchasing/inventory.
- MEP trades.
- Most common is when a new piece of equipment, method or software is purchased, and vendors will assist in training workers, CAD, etc.
- No (15 responses).
- Refrigeration service companies.
- Specialty mechanical connections or welding. Unique job management systems for special job situations.
- We do job hazard analysis from a safety standpoint. This is a form of JITT.
- Yes, especially in health care.

Exhibit 19: What would be the main barriers and challenges for using JITT? (Consider the challenges for employees, contractors, manufacturers, and suppliers, for instance.)

- An adequate supply of teaching materials and equipment.
- Analyzing who would benefit and when a person needs JITT. Where do you go to find the training needed for that employee?
- Availability when it is needed.
- Being proactive.
- Being too busy with business challenges to focus on the training when needed.
- Can the employee properly absorb the info that quickly?
- Current mindset. JIT requires a modified approach to shop fabrication, detailing, and purchasing.
- Delivery system and content preparation and maintenance.

- Extra expense and time involved.
- Finding and arranging for the appropriate training, scheduling training time, and possibly the cost of tailoring training to the specific needs.
- Finding one source to use most of the time.
- First, you must have people who want to learn and work hard to do the task at hand.
- Getting the trainers.
- Having a proven curriculum in place. Utilizing JITT in lieu of current training programs.
- Having a training syllabus prepared before the demand (client, engineer, regulatory authority) requires it.
- Having the training tools and personnel available when the training needs to be done, without delay and without a high level of cost.
- Identifying the training needed and having the time prior to needing it to implement.
- JITT is critically important, but a training culture is hard to change, and it has to be driven. Management has to be 100% supportive.
- Just the fact that it's something new to them.
- Keeping that trained person in the specific department that the training was directed for.
- Knowing when to use it.
- Lack of industry summits to collaboratively discuss the challenges and needs.
- Lack of flexible resources to go into action when needed.
- Learning groups might be smaller rather than a whole department or crew, so not all staff or workers might get the training, or in the same manner. This then could make the employer use people who took a class to self-teach others in the company, and the passing of knowledge might not be as thorough.
- Like all training, the time it takes to train takes away from installation time.
- Logistically, training field employees once they are on a jobsite and ensuring the training occurs before the employee performs the work applicable to the type of work that will be done.
- Might not be used that often.
- More site- or job-specific programs and applications.

- Need to have field staff licensed and certified. Need to have professional staff hold PE licenses and LEED and Lean certifications, which have to be prepared for over a long period of time.
- Not for our company, as we are small (fewer than 10 employees).
- Not enough correct scheduling and jobs go sour.
- Obtaining a qualified person to do the training. Salesmen are not qualified, since, in some cases, the equipment that they are training you on is the first time they have sold or seen the actual piece of equipment.
- Planning and facilitating the timing of the event, such that employees have enough time to obtain the skill sets prior to the execution of the work. This would apply to both contractors and manufacturers. Keeping it focused is the key.
- Scheduling and work flow.
- Scheduling conflicts, facilitator availability.
- Scheduling the training, typically done during a slow period versus my perception that it is now right when you may be busiest.
- Serving selfish interests clashes with JITT. For example, it would be better for the shop of an HVAC subcontractor to manufacture and deliver all the sheet metal to the job even though the field staff and GC pay the price handling, storing and working around the mountain of duct.
- Technology on jobsites, qualified trainers at remote sites.
- The ability to set aside time for training as it is currently.
- The biggest challenge is to retain the training knowledge. The JITT process requires that the employee be able to perform in accordance with all of his or her training.
- The difficulty scheduling training at just the right time, especially if we need to coordinate the attendance of multiple employees.
- The lag in understanding the system before implementing.
- The main barrier is scheduling and coordination. We've used it successfully in the past, but scheduling is usually the hurdle. If you don't quickly incorporate what you've learned, you lose a great deal.

- The task must be well-defined.
- The willingness of employees to invest the time and effort to learn something new.
- There is so much to know in this industry; I do not know how JITT works, but how can one person comprehend all that is needed to know in a short amount of time? It is continuous learning in this industry.
- Time.
- Time constraints, the jobs we are fortunate to get are usually a 'hurry and get it done' type, and we can't spare the time to take a person away and putting the schedule at risk. The few customers are demanding customers.
- Time. Cost. For individuals to stop to train while busy is hard. However, it makes more sense for JITT since we have a project than to do it while slow and lose some knowledge waiting for a project.
- Timing.
- Timing.....how and when.....who decides?
- Timing and scheduling—taking field people off projects to train for next project.
- We could probably use it for office people only unless it was an approved training module by the Union.
- We need people who are trained to think on their own. When someone can take minimal information and apply rational thought and prior knowledge to get something done, that is when that person is the most valuable to an organization. If people need training for every process they undertake, they simply are not thinking for themselves.
- You won't always have time to train someone prior to performing a task. You need some pre-trained people.

Exhibit 20: Top-five Benefits Expected From JITT If Used in the Future

Please rank the top-five benefits you would expect from JITT if used in the future. (*1=highest benefit, 5=lowest benefit*)	Average Importance
Increased cost-effectiveness of training investment	2.4
Improved quality of work	2.5
Improved productivity	2.8
Skill upgrade for new/unique work	3.0
Lower cost of labor	3.2
Competitive advantage	3.2
Less rework	3.3
Increased morale on the project	3.3
Easier to find the needed workers for the project	3.7
Attract/retain employees	3.8

Exhibit 21: Comments and examples where JITT has been used successfully for HVAC/Sheet Metal companies

- BIM/CADD training when implementing new software, safety, and operator training provided by rental equipment vendors; installation and startup training for new equipment technologies.
- CAD, BIM, supervisor training, Trimble training, new shop and field tools equipment, lean procedures.
- Confined space, fall protection.
- Installation of variable refrigerant systems; we used JITT to train our service employees.
- Internal use of Trimble unit.
- Jobs running smoothly and actually making a profit.
- Material purchasing and reduction of stored materials on-site.

- Mostly office personnel, showing what is needed prior to a project and getting the task correct and timely. This has also worked with shop laborers.
- Need more computer skills.
- New product implementation.
- New skills or materials.
- Pre-task planning is JITT. The men in the shop or on the job review the tasks and best practices they have planned for that shift. When a new tool is introduced on a project, it usually includes some type of training.
- Train workers on unusual equipment where it is not cost-effective to train all employees at one time.
- Training in the use of fabrication of rigid board ductwork. New systems and products in our industry.
- Training users of Trimble point location.
- Utilized an outside training consultant for welding just prior to performing the project. It sharpened the skilled and brought up the less skilled quickly with a focus on the actual work to be performed. It was extremely successful.
- We built a medical clinic for a client that used Lean practices all the way through design, mock-ups and construction. We utilized more extensive prefabrication than we ever had before and saw good benefit. All the subcontractors had to participate as a condition of hire.
- We were able to train sheet metal workers with no tab experience to perform limited repetitive tab tasks.
- We've used it most successfully when training for work that is new to our people.
- When choosing someone to learn a new skill by identifying his or her strengths and weaknesses through past performance, you tend to get people who are more capable, confident and willing to learn a particular skill. These results in better buy-in from the employee, improved quality, less rework, and better attitudes throughout the shop and office.

Exhibit 22: Which of the Following Metrics Does Your Company Use to Evaluate the Differences of the Training You Provide?

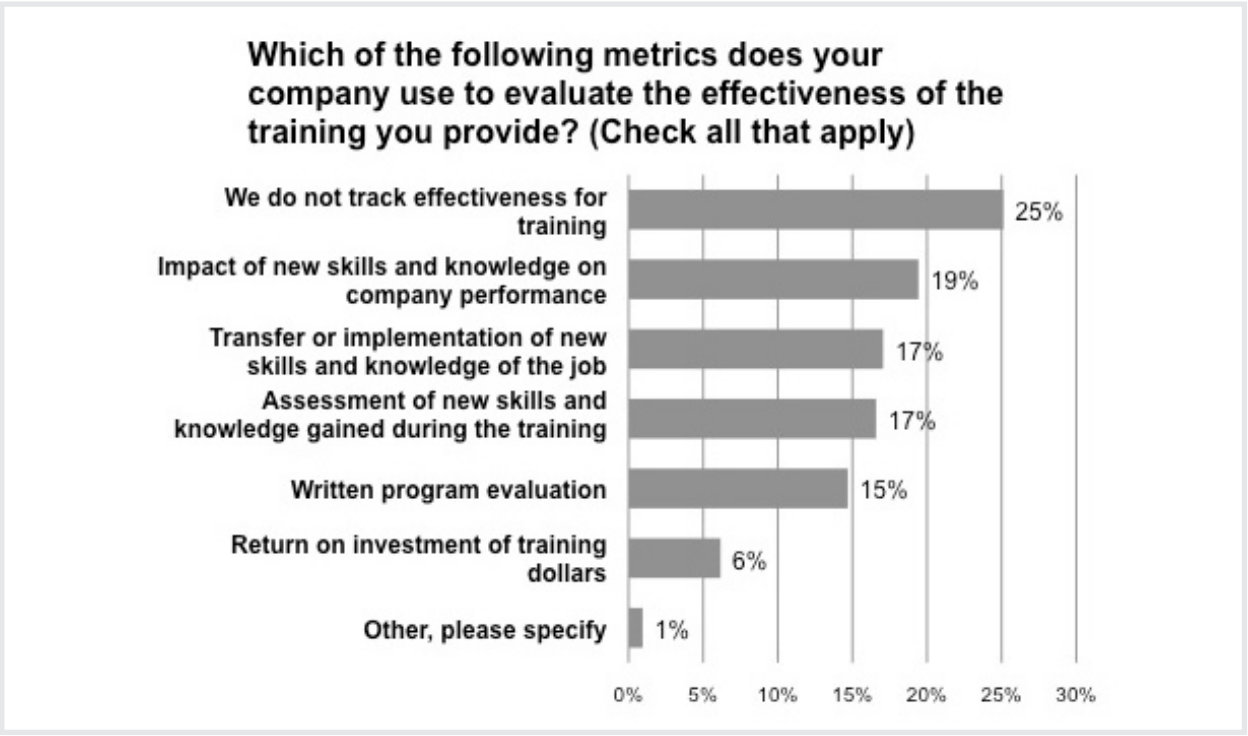


Exhibit 23: What Type of Performance Evaluations Do Your Employees Receive?

4 APPENDIX 2

Sample: Staff Training Needs Assessment Form

Staff Training Resource Requirements			
Today's date:		Training Needs:	
Form Completed by: (name)		Time Frame /Status:	
Customer Name:			
Project:		Job #:	
Location:			
Contractor:			
Training Needs Assessment			
aining Needs Assesment for Project /Ta			
Training/Skill Description:			
Existing training module or program t complete (note "Special" if this program requires a new program to b used.) :			
Timeline			Comments
# of Personnel Needing Training:			
Date Training/Skill Required:			
Training Delivery Method/Source:			
Training Program Dates:			
Training Completed Date:			
Training Completion Verified by:			
Notes (e.g., New equipment, new personnel or markets)			

Staff and Training Resource Requirements			
Today's date:	10/8/2013	**Training Needs:**	Change order pricing
Form Completed by: (name	Tester	Time Frame /Status:	8 days for training starting ASAP
Customer Name:	N/A		
Project:		Job #:	Internal training
Location:	HQ		
Contractor:	Our Company, Internal		
Training Needs Assessment			
aining Needs Assesment for Project /Ta	Change order pricing		
Training/Skill Description	Requires basic competencies in estimating, software, takeoff skills and summary estimate prep.		
Existing training module or program t complete (note "Special" if this program requires a new program to b used.) :	Training with department personnel to familiarize new trainee with system		
Timeline			Comments
# of Personnel Needing Training:	1		Jerry Smith: new employee
Date Training/Skill Required:			
Training Delivery Method/Source:	Internal department managers		
Training Program Dates:	10/09/13		
Training Completed Date:			
Training Completion Verified by:			
Notes (e.g. New equipment, new personnel or markets)	New estimating trainee		