

Ekaterina Nironen

Improvement of Study and Production Processes at Digital Printing Laboratory

Helsinki Metropolia University of Applied Sciences

Bachelor of Engineering

Degree Programme in Media Engineering

Thesis

7 November 2016

Author(s) Title Number of Pages Date	Ekaterina Nironen Improvement of study and production processes at digital printing laboratory 37 pages 7 November 2016
Degree	Bachelor of Engineering
Degree Programme	Media Engineering
Specialisation option	Printing Technology
Instructor(s)	Toni Spännäri, Senior Lecturer
<p>The aim of the thesis is reorganizing the working process at Digipaino printing laboratory because of a new form of work added. The new form is the workshops where the students are able to print their small-run and special jobs themselves with the help of video instructions and two volunteers.</p> <p>To test the demand for the project and gather the range of necessary changes, the workshops were launched “as is” first. It was proven that such form of work is on demand, but improvements are necessary to make the work process smoother.</p> <p>Basic information concerning services, prices, and common technical requirements was placed at Digipaino Wiki space. A template for advertising and instructional messages coming from Digipaino was created.</p> <p>A set of video instructions was made. It turned out especially useful as the lab trainee has to handle the workshops alone. The volunteers for this task are absent due to the changed study schedule of printing technology students.</p> <p>Concerning further development, more advertising using school’s video screens and social networks can be done as the word of mouth was proved to be the least efficient way of advertising. Also, the set of videos can be expanded later.</p>	
Keywords	on-the-job training, instructions, instructional videos, lean, digital printing

Contents

1	Introduction	1
2	Work Training in Lean Manufacturing Environment	3
2.1	Principles of Adult Learning	3
2.2	Characteristics of an Effective Work Training	6
2.3	Lean Principles	8
2.4	An Effective Lean Training Session	9
2.5	An Effective Lean Work Instruction	11
2.6	Potential Difficulties of a Work Training Session	14
2.7	How to Evaluate Training Results	16
3	Situation at Digital Printing Lab at Metropolia UAS	17
3.1	Current Situation with Workshops at Digipaino	17
3.2	Improvement of Workshop Organization Process at Digipaino	18
3.2.1	Information About Workshops and Their Advertising	19
3.2.2	Working Hours	21
3.2.3	Production Time	22
3.2.4	Technical Requirements	23
3.2.5	Prices	25
3.2.6	Print Runs	27
3.2.7	Equipment Problems	28
3.3	Production of Video Instructions	29
4	Discussion	32
5	Conclusion	34
	References	36

1 Introduction

Working processes at Digipaino Printing Laboratory of Metropolia University of Applied Sciences need reorganizing due to the changing roles of staff. As Digipaino is a university printing house, most of its customers are university staff and students. Before the students did not have direct access to printing equipment except during printing courses; the trainee was handling all the printing orders. The main change is that the students are going to print their small-run and special jobs themselves at certain days of the week. In addition to the trainee, there are going to be two trained student volunteers, who will help with the use of equipment and materials.

The main aim of the changes is to continue the improvement of the production process at Digipaino towards lean production. After the implementation of this scheme the lab engineer and the trainee will have more time for larger customer orders, and the senior lecturer will be able to concentrate on his work, while the students can have their jobs printed and at the same time learn how to use the equipment. This will support both roles of Digipaino, a university printing house and a laboratory.

Using printing equipment is quite a demanding task, as it requires either special knowledge or very careful following of the instructions. These two help to keep the machines in working condition, avoid waste of supplies and time, and ensure working safety. As only a small part of the students are taking printing courses, the main focus should be made on proper instruction, providing the manuals, and careful observation of those who use the machines. Instruction and observation are provided by the trained students.

Regarding written/recorded manuals, at the moment there is only trainee orientation checklist. So, there is need for additional manuals which multiple persons can access and use easily, letting the lab engineer and the senior lecturer do their work. Also, because of this change, smaller tools storage system has to be reorganized to a clearer and more understandable one.

The above said requires creation of the manuals and training the first group of students. The already existing thesis on improvement of production processes in

Digipaino of spring 2014 can be used as one of the information sources and the base for the detailed analysis of the situation.

Video instructions on how to use the machines and two trained student volunteers, who can work further helping the students with their printing jobs, will be the result of this thesis work.

2 Work Training in Lean Manufacturing Environment

I hear, I forget;
I see, I remember;
I do, I understand.

Chinese proverb

2.1 Principles of Adult Learning

Conscious learning process starts from childhood, from the very basic activities such as experiencing the world around, counting, reading, and acquiring common knowledge. Learning process is lifelong, and it includes both new everyday life activities (how is a new mobile application or a new kitchen appliance used?) and work procedures. However, sometimes researchers consider child and adult learning to be completely different processes due to psychological and social reasons.

For instance, Malcolm S. Knowles, a famous researcher of adult learning principles, features two different models of adult and child learning, andragogical and pedagogical respectively [1, 8-9]. The main principle of andragogical model is described as self-direction ability of adult learners, or taking responsibility for their learning process and being proactive during their training [1, 9].

Also, the researcher states that adults' diverse experiences greatly impact learning too, allowing the individual be rationally critical towards what is taught, acting as a source of learning for other group members, and being a hindrance to new ways of thinking and acting due to the power of habit. He considers experience a sustainable part of an adult's "self-identity" where new knowledge and skills have to integrate. [1, 10-11]

Next, according to Knowles' work, adult learners are motivated mostly by external factors, such as life or work situation which requires performing of certain new types of tasks. Such motivation is easily withdrawn by changes in life circumstances. [1, 11]

Moreover, adults are very practically oriented in their learning; in other words, they intend to apply their new knowledge and skills immediately [1, 11; 2, 14]. Children in the pedagogical model learn the information which they might use in a distant future [2, 14].

Robert W. Lucas, an expert in creative training, describes similar traits of adult and child education. According to him, “an individual’s age, prior experience, motivation to learn, and intelligence” are important factors which impact learning [2, 12]. He considers motivation to be external for children, and internal for adults. Grades are less important for adults than the skills which they obtain during the training. Adults want to apply knowledge immediately. Adults look at the leader as a co-participant expert voice, while children expect direct instruction from the teacher. Children are evaluated by the instructor, while adult learners share the evaluation with the instructor. [2, 14]

The two approaches have much in common, and are mostly based on the experience the person has gained and psychological maturity of the personality. They both agree that teaching adults mostly practical skills and children mostly information is natural as there are more areas which are completely uncommon to the latter [1, 8; 2, 14]. However, Malcolm S. Knowles considers both models possible for use with the learners of any age dependent on the content of learning and learners’ motivation [1, 12-13]. Robert W. Lucas splits two educational models completely based on the learner’s age. According to him, motivation towards learning and proactivity during the learning process depends on the age only. He considers frontal instruction to be the preferable method for educating children, and for adults he suggests using various content-based workshops and trainings. [2, 14]

Researcher of adult learning Mark Tennant strongly disagrees with the age-only approach to the choice of educational model. For example, he states that independency and self-direction in learning is more defined by its content and purpose than by the age of a learner. Of course, the content should be age-appropriate. For example, adults work with controversial and abstract concepts in a better way, while for children these concepts should be simplified into definite answers and illustrative examples. However, the main researcher’s point is that adult learning is not always “problem-focused”, and child learning is not always “subject-focused”. It again depends on the learning content, and it is the content that defines the form of teaching. [3]

Moreover, both external and internal motivation may equally stimulate children and adults in their learning. According to the researcher, the internal need for learning in children exists not only because of biological development, but also because of the necessity to fulfill certain social roles just the same way as adults. In turn, adults’ brain also has a certain biological need to build new neural connections in order to stay

“alert” and develop. This way both groups have the same grounds for two types of motivation. [3]

My point of view on teaching methods and motivation is closer to the age-independent one. First, different types of motivation can be presented in any age group, dependent on whether the content is interesting for the learner. For instance, at a preschool crafts lesson one can meet an internally motivated 6-year-old trying to make the best greeting card for his mother. Most probably, at that moment the child is not thinking “Now I want to develop my spatial perception as well as drawing and fine motor skills”. Instead they focus on the thing which is being done to make parents happy. As another example, an adult employee may be externally motivated by his boss sending him to a job training, after which the employee will be rewarded with a salary raise or another bonus. The content of the training might be secondary in this case. In other words, both children and adults may be motivated both externally and internally. The type of motivation depends on the content of the training and its personal value for the trainee.

However, the experience part differs significantly between adults and children. Adults come to workshops and trainings having various backgrounds and experiences. Requiring knowledge and skills in one field, they might be experts in another one. They bring their experiences into the learning process, and base their current opinions on them [4].

Next, children are future adults, so they naturally learn not only pure information, but also age-appropriate skills. No learning exists for the sake of learning itself [3]. People learn how to speak to be able to communicate with others, they learn how to read and write to be able to operate written information and produce it. Certain professions (such as professional sports) require serious involvement from early childhood, thus children start learning real skills and just continue their training becoming adults. Many practical things children learn are used immediately, and they are learnt not through frontal instruction but by the “training” required to acquire the skills.

More than that, with the development of technology the role of frontal instruction has significantly dropped, and other teaching skills have become a more important thing even at secondary school. Theoretical frontal instruction very often creates a gap between life and education. It can be appropriate for fundamental issues, but even fundamental issues nowadays can be learnt with the help of other methods, such as vide-

os, edutainment etc. On the other hand, adults sometimes need expert instruction (for instance, first orientation or where to find further information) which is easily done in a form of lecture. So, frontal instruction has not yet completely disappeared, but its role in education is constantly decreasing.

All in all, adult and child education are not dramatically different by motivation or form. The difference is in the content, further application of knowledge and skills, the level of responsibility, and potential consequences of failures. Application of knowledge obtained at school quite seldom involves responsibility to other people. Grades for a school internal test or mistakes in doing things lead to negative consequences for the learner only or a limited amount of people in their inner circle. After on-the-job training people are often supposed to act within complicated processes as well as be responsible for themselves, other workers, materials, and equipment. Failures in a work process may lead to serious financial consequences, breaks in production, waste of materials, damage of equipment, loss of customer trust, and breaks in complementary working processes etc.

The instructor's goal at a job training is to make learners qualified for certain types of work tasks. The instructor should provide proper material and timing for the training, and motivate participants. Also, the instructor has to make the participants' attitude serious enough if it has not been so before, at the same time treating them in a respectful collaborative way. [4]

In order to build an effective training it is important to focus both on the content and on the teaching approach. If both of them are thoroughly prepared, after the training the trainees will have the set of skills necessary to solve the problem they came with. The next chapter is focused on the aspects which make the training effective for learners.

2.2 Characteristics of an Effective Work Training

As discussed in the previous chapter, knowing of theory is never equal to its application. To transform knowledge to work one must practice exactly the process which is aimed to be learnt.

However, people process information and turn it to action in many different ways. Among other researchers Robert W. Lucas divides learners into auditory, kinesthetic, and visual ones by their “preferred learning modality” [2, 15]. As it follows from the name, auditory learners learn best from what they hear, and they can expand their understanding in conversations. Voice (tone and pitch), loudness, and clear articulation are important to them. [2, 16] Visual learners learn best from what they see, be it pictures, schemes, or videos. Color and light are important to them as well as body language, gestures, and face expressions. [2, 19-20] Kinesthetic, or tactile, learners learn best from actions, for example, demonstrations, tries, and taking notes. These are the people who walk around the room and think at the same time. [2, 20-21]

Also, Robert W. Lucas states that most people have one main learning modality and another secondary one [2, 15]. For example, a person can be a visual learner with a secondary kinesthetic modality. This way, visual instructions supported by doing the actual thing at the same time will bring the best result for this learner.

Thus, a training session should be organized in a way that trainees with different preferred learning modalities would find a suitable way of processing the material. During a live training the instructor should provide the learners with all the available opportunities to use their preferred learning modality: say things aloud, provide additional visual guides, demonstrate the actual process with materials and equipment, and let the learners try the process themselves. Concerning recorded instructions, videos are the ones closest to the criteria, as participants can see the teacher, hear the instructions, and do the thing taught at the same time.

Moreover, different types of memory are involved in different stages of learning process. Sensory memory is responsible for processing all the sensory signals present during the training, such as light and temperature in the room, instructor’s tone and pitch of the voice, bright color of the instructor’s t-shirt etc. Working memory is short-term memory which is in action during the training. It is processing the information either on the way to move it to long-term memory or to forget. Long-term memory is the place where information is moved after training for long-term storage if it is considered important enough. If all of memory types are actively and purposefully used in the learning process, the learning outcome is more successful. [5]

The previous statements on learning channel diversity are confirmed by several research works. The main conclusion is that the combination of seeing, hearing, and doing the task is the most efficient way to learn practical skills. For example, Kiyoshi Suzuki writes that if the training participant can “hear, see, and practice” the process at the same time, 90% of the information stays in long-term memory, and transforms into skills (versus 10% for “hear only” and 20% for “see only”) [6, 39].

The same teaching approaches are compared in the article written at the Institute of Production Engineering and Automation in Wroclaw. Their research demonstrates 90% efficiency for “practiced” tasks (the least effective way is “read” – 10%; however, “seen and heard” together receive quite a high score of 70%). [7, 21] Robert W. Lucas states that people remember “90% of what they see, hear, say, and do” while pure doing without instructor’s comments gains only 60% of efficiency [2, 35].

The common place in all three research works is that the more types of learning are involved, the easier the information is acquired, absorbed, kept in long-term memory, and transformed into skills. However, is important not to overload the training and choose proper information, with the main accent on the content and not on the form [8]. One of proven ways of separating necessary from the unnecessary is lean management approach, and the next chapter is focused on lean principles and tools in more detail.

2.3 Lean Principles

Lean production is based on creating value for the customer at each step of the working process. The value for the customer is something essential in the product that they want to have, and are ready to pay for. Anything in the working process that does not create value for the customer is considered to be waste and is eliminated from the workflow. [9] Examples of waste are waiting, or waste of time in the working process; defects or rework; motion, or unnecessary worker’s moving around production area [10].

The working process is analyzed and changed using a number of tools. Lean management tools are a way of making the problems visible and solving them. For example, Jidoka concept, or immediate stop of work in case of a problem and fixing it imme-

diately results in quality implied at each production step. 5S tool (sort, straighten, shine, standardize, sustain) helps organize the tools and production environment in an optimal way. Using these and other tools, the organization is exposed to Kaizen, or continuous improvement which leads to decrease in costs and increases customer satisfaction. [11]

Lean can be applied not only to a manufacturing environment, but also to any organization or process, as first of all it is the way of thinking. Lean management in organization is focused on what the customer really wants, and how to achieve it with minimal expense while sustaining quality. [12] The next chapter defines the “customer” in a job training situation, and the observation how an efficient on-the-job training can be built with the help of lean concepts is presented.

2.4 An Effective Lean Training Session

In case of on-the-job training, there are two “customers”. The first one is the trainee who obtains new skills; another one is the manager who fulfills certain organizational needs through trainee education. Anything which does not contribute to achievement of these aims is waste which should be excluded from training programs and work instructions [8].

Three types of memory have been discussed in the previous chapter. Acting lean for sensory memory would be removing all the distraction and irritation from the training space, such as improperly working equipment or loud noise. Instead the learner’s sensory attention should be drawn to the key elements of the training. [5] For example, if it is a training on how to print a poster, the design of this poster should be attractive and distinctive. This way the trainee might want to create a similar one and print it out, it will be fixed in the sensory memory, and the steps will be remembered better.

A strong learning objective, or what the trainees will be able to do after completion of the training, significantly improves the use of working memory [8]. The whole process, examples, materials, and so on, should support this ultimate goal. The material should be divided into small parts in order not to overload the trainees with information. The pieces should be simple and clear, and each lesson should include active participation of the learners where it is possible. Also, anything which does not have to be memo-

alized should be included in the training aids. [5] Linking to previous material and experiences helps systematizing the new material and storing the information in the long-term memory.

Also, hands-on exercises and working on actual products significantly help remember the new information. According to lean trainer Marek Piatkowski, Participation is the final non-avoidable step of lean learning process (the first two are Explanation and Demonstration) [13]. Hands-on practice transforms knowledge into skills faster, as the trainee is able to see the actual work stages and steps, and the potential difficulties of making a real product. It also demonstrates the level of the trainees, and the instructor is able to determine whether they need further training. [5]

Proper timing of the training is also important. Just-in-time training is the training which is done right before it is needed [4]. This is reasonable, because people forget procedures and details which are not used. Moreover, as lean implies continuous improvement, the process may have been changed since the accomplishment of the early training.

To provide the optimal amount of the material the trainer can do the value-stream mapping. In other words, the trainer can draw a flowchart with all the parts of the topic the trainee should know, and check if there are too many or too few of them. The same procedure may be taken for each training piece. [8] This way the training/instruction may be restricted to 4 to 7 pieces which the brain is able to keep in the short-term memory [5].

The long-term goal of the training should be remembered as well. The goal of training for the manager is not only the direct end result itself. [8] When the product has been manufactured, the end result is checked, faults are found, and the process is analyzed in order to determine what should be improved in its next iteration. Then next time better quality can be achieved, because the process itself implies better quality too. [14, 124] The analysis is done together with the worker, and the power of “spoken word” is strong there. The specialists who do the work can sometimes act as instructors [13]. This sounds logical, as the one who is doing the work, knows the details of the process the best. Such improvements are especially visible in case of multi-step processes, when the quality of the next step depends on the previous one. There are many of such

in printing production, where the product goes through prepress, printing, and finishing, where each stage may consist each of many sub-steps.

Moreover, everyone involved in the process is trained at the production line, even if the work task is management. This provides deeper knowledge of the process. Another reason for it is that the environment is changing continuously, and to be effective any worker, including management, should have good practical knowledge of processes and materials. [13] Otherwise the managers might not know what they are actually managing.

Responsibility of the lean instructor is high when defining the training and methods. Toyota Production System, where lean comes from, has a motto: If the Worker hasn't learned, the Instructor hasn't taught. [13] This way the instructor is more careful in choosing the method and more result-focused.

Altogether, lean learning is all about only the necessary material, stress on hands-on practice, and immediate application of the knowledge. Marek Piatkowski has found a metaphor of a "military camp – I will teach you a small task, and when you have learnt it, I will teach you another one". He finds this approach suitable for adults, who learn best by building new experiences on existing knowledge and skills, and not school style of training with theory and exams only. [13]

2.5 An Effective Lean Work Instruction

A way of educating employees without organizing a specific training would be a work instruction. Unlike a job training, an instruction is always in place, and ideally it is a quick way to solve a problem or obtain the necessary knowledge. In practice different outcomes are possible. Often manuals are created and composed in a way that the operator stops reading them before the necessary point is found. There is one main problem: too much information which is poorly organized. Certain lean ways of working with instructions are reviewed in this section.

One of the leading companies in documentation software, Dozuki, sticks to lean principles in its work. Their technical documentation guide states that first of all "the best work instructions make complex processes feel simple—even when they really aren't".

Dozuki derives from IFixIt, a company practicing repair work of the devices and providing instructions to people who want to repair things on their own. [15] This means that they have vast experience in both writing and using manuals, so the extracts from their expert advice are reviewed below.

First of all, to write an instruction a person needs understanding of the process. This means that typically an engineer will create a better working instruction than a pure technical writer. [15] This is even a norm in lean society. If this is an instruction for the machine, an input from the manufacturer is desirable [16].

For simplicity complex processes are divided into a number of elementary steps. Despite simplicity, the instructions have to be very specific to ensure clear understanding and safety of the process. Especially in dangerous points the instruction should not only name the action, but describe the whole flow of the process one point after another. For example, instead of saying “remove the blade from the cutter” the writer should say which part is held, which side is pulled, and so on. Otherwise the user is under the risk of cutting their fingers. [15]

Easy-to-use instructions are short and written in simple language understandable for target users. No undefined words such as “quite”, “somewhat”, “sort of” can be present, wording has to be precise. The writer knows who their potential audience are. The text should sound natural when addressing them and the manuals should not be too complicated for their level of knowledge. [15]

Adding pictures where necessary helps to avoid potential mistakes. A camera with sufficient resolution and a tripod are important to provide details and avoid blurriness. The process should be in the center of the frame. Close-ups are working provided a bigger orientation picture is present. Hands are a powerful demonstration tool, but the action should not be covered with them. Usually the pictures should be edited, and markups have to be added to draw the attention to certain parts. [15] In my opinion, which is based on what I have studied at video courses in Metropolia, the same rules apply to video instructions.

Videos work even more efficiently than photographs as they give a feeling of real practical training with a teacher. But they should contain only essential information and be as short as possible (30 seconds per step is the maximum, even a 3 second video may

work if the correct moment is chosen). It makes searching through videos easier. Videos supported with written instructions or subtitles work better, as they give instructions both with text and picture. However, voice instructions can be omitted because they significantly complicate translation process. Placing faces in the video has to be avoided either, because they do not add valuable information, and might create additional difficulties if there is an update or an extension long time after the original video has been created. Videos are hard to print out, so “purposeful” preview images may help in this case. [15]

The users should be instructed not only how to properly use the equipment, but also what the potential risk and dangers are. As users often only look through the instructions without reading them carefully, these points should be complemented with eye-catching warning symbols. [15]

According to Dozuki, a functional work instruction never has a final version. It is constantly changing by its users. Testing of a finished instruction is required. In this case it means teaching and watching the learners using the instruction. If the end result is as expected, the instruction is well-created. Also, a professional instruction can be given to an amateur. This tests the clarity. Gathering feedback on the instructions is a necessary thing. Users can tell where the instructions or pictures are unclear and need improvement. The creator should ask for feedback directly. [15]

The main goal of Dozuki is documenting standardized work, or in other words, best practices. Following these, in turn, leads to stable quality. Such instructions also serve as an educational tool. [15]

Marek Piatkowski mentions the reasons for such recommendations, and his reasoning is very similar to Dozuki. According to him, work instructions help define three main parameters of standardized work: takt time, working sequence, and standard in-process inventory. In other words, the user can estimate how much time the process would take, what are the stages, and what is the proper outcome at each stage. [13]

Standardized Work Sheet is a document which acts as a guideline for the trainee in his/her tries. If the process is standardized, together with the process the trainee learns the right way of using tools, equipment, and materials. All these allow learning not only how to do the job, but also the small “secrets” of how to get the best results. [13] How-

ever, knowing the best practices does not mean there is no more room for improvement.

Following the standardized work procedures reduces production waste, both material and non-material. If the work is done according to standard procedures, there is less risk that someone would “invent” new work techniques out of incompetency and would waste time, spoil materials, and finally re-work.

Also, work instructions are used to find production problems, detect equipment errors, and ensure working safety. If the procedures are followed, and the outcome is not as expected, the work instruction is the starting point to analyze where the problem comes from. Instructions are not a set of strict rules, but an orientation point to identify problems. In this context the difference between the standard and the actual state of things is considered a problem. [13]

On the one hand, a lean work instruction is as short as possible and very clear. On the other hand, it does not let one “skip” the steps of work process. Some of the steps be considered unimportant and unnecessary, but in reality they can be critical moments in speed, quality, and safety of production. It reminds of the famous “the devil is in details”, because one small error pulls another change in the process, and this way the process is constantly losing quality by its end. Finally such way of working may even lead to a satisfactory result, but the effort and resources spent to get the result might be unreasonably high. Lean work instruction is created to avoid this form of waste, and to educate new employees the best existing practices from the very beginning.

2.6 Potential Difficulties of a Work Training Session

If you do not have time to do it right,
when do you have time to do it over?

John Wooden

In a perfect world the training is going according to its pre-planned scenario. However, my 4 years of full-time teaching experience have demonstrated that in reality difficulties may arise at any stage of the training. Organizational problems such as coming late, absence, and inattention are common at different levels of education, and every trainer

has its best practices on handling these, but they are not a subject for this thesis. Instead problems specifically related to job trainings are discussed in this chapter.

When adults are at a work training situation, they “get back to school” in a certain way; but if they are really treated like school children, it creates a conflict between their adult identity and the action they are participating in. To avoid this problem Malcom S. Knowles suggests organizing an orientation session before actual training [1, 17-18]. Thus, the adults would know the bigger picture of what they are learning, connect it to their previous experience, and be able to decide whether they need it or not. In the learning process adults should be treated with respect. The trainer acts more as an expert voice and gives relevant feedback demonstrating the pluses and minuses of the end result [5].

As it was previously discussed, standardized work plays a big role in lean management. Not every trainee is eager to follow the work instructions step by step, they might think they can do it faster or find another, more effective way. The role of the trainer is to explain why work is done in a certain way. This way they ensure that the process is followed through, as the worker understands the logic behind it. For example, a forklift driver has to carry one box of material to the production line ten times instead of taking a pile of ten boxes once. He does not understand why it is done this way. The trainer’s task in this case is either to give a simple explanation what is the trainee’s contribution to the working process (it creates more manufacturing space for conveyor workers), or to set non-breakable rules as a last resort. [13]

However, it does not mean that the rules cannot be changed with time. Standardized work means best existing practices, and if the trainee creates a better practice and can reason it, new rules can come.

A “learning contract” in some form is suggested. This means that the learner receives all the information and provides informed consent afterwards. Then instead of the learner’s personality the trainer may address the “contract” as a ground for interaction between two adults. [1, 18-19]

The difference is that children are taught how to behave. Adults know what correct behavior is, and reminders may hurt their “adult” identity, so the focus is on the subject and on the process instead of forming of other adults’ personality.

2.7 How to Evaluate Training Results

Lean management is focused on continuous improvement, which means small changes happening all the time. So, training data has to be continuously collected and analyzed in order to improve future training sessions.

First, evaluation can be based on trainees' objective and subjective feedback. Subjective feedback is received through surveys demonstrating "trainee reaction", or the feelings and thoughts straight after the training. "Trainee learning" means tests after the training is complete. Objective knowledge and skills are measured with these tests. "Training job performance" data is gathered through on-the-job observations before and after training [5]. On the base of all three components the teacher measures the effectiveness of the training for the trainees.

Another way of evaluation is Minimum Viable Product (MVP). It allows experimenting and learning together with the customer using a minimal amount of resources. [14, 80-81] Such a product can be produced during the training and then the final result and the process can be compared to their previous versions. This demonstrates how useful the training is for the final "customer", or the trainee.

One Metric That Matters (OMTM) can be used for measuring the effectiveness from the perspective of the enterprise and its management. OMTM answers the most vital question about the product (for example, how much waiting time has been reduced) and determines if the process is progressing, the reasons which caused the progress, and the way the enterprise is improving. [14, 82] OMTM gives the manager criteria according to which they estimate if lean management has been practiced efficiently.

Simple field testing is done to evaluate the work instructions. The users are asked to follow the instructions, and if they are able to get a proper end product, the instruction has fulfilled its task. [15]

All in all, the part which is meant to be improved first has to be evaluated first. The main evaluation method is chosen based on the initial development goal. Be it educating the trainees, process improvement, or anything else, in lean management they are all connected together. This means that when one thing is improved, the whole process automatically improves together with it.

3 Situation at Digital Printing Lab at Metropolia UAS

3.1 Current Situation with Workshops at Digipaino

Digipaino, or digital printing laboratory at Metropolia UAS, is a small-scale printing house, whose main customers are students and staff of Metropolia. Products for coursework and events at the UAS as well as individual orders are printed there. Digipaino is not a commercial printing house, that is why it is not advertised anywhere. Students know about it through the courses or the word of mouth, a few outside customers have come there through someone related to Metropolia.

Furthermore, printing technology students use the lab for their studies. So, many students got acquainted with the lab through printing courses. However, recent changes in media field led to a reorganization of the curriculum, and the old Media Engineering department was shut down. The education of graphic engineers ended at that time, and the focus shifted to digital media. It became a part of ICT studies as a major.

The sticker informing about working hours for students' individual jobs was on the main entrance door of the lab. Since the sticker had been removed at the time of major equipment update, and until February 2016, there was no other information about this option except the word of mouth.

To sum it up, not many students were coming to the lab to print their small-run and special jobs anymore. For instance, in January and February 2016 only 5 students printing their individual jobs visited the lab within a 7 week period.

Thus, one of the main aims of this work is to inform the students who need prints for their individual study projects, hobbies, or personal use, about such an option available at Metropolia UAS. For example, graphic design students can be encouraged to print their illustration and/or photography portfolios. Healthcare students, who need large-format posters for their individual coursework, could also use the lab for this purpose. Also, students from any other departments and startups at Metropolia can print their business cards or any other materials at Digipaino.

In order to offer not only a service, but also make it a part of study process for those who are interested, this work was launched in a form of a workshop where students

could participate in making their own products. To test the demand for the project and to gather the range of necessary changes and manuals, the workshops were launched “as is”, without taking any additional action first. From February to May 9 sessions altogether were held. The sessions were taking place on Fridays 10-14, when most other production tasks of the week are already done.

It was discovered during the sessions that different kinds of products are on demand. The figures below show how many times a certain type of products was printed at workshops:

- photographs – 6 times
- business cards, large-format posters, hardcover books – 4 times for each product type
- banners, small-format posters, flyers, postcards, invitations, booklets – 2 times for each product type
- stickers, textile transfer prints – 1 time for each product type.

Except printing on-the-spot, the students came to see which product types are available and what the prices are. Some of these enquiries later turned into regular orders. For example, students printed exhibition photographs, posters, and sticker labels this way.

All in all, the above said demonstrates that in general there is demand for individual printed products among students. When they were informed that such a working format is available, they started using it. However, there is a number of improvements in the working process which could be made. They are described in the next section as a set of problems and measures already taken or possible solutions.

3.2 Improvement of Workshop Organization Process at Digipaino

Problems arising during workshop hours can be divided into two parts – communication problems and technical problems. The first happen due to lack of standardization and its clear presentation to students (such as absence of a single price list and only “ap-

proximate” price conceptions). The latter is service breaks due to technical problems (for example, clogged nozzles on an inkjet machine).

3.2.1 Information About Workshops and Their Advertising

At first workshop days at Digipaino were advertised using only the word of mouth among fellow students in Leppävaara, and it was not a very successful approach, as it attracted altogether only 10 students in 8 weeks. Moreover, such a method made it impossible to involve students from other campuses of Metropolia. So, another information channels had to be used. Tuubi announcement was written and placed on Tuubi system by the senior lecturer. Although it stayed on the main page for only 3 hours, the progress was immediately noticeable at the next session. 5 students came to print their jobs (compared to 1-2 at the sessions before); except that, there came students to ask for information and see the products available at Digipaino.

In addition to Tuubi announcement, the sign stating the walk-in hours was placed on the main entrance door. It would help visitors know about the service. Furthermore, an informational poster was designed to send to other campuses.



Figure 1. The door sign on the main entrance door.

Also, the possibility of using the screens in the entrance hall was discussed. All this would inform students about the availability of the service, both offline and online.

Another side of this question is that students non-related to printing do not know what Digipaino is. During workshop sessions there came comments that the students did not know the lab existed at all, or they did not know it was a part of Metropolia UAS. Digipaino does not have its own website. The lab is mentioned on the website as a part of Valovirta unit, which combines design, audiovisual work, digital media, and print. The information included there is very general (e-mail, location, and it is mentioned that different products can be printed using different materials, without any detail or example). Also, Digipaino is mentioned on Metropolian IT-wiki, but there are no details either except that posters and other special products can be printed there. This means that, basically, that the students can find out more about the lab only by coming there, but it is not always possible, if the lab engineer and the trainee are busy with the orders which came by e-mail or were just pre-planned at the time of visit.

So, the information about what Digipaino is and when it can be visited, should be presented more clearly online too. It was decided to use internal Wiki pages for common factual information, as they are easily accessible by students and staff of Metropolia, and at the same time they require login credentials, so this information cannot be valued as advertising. So, the common information about the lab was placed on the first page of Digipaino workspace in Wiki. It describes Digipaino, its working hours, and location. Also there are links to more detailed information on printing, such as price list and instructions on how to correctly prepare the files for printing. To make the information more accessible, the link to this page was placed onto the door sign as a quick-response code with a "Read more about the services" comment.

[Pages](#)

Digipaino

Created by Petri Sillmää, last modified by Ekaterina Nironen on 18.10.2016

Welcome to Digipaino, the printing laboratory at Helsinki Metropolia UAS. Here we study printing technology and print your stuff for student-friendly prices.

Working hours

Walk-ins on Fridays 10-14

Then you can get information and help from our trainees as well as make certain printed products by yourself. Workshops are aimed at individual students and staff members of Metropolia.

Questions and orders at other time: digipaino@metropolia.fi

Take a look at work process and results on Instagram: [@digipaino](#)

Location

Metropolia Leppävaara
Vanha Maantie 6
02650 Espoo

More info about printing your work

[Services and prices](#)

[How to prepare your files for printing](#)

Figure 2. General information about Digipaino on Metropolia Wiki space.

3.2.2 Working Hours

The next area to improve is working hours and production time issue. Within the experiment time there were 7 unexpected walk-ins from students. The reason could be that workshops were mainly advertised verbally, and for a certain time there was no sign clearly stating the working hours on the door or anywhere else. When such unexpected walk-ins happened, the jobs were printed on the spot if there was no hurry in the lab. If production or other working tasks were going on, then the student had to wait until the “official” workshop time. In both cases, the students were informed about the actual working hours, and a business card with the e-mail where orders could be placed outside the workshop hours was given to them as a temporary measure.



Figure 3. Metropolian Digipaino business cards.

The door sign clearly stating walk-in hours and the contact e-mail has decreased unexpected walk-ins, customer dissatisfaction if the service was not available immediately, and production stoppages happening due to such walk-ins.

3.2.3 Production Time

The next issue, connected to the previous one, is unrealistic expectations concerning production time. Five out of seven unexpected walk-ins have had the “urgent” label (for example, the students wanted to print booklets and business cards for a meeting starting in three hours, or a poster for the course presentation in 20 minutes). If a single A2 poster can be printed within 20 minutes provided the file is correct, the equipment is not busy and already on standby-mode, more complicated products need more time to produce.

For example, hardcover book production includes such separate but consequential steps as printing the cover and the inner sheets, cutting both of them and the inner board, laminating the cover, assembling the cover, and finally binding the book. This means that a mistake at the beginning or in the middle of production process influences

the rest of it, and leads to new mistakes, some of which are unlikely to be adjustable. A mistake in cover measurements which has been seen only when the cover is assembled together with its cardboard parts and inner pages means that the production goes back to prepress stage (or making adjustments to the InDesign file), then the cover has to be printed, laminated, cut, and assembled again. As the trainee is not always able to immediately find the mistake in the file due to lack of experience, rework is common, and adds to production time. Production time may not be known to the students who are not related to printing, but they have to be informed before the printing has started, so that they could make a decision if they have time to wait or will find another solution.

3.2.4 Technical Requirements

Another issue was the absence of clear explicit technical requirements, such as file format, scale, adding bleed area and crop marks. They were delivered to the customer verbally or by e-mail, but not presented anywhere else. Such requirements as bleeds and crop marks are not in the area of common knowledge, and it is not obvious that they are necessary for a proper output. Missing bleed area and crop marks create problems at the finishing stage, which increase waiting time and in some cases may even lead to rework.

To decrease the amount of faulty files and possible rework for this reason, the list of essential technical requirements was placed on Wiki. Technical concepts of bleed area and crop marks are explained and illustrated in a separate article.

How to prepare your files for printing

Created by Ekaterina Nironen, last modified on 19.10.2016

General requirements

- PDF file format
- scale 1:1
- image resolution >200 dpi
- bleed (3-5 mm) and crop marks

Product-specific information

Business cards

Standard size 50x90 mm

Vinyl stickers and textile transfer prints

Printed + cut

- .AI (Adobe Illustrator file) format
- 2 layers: bottom layer for artwork (your picture/vector art), upper layer for cutting lines. The color of cutting lines should be clearly visible on the artwork layer.

Figure 4. General and product-specific technical requirements.

The absence of clear technical requirements and correction in the files for printing on the spot are against the lean principle of doing it right the first time. They create the waste of waiting and sometimes defects, if the incorrect files were not spotted on time.

Also, some of the critical tacit knowledge which is collected at Digipaino on a day-to-day basis existed only in a verbal form, although they are not obvious. For instance, for successful textile transfer prints it is necessary to put two baking sheets and a piece of transparent film in between on top of heat transfer images. It is not mentioned in any manual, and is only a result of trial-and-error daily practice at Digipaino. To make sure the students have successful prints the picture of the whole set-up should be presented near the machine. It helps avoid three stages of rework which consists of printing, drying, and cutting the transfer print.

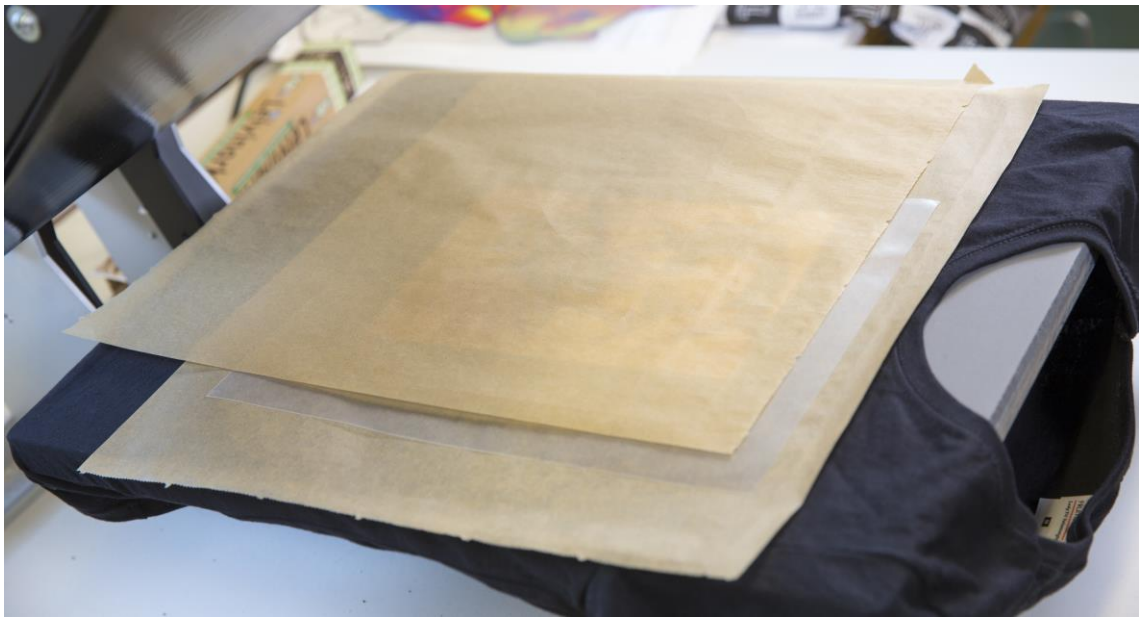


Figure 5. T-shirt transfer print set-up.

When the t-shirt is printed according to the correct set-up scheme, the customer is likely to be satisfied with the result of this first and only attempt. The ink does not come off from the transfer print, and there is no need for printing, cutting, and pressing again. There is no need for another t-shirt either. This means that the waste of defects is excluded. The customer is more likely to return the next time, and the lab saves itself materials, which is lean as it means maximizing the quality with the minimal possible resources spent.

Certain parts of daily working process seem obvious to the workers at Digipaino, but in fact they do not belong to common knowledge. For example, one of them is how to send the files to the job queue on RICOH C7100X from Mac workstations. Although it is a simple procedure, and after explaining how to use Command Workstation 5 the workshop participants could do it by themselves, it still had to be explained to every new coming person separately. That is why it has become the first of the list of video instructions – any printing on RICOH C7100X starts with it, including popular business cards, flyers, and posters. Using a video instruction instead of repetitive explanations would save time for other tasks.

3.2.5 Prices

Prices at Digipaino are mostly determined individually, product-based, and there is an obvious lack of at least approximate prices for certain products. The old price list includes different-sized sheets printed on RICOH C7100X, and business cards from all the range of products. Customers are coming to make products, and not separate sheets. The price list states that the prices do not include finishing except for trimming. It raises questions if folding, creasing, or any other finishing option is necessary, as there is no clear price list for that.

Metropolia/Digipaino hinnasto 1.2.2010

Hinnat voimassa toistaiseksi.

Hinnat eivät sisällä jälkikäsitteilyä, lukuun ottamatta puhtaaksileikkuuta. Puhtaaksileikattavat A4/A3-tuotteet painetaan SRA-koossa.

Kysy tarjousta muiden tuotteiden ja määrien kohdalla.

Sisäiset hinnat (Metropolian osastot, työntekijät ja oppilaat):

Sisäinen värillinen	e/arkki	e/arkki	e/arkki	e/arkki	e/arkki	e/arkki
Colotech 100 - 160 g/m ²	A4 4/0	A4 4/4	A3 4/0	A3 4/4	SRA3 4/0	SRA3 4/4
1 - 9	0,25	0,50	0,50	0,75	0,60	0,85
10 - 100	0,24	0,48	0,48	0,71	0,57	0,81

Sisäinen värillinen	e/arkki	e/arkki	e/arkki	e/arkki	e/arkki	e/arkki
Colotech 200 - 280 g/m ²	A4 4/0	A4 4/4	A3 4/0	A3 4/4	SRA3 4/0	SRA3 4/4
1 - 9	0,40	0,60	0,60	0,85	0,75	1,00
10 - 100	0,36	0,57	0,57	0,81	0,71	0,95

Sisäinen mustavalkoinen	e/arkki	e/arkki	e/arkki	e/arkki
Business 80 g/m ²	A4 1/0	A4 1/1	A3 1/0	A3 1/1
1 - 9	0,10	0,18	0,18	0,36
10 - 100	0,07	0,15	0,15	0,18

Erikoistuotteet:

Käyntikortit	100 kpl	200 kpl	Colotech+ 300 g/m ² , 50 x 90 mm
	15	25	painovalmis aineisto (PDF, TIFF, JPG)

Ulkoiset hinnat:

Ulkoinen värillinen	e/arkki	e/arkki	e/arkki	e/arkki	e/arkki	e/arkki
Colotech 100 - 160 g/m ²	A4 4/0	A4 4/4	A3 4/0	A3 4/4	SRA3 4/0	SRA3 4/4
1 - 9	0,40	0,75	0,75	1,10	0,95	1,30
10 - 100	0,36	0,68	0,68	0,99	0,86	1,17

Ulkoinen värillinen	e/arkki	e/arkki	e/arkki	e/arkki	e/arkki	e/arkki
Colotech 200 - 280 g/m ²	A4 4/0	A4 4/4	A3 4/0	A3 4/4	SRA3 4/0	SRA3 4/4
1 - 9	0,55	0,90	0,90	1,30	1,10	1,45
10 - 100	0,49	0,81	0,81	1,17	0,99	1,31

Ulkoinen mustavalkoinen	e/arkki	e/arkki	e/arkki	e/arkki
Business 80 g/m ²	A4 1/0	A4 1/1	A3 1/0	A3 1/1
1 - 9	0,15	0,25	0,25	0,50
10 - 100	0,11	0,22	0,22	0,27

Erikoistuotteet:

Käyntikortit	100 kpl	200 kpl	Colotech+ 300 g/m ² , 50 x 90 mm
	22	34	painovalmis aineisto (PDF, TIFF, JPG)

Handwritten note on a yellow sticky note:
A2 6,-
A1 12,-
A0 24,-
Tarra 25,-/m²

Figure 6. The old price list at Digipaino.

The inkjet print prices are presented for Epson Stylus Pro 4900, which prints mainly photographs. There is also the price for basic A2, A1, and A0 large-format posters, and for a square meter of basic vinyl on a Post-It note. Other prices for Epson GS6000 prints are not stated. This means that at least textile transfer prints and banners are absent on the price list.

A new price list including the full range of products was created. It states the price per product or minimal batch of products. The price for the materials has been set in meters instead of square meters in order to avoid situations when not the whole width of

material is used, and the price is questionable due to that (such as a long but narrow banner which cannot be imposed horizontally and leaves a lot of white space on the sides).

Services and prices

Created by Ekaterina Nironen, last modified on 3.10.2016

All the prices are valid for Metropolia students and staff. Prices do not include finishing (except final trimming).

Product	Material	Price
Vinyl stickers	Avery MPI 2004 basic vinyl, width 60 cm	25 €/m
	Avery MPI 2006 hi-tack vinyl (stronger glue), width 60 cm	? €/m
	Avery MPI 3601 thick vinyl, width 60 cm	? €/m
	Colored vinyl for cutting (black, red, green, blue), width 60 cm	10 €/m
Transfer prints on textiles (t-shirts, tote bags etc.)	Easy Apply, width 50 cm (cut only)	28 €/m
	Easy Apply, width 50 cm (printed + cut)	? €/m
	T-shirt	? €
Banners	Coala Frontlit 510 g/m ² PVC, width 160 cm	30 €/m
Business cards Min. order 50 items	Colotech 300 g/m ² uncoated paper	15€ /50 cards
		25€ /100 cards
Flyers Min. order 50 items	Edixion 140 g/m ² uncoated paper	6€ /50 flyers A6 (single-sided)
		8€ /50 flyers A6 (double-sided)
Posters	Edixion 140 g/m ² uncoated paper	15€ /50 posters A4
	Lumisilk 150 g/m ² matte paper	30€ /50 posters A3
Large-format posters (size A2-A0)	180 g/m ² uncoated presentation paper	A2 - 6€
		A1 - 12€
		A0 - 24€
Photos	Epson Enhanced Matte 192 g/m ² photo paper, A3+	3€
	Epson Premium Luster 250 g/m ² photo paper, A3+	3€
	Epson Traditional Soft Gloss 325 g/m ² photo paper, A2	10€
	Tecco Fine Art Rag 310 g/m ² , A3+	6€
Large-format photo prints	Coala Photo Satin 190 g/m ² , width 61 cm	? €/m
	Coala Photo Matt 180 g/m ² , width 106,7 cm	? €/m
	Euromedia Art Banner 240 g/m ² , width 108,6 cm	? €/m
CD and DVD covers	Edixion 140 g/m ² uncoated paper	8€ /50 CD covers
		15€ /50 DVD covers
Postcards, invitations Min. order 50 items	Edixion 250 g/m ² uncoated paper	7€ /50 cards A6 (single-sided)
	Invercote 250 g/m ² matte/uncoated paper	9€ /50 cards A6 (double-sided)

Finishing price list

Work	Price
Folding	0,15 €/item
Saddle-stitching	0,20 €/item
Perfect binding	3-10 items: 1 €/item
	>10 items: 0,50 €/item
Wire binding	? €
Banner finishing (tape + grommets)	? €
Canvas framing	? €
Hole punching	? €
Rounded corners	? €

Standard paper sizes

A0 - 841 x 1189 mm

A1 - 594 x 841 mm

A2 - 420 x 594 mm

A3 - 297 x 420 mm

A4 - 210 x 297 mm

A5 - 148 x 210 mm

A6 - 105 x 148 mm

Figure 7. The new online price list at Digipaino.

3.2.6 Print Runs

The students who want to print their individual jobs sometimes ask for too small runs even for such a small-scale production as at Digipaino. During the workshops there came questions if it was possible to print 5 different postcards, 8 business cards, or 7 booklets. The problem is that 5 postcards or 8 business cards is a smaller amount than one untrimmed printed sheet (in a standard production at Digipaino 8 A6 postcards can be printed on a single SRA3 sheet, 10 business cards on a single A4). Each of the prints being different, both portrait and landscape, creates problems in imposition and requires changes in the file (rotation of the pages). Also, proofing does not make sense

when printing such runs, because it requires the same amount or even more paper as for the end product. The whole set-up and production process in this case requires too much effort and resources compared to the end result.

Thus, it makes sense to inform the students about minimal runs on certain products such as business cards, flyers, postcards, and booklets. The minimal amount is indicated in the price table.

3.2.7 Equipment Problems

Significant problems with the equipment occurred twice during 9 workshops. Both times it was clogged nozzles on Epson 4900 which led to stripes on prints. Once it was possible to clean the print head, although it took about 30 minutes to do it, which was extra waiting time for the customer. Another time nozzle cleaning was not successful, and the student left the lab without prints. Nozzle check and cleaning take time (one session in powerful cleaning mode lasts for 10 minutes or more, and multiple sessions are often needed). Also, now there is a permanently clogged black ink nozzle on Epson Stylus Pro 4900 which does not prevent printing photos completely, but sometimes it is visible on shadow areas.

Regular maintenance of the machines outside production hours, such as daily nozzle check and cleaning if necessary can help avoid such problems. This kind of problems cannot be predicted or eliminated in any other way, as clogged nozzles are one of the characteristics of inkjet printer operation, if the printer has not been used for more than a day.

On the one hand, the above mentioned problems were not a serious obstacle to daily production at Digipaino where orders come mostly by e-mail. The information is familiar to workers at Digipaino, at least the senior lecturer and lab engineer, or easily accessible. On the other hand, solving these issues is important for creating a more customer-friendly environment at the workshops, as the rules and requirements are explicitly presented using different information channels. They can be checked in advance instead of being verbally explained by the workers multiple times to each new customer, and presented this way they are unlikely to be taken personally. Although initially the video instructions were the main part of this work, without these adjustments the instructions would lead to questions concerning everyday practices.

Such minor adjustments rely to the lean principle of continuous improvement at a working place. Poor organization of working process (such as lack of information) decreases value for the customer and leads to waste in production. For example, without clearly stated working hours, prices, and print runs the customer has difficulties in getting the product (at least has to wait or come another time). It decreases the final value of the product for the customer which is against the ground lean principle.

The waste is excluded at certain production points, which leads to improvement of a specific process and increase of overall process quality. This way better customer satisfaction is provided.

3.3 Production of Video Instructions

As the video instructions are going to be used by students from different departments with different technical skills, the equipment chosen for instructions has to have a short set-up time, a relatively simple workflow, and be safe enough (for example, automatically moving blades and high temperatures should be excluded from the list for safety reasons). Long, multiple-step work is likely to cause errors and require a lot of help and rework, waste of time and materials. Furthermore, the most popular and simple products should be on the instructions to free the trainee's time for help with more complicated production during the workshops.

Concerning the above said, the following pieces of equipment were chosen for video. The script containing main stages for each video is presented below:

Sending files to RICOH C7100X through Command Workstation

This is a screen-recorded video. First Command Workstation 5 software is opened at one of the Mac workstations in the lab. Metropolia C7100-server is chosen, and the Mac workstation is connected to it. Then the user logs in under Operator username; there is no password. The job queue opens; the user drags and drops the files for printing into the job queue. The files are on the RIP station of RICOH C7100X.

Printing business cards on RICOH C7100X

The operations on the screen of RICOH RIP station are recorded for this instruction. The ready-made imposition template is used to simplify the workflow and make it accessible for non-printing students.

The user right-clicks the file for printing; “Impose” menu item is chosen; imposition settings window opens. “Business cards 50x90 portrait” or “Business cards 90x50 landscape” template is chosen dependent on the orientation of the file. The settings window is closed, the imposed job file (.dbp file) is saved. The user right-clicks the .dbp file, “Properties” menu item is chosen. Correct paper is chosen from the paper catalog in the “Media” tab. Then the user opens the dropdown menu. “Print and hold” option is used to send the job for printing.

Cutting business cards with UCHIDA BC-10

First, the top margin of the printed sheet is measured. Then, the sheet is put inside the tray. Top margin measurement is adjusted and saved. “Start” button is pressed. If the cards are cut properly, the whole batch can be cut.

Printing photographs on Epson Stylus Pro 4900

The file is dragged and dropped to Mirage Pro software. Then Epson Stylus Pro 4900 is chosen from the list. The correct paper (Luster or Matte) is chosen from paper catalog. Paper size is set to A3+. The photo is centered by checking “Center horizontally” checkbox. “Print” button is pressed.

Trimming photographs with KeenCut large-format cutter

The handle on the side is raised to lift the cutter bar. The photo is placed under the cutter bar and evened to make a straight cut. The handle is lowered down to hold the photo. The blade holder is pressed on the left side and pulled along the cutter surface.

As the main aim of videos is to help students make their own printed jobs, and not learn the process in the smallest detail, the videos have to be short (less than one minute long). There are no audio instructions, as it significantly complicates production process. Instead they are subtitled at the moments which may cause doubt.

Video instructions were shot with Canon EOS 5D Mark III, post-production done in Adobe Premier Pro CC. For screen recording Open Broadcaster Software (OBS) is used. The instructions are published on Youtube, and placed into Metropolia Wiki page.

To make the instructions as clear as possible close-up shooting is used; there are only hands in the frame, which excludes unnecessary distraction and makes possible adjustments easier.

Having the video instructions at the lab ensures proper timing and motivation for the training of students. First, the students apply the video material into practice immediately, which is in accordance with just-in-time training principle. Also, the participation in the workshops is voluntary, the students want to have the products they are producing (sometimes opposite to the lab hours), and so they have enough motivation for a better end result.

Different learning modalities are used for the learning process – visual in the videos, kinesthetic in the making of the products. Auditory learning is possible through the interaction with the trainee if necessary. In accordance with the lean training the videos are short enough (up to 30 seconds), and contain 4 to 7 working steps each. There is a clear training goal for each video; the students know what they will be able to do after following the instruction.

Feedback can be gathered on the basis of the video instruction. It is quite easy to evaluate if the instruction is functional: if the result comes as expected, the video training has been efficient. However, due to existing time limits the testing of the videos is yet to be done. The only data available so far is that the same steps were used at explanations during the workshops and laboratory works, in general leading to the expected results.

4 Discussion

As it was stated at the beginning, the project has both educational and management purposes. A set of video instructions and an educated group of students who could volunteer at Digipaino during workshops were supposed to be the main results of the project.

A set of video instructions was created; the equipment was chosen in accordance with the easiness and straightforwardness of the workflow as well as its safety. The instructions comply with lean training principles. For example, they are kept short enough, each of them contains 4 to 7 essential production steps, and each video is aimed at a clear final outcome. This means that they should serve as an efficient material for training at the workshops at Digipaino.

However, there has been a problem finding the students eager to volunteer during the workshops. It is quite obvious that they have to be printing technology students, so that they could use this volunteering experience as a part of their studies and maybe as a basis for further internship at Digipaino. After the curriculum was changed, printing technology students studying in Finnish have intensive courses every day 10-16, and Media Engineering department in English was shut down. So, there were no volunteers in the lab at the time of the experiment.

Thus, the changes at the laboratory had to be directed at making the lab engineer's and the trainee's work easier during the workshops. This means that if there are no volunteers at the moment, the lab should be made more accessible to the workshop participants, so that they could anyway find the necessary information and be able to print simple jobs on their own. First, basic information such as services, prices, and common technical requirements were placed at Digipaino Wiki space. Second, a template for messages coming from Digipaino was created. It serves two aims: instruction and advertising. At the moment the template has been used as a door sign, a template for instructions on the wall, and a poster sent to other campuses in advertising purposes. Third, the set of videos published at the Wiki space ensures that the students are able to learn how to print simple products by themselves. These three parts listed above form the first version of a student guide to Digipaino.

Concerning further development, more advertising using online and offline channels can be done. The word of mouth turned out to be not a very efficient means of advertising; except for posters, video screens at the main hall of Leppävaara could be used; also, the products made at workshops could be photographed, and the pictures could be placed to Wiki or, for example, Instagram account, to provide examples of work which can be done at the workshops. Also, the set of videos can be enlarged with, for example, large-format poster printing. This can increase the existing demand for this work format.

5 Conclusion

The aim of this thesis work was returning and improving the practice of printing students' small-run and special jobs at Digipaino, digital printing lab at Metropolia. The students were supposed to print certain jobs by themselves with the necessary guidance from the trainee instead of only receiving service and waiting for their jobs to be printed. The aim was achieved through reorganizing a part of current working processes, and production of supporting materials for the workshops.

During the experiment workshops it was proven that such work form is on demand, as the students ask to print individual products such as photographs, business cards, posters etc., but improvements are needed to make the work process smoother. The information about the lab itself and workshops, working hours, technical requirements, production time, prices and minimal runs had to be presented explicitly to the students. In addition, for the students to be actually able to print simple products the instructions on how to use the machines had to be produced.

With the help of videos and supporting materials during workshops the trainee has more time for help with more complicated jobs, allowing the students check general information and making simple products by their own using supporting materials – videos and instructions. It turned out especially useful as no volunteers are found at the moment, and the trainee has to handle the workshops alone.

Supporting materials significantly reduce the amount of waiting time and rework at the lab during workshops. These changes rely to lean principles of creating more value to the customer, waste elimination from the production process, and continuous improvement of production environment.

The production of video instructions, which was the initial plan for the work, made sense only after general information was presented explicitly through short articles and wall signs. Thus, instead of a batch of video instructions only, there was done a set of supporting materials, including information template, informational and instructional articles, and videos.

Due to existing time limits the videos are yet to be tested and improved if necessary. Along with further presenting of workshops through different information channels at Metropolia, testing and improving video instructions form a future job perspective.

References

- 1 Knowles Malcolm S. and associates. *Andragogy in action. Applying modern principles of adult learning.* San Francisco, the USA; 1985.
- 2 Lucas Robert W. *The creative training idea book. Inspired tips and techniques for engaging and effective learning.* New York, the USA; 2003.
- 3 Tennant Mark. An evaluation of Knowles' theory of adult learning [online]. *International journal of lifelong education* 5-2, 113-122; 1986. URL: <http://www.tandfonline.com/doi/abs/10.1080/0260137860050203>. Accessed 7 November 2016.
- 4 Dalto Jeffrey. Putting adult learning principles to work [online]. *Convergence Training*; 25 September 2012. URL: <http://blog.convergencetraining.com/putting-adult-learning-principles-to-work>. Accessed 7 November 2016.
- 5 Dalto Jeff. Applying lean manufacturing principles to job training [online]. *Industry Week*; 17 June 2015. URL: <http://www.industryweek.com/lean-six-sigma/applying-lean-manufacturing-principles-job-training>. Accessed 7 November 2016.
- 6 Suzaki Kiyoshi. *The new shop floor management. Empowering people for continuous improvement.* New York, the USA; 1993.
- 7 Bartosz Misiurek, Tomasz Koch. Teaching formula of the training for operators on effective application of lean management tools. *Management and production engineering review*, 5-1, 21-27; March 2014.
- 8 Dalto Jeffrey. Applying lean value stream mapping to training [online]. *Convergence Training*; 2 June 2015. URL: <http://blog.convergencetraining.com/applying-lean-value-stream-mapping-to-training>. Accessed 7 November 2016.
- 9 Lean manufacturing introduction. *Lean manufacturing and operations management* [online]. 2009. URL: <http://www.leanmanufacture.net/>. Accessed 7 November 2016.
- 10 T Earley. 7 wastes of lean manufacturing [online]. *Lean manufacturing tools*. URL: <http://leanmanufacturingtools.org/77/the-seven-wastes-7-mudas/>. Accessed 7 November 2016.
- 11 T Earley. What is lean. *Lean manufacturing definition* [online]. *Lean manufacturing tools*. URL: <http://leanmanufacturingtools.org/34/lean-manufacturing-definition-2/>. Accessed 7 November 2016.
- 12 T Earley. Lean Thinking. *Lean Principles* [online]. *Lean manufacturing tools*. URL: <http://leanmanufacturingtools.org/39/lean-thinking-lean-principles/>. Accessed 7 November 2016.
- 13 Piatkowski Marek. Training recommendations for implementing lean manufacturing [online]. *TWI network*; 2016. URL:

- <http://twinetwork.com/files/upload/articles/Training%20Recommendations%20for%20Implementing%20Lean%20-%20Marek%20Piatkowski.pdf>. Accessed 7 November 2016.
- 14 Humble Jez, Molesky Joan, O'Reilly Barry. Lean Enterprise: How High Performance Organizations Innovate at Scale. Sebastopol, the USA; 2014.
 - 15 Wiens Kyle, Bluff Julia. Tech writing handbook [online]. Dozuki; 2016. URL: https://d1ulmnr4d4i8j4.cloudfront.net/static/pdfs/dozuki/dozuki_tech_writing_handbook.pdf. Accessed 7 November 2016.
 - 16 Standard operating template and writing. Lean manufacturing and operations management [online]. 2009. URL: <http://www.leanmanufacture.net/leanterms/soptemplate.aspx>. Accessed 7 November 2016.
 - 17 T Earley. Seven wastes of service. Customer perception [online]. Lean manufacturing tools. URL: <http://leanmanufacturingtools.org/81/seven-wastes-of-service-customer-perceptio/>. Accessed 7 November 2016.