Integrating Companies in a Sustainable Apprenticeship System

Project 2017-1-DE02-KA202-004174

Intellectual Output 3

Train-the-Trainer Manual

Stitching

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Version: Final

Erasmus+

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1. Introduction

1.1. Aims of the ICSAS Project

The aims of the Erasmus+ project «Integrating Companies in a Sustainable Apprenticeship System» are to

- induce the existing Vocational Education and Training (VET) systems to train skilled workers for footwear manufacturing in Romania and Portugal to develop towards work-based learning (WBL) and improve the sector-specific tutor training in Spain and Germany
- develop a sector qualification framework and the referencing of national qualifications of Germany, Portugal, Romania, and Spain.

1.2. Eleven Manuals to Guide In-Company Tutors

Within this project, the project consortium has committed to editing eleven manuals which are intended to prepare in-company tutors and provide support for the work-based learning phases of the apprenticeship.
The work-place specific know-how (for example in the cutting department) will be imparted by skilled workers from this department. They will take on the role of in-house workplace instructors/trainers.

- demonstrating the operations which the apprentices are supposed to learn to perform
- guiding and supervising the apprentices during their first approaches as their skills are becoming more and more advanced
- leading them towards an independent performance of the task

Furthermore, each company enrolled in work-based learning will appoint a Head of Training who is responsible for

- planning of the order of the overall training of each apprentice (how long each apprentice will be trained at each learning station and in which order)
- assessing and documenting the learning progress of each student at each learning station

The chapters of this document are not meant to replace a textbook. They are meant to provide support to the trainers to plan the work-based learning activities with the trainees. The workplace trainers are invited to gather more information from other sources.

1.3. Take Your Apprentices on a Guided Tour

Before you start the hands-on training in a specific department, please make sure that the apprentice has been given a tour of the entire company including all departments.

For example, you could start with presenting the types of products your company manufactures and their intended use, the different customer segments, the distribution channels etc. Allow the apprentices insight into the product creation and manufacturing

processes, i.e. product design, pattern making, purchasing department, production planning, and all production departments to warehouse and logistics.

Present some shoe models your company produces (as in Fig. 1). Your trainees will better understand the complexity of the product “shoe.

Fig. 1: Views of shoe parts like on this photo can be very helpful for the trainee to understand the complexity of a shoe

2. Stitching

Stitching is a complex process that allows joining two layers of material by passing through a needle and thread. The seam joining of two or more pieces is accomplished using a flexible element (thread, cord, string) that passes through the holes made by a working device (the sewing needle in the case of sewing machines for uppers). The seam maintains the integrity of the joined pieces at various stresses both in the manufacturing process and during the use of the product.

The priority in stitching is to get a durable seam. In addition to strength, the aesthetic of the seam, influenced by fashion and trends, is becoming more and more important. Changing the aspect of the stitch is possible by selecting the needle type (with different shapes of the needle blade) in correlation with the thread characteristics.

2.1. Sewing rules

Types of stitches and seams

The stitch is a loop of thread or yarn resulting from a single pass or movement of the needle in sewing. A seam is defined as a line over which two or more materials/pieces are placed over each other. Depending on how the threads are interlacing and move over and between the materials, joining them, the mechanical stitches are categorised according to ISO 4915-1991.

In the footwear manufacturing, the most usual stitches, classified according to ISO 4915-1991, are:

- locked stitch - class 300
- single thread chain stitch- class 100
- double thread chain stitch- class 400

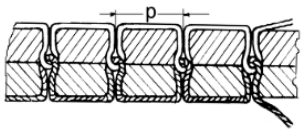
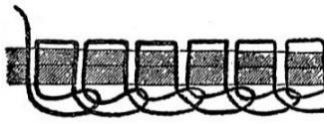
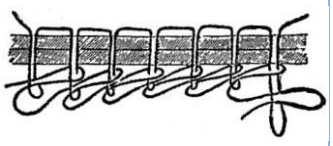
Type of stitches	Representation	Position on the material or pieces
Locked stitch This stitch is made up of two threads.	 *Source: Wikipedia*	  *Source: www.minerva-boskovice.com/887-160020*
Single thread chain stitch This stitch has only one thread which forms a chain on the underside of the material.	 *Source: Wikipedia*	 *Source: https://milohshop.com/products/waxwing-leather-noce-classic-bifold-with-chain-stitch-135*
Double thread chain stitch This stitch has two threads. The chain is formed on the underside of the material.	 *Source: Wikipedia*	 *Source: http://englishsourcery.com/M2fPTOcCuWQ.video*

Table 1: Types of stitches

The above figure shows how the upper thread and the bobbin thread are interlocked in case of an lapped stitch. The needle penetrates the material and moves down to its lowest point. The bobbin hook catches the upper thread, and carries it around the bobbin and bobbin thread. The thread is then pulled up into the material, completing the stitch.

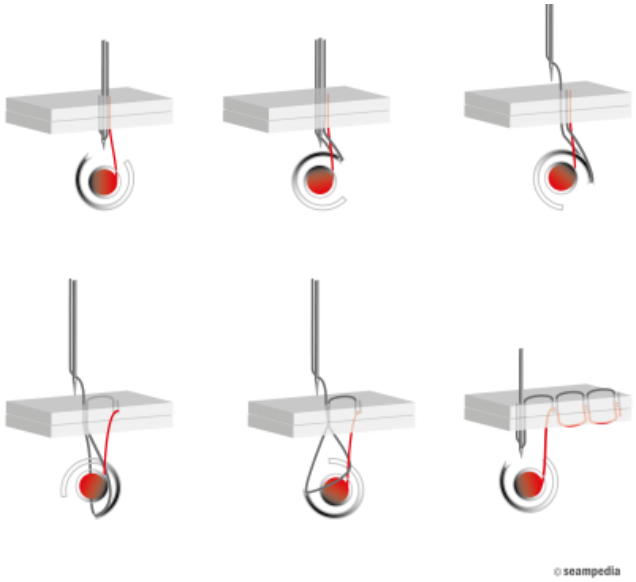
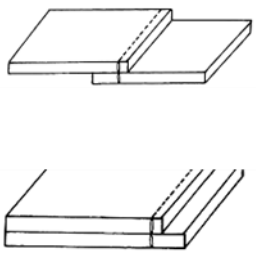


Fig. 2: How the stitch is done
Source: www.seampedia.com/en/by-the-sewing-stitch-begins-the-sewing/

The basic seams that are used for closing the uppers of the shoes are (Table 2):

- Lapped seam;
- Closed seam (180°);
- Brooklyn seam;
- Butted seam.

These types of seams require appropriate technological allowances, depending on the materials, their thickness, the number of stitches and the presence or absence of decorative elements/perforations.

Type of seams	Representation	Examples of application
Lapped seam		• joining quarter and counter, quarter and vamp, linings  *Credit photo: ISC*

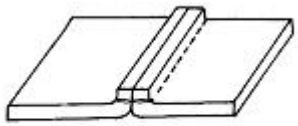
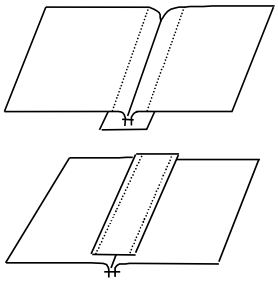
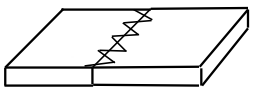
Closed seam (180 °)		• closing the quarters or counters on the back contour  *Credit photo: ISC*
Brooklyn seam (based on closed seam)		• closing the quarters or the counters on the back contour  *Credit photo: ISC*
Butted seam		• joining two pieces of the counter using the cross (zig-zag) stitch; joining pieces of lining; seam for closing an edge  *Source: www.duerkopp-adler.com/export/sites/duerkoppadler/commons/download/technology_praxis/Technologie_Praxis_shoes.pdf*

Table 2: Type of seams

Top seam refers to the stitching the topline of the shoe. This stitch has two roles:

- It fixes the lining
- It fixes the binding or folding allowance

In this case, the sewing machine may have a knife mechanism to trim away the lining allowance, namely also trimming allowance.

Fig. 3: Post bed machines with integrated direct drive for inserting lining and undertrimming; Source: www.minerva-boskovice.com/888-356020

Needles and threads

The needle is designed to perforate the leather and to transport the thread from one side of the materials to the other. The parts of a classic needle are shown in Figure 4. The main reasons why the correct selection of the needle is so important are:

- To produce a strong seam
- To obtain a good qualitative appearance of the seam.

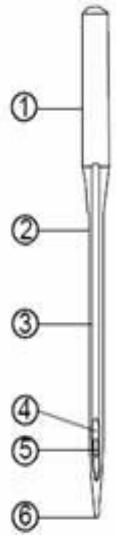


Fig. 4: Needle

1-Shank (with cone/shoulder) - is the thickest part which is inserted into the needle bar of the machine.

2- Blade – is the part that passes through material. It has two grooves (3- Long groove and 4- Short groove)

The point of the needle includes the eye (5) and the tip (6). The point penetrates the material, forming a hole for the tread to pass through.

The point of the needle has different shapes, allowing it to be used in various materials and applications (Table 3).

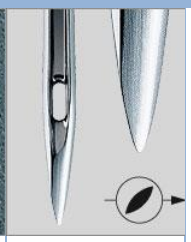
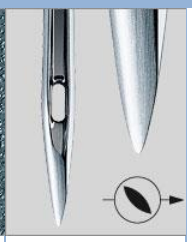
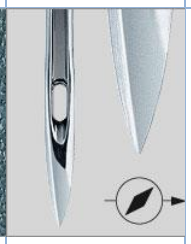
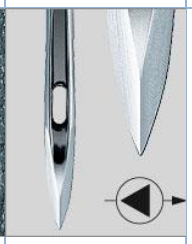
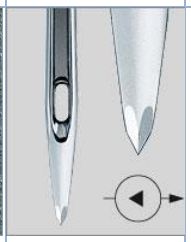
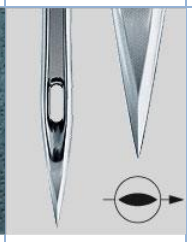
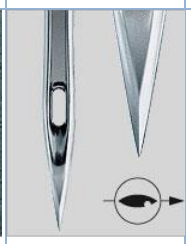
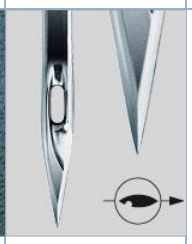
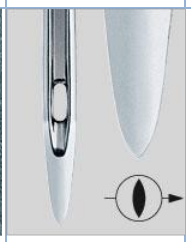
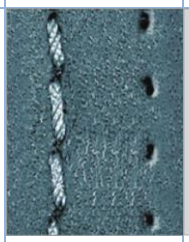
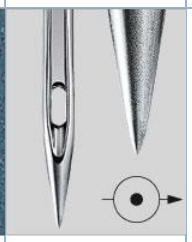
Type of needle (code)	Stitch appearance, perforation aspect	Needle point	Applications	Type of needle (code)	Stitch appearance, perforation aspect	Needle point	Applications
LR			Shoes and leather goods	LL			Bags, shoes, car upholstery
VR			Decorative stitches on thick and medium thickness leathers	DH			Belts, briefcases, heavy shoes, plastics, upholstery
SD			Footwear, fine leather goods, embroidery	P			Decorative stitches, footwear, handbags, bags, belts and upholstery
PCR			Shoes, upholstery and bags	PCL			The seam appears like the one made with P-type needles
S			Footwear, handbags, belts and accessories	R			Soft leather sewing, leather embroidery, sports shoes, clothing, car upholstery

Table 3: Needle type, needle point, and recommended applications (source: Groz-Beckert)

The quality and strength of the stitching is determined by the physical and mechanical properties of the **sewing thread** that can be twisted in S or Z. The thread quality is measured by the following parameters:

- nature of thread
- thickness
- strength
- elasticity

- resistance to abrasion
- uniformity
- contraction degree
- appearance, colour.

All the above parameters give to the thread good sewability characteristics, which may influence the sewing performance. The requirements that define the superior sewability of thread are:

- No breakages in high-speed sewing
- Smoothness and a high level of abrasion resistance to pass easily through the machine guides
- Consistent stitch formation to avoid skipped stitches
- No changes in tension during sewing

Table 4 presents the needle (thickness) and thread (fineness, composition) characteristics for different assortments of leathers.

Type of leather	Needle size		Thread size, measured in TEX*		
	mm	Symbol	Cotton	Silk	Synthetic
Goat leather, velour	0,60	60	85/3	80/3	120/3
Pressed or patent leather	0,70	70	60/3	80/3	100/3
Swine leather	0,75	75	60/3	80/3	70/3
Leathers with thickness less than 1 mm	0,80	80	60/3	80/3	70/3
Leathers with thickness more than 1 mm	0,9	90	40/3	60/3	50/3
Heavy leather	1,15	115	54/3x3	-	30/3

Table 4: Characteristics of needle and thread according to material

** Note: Tex is the most used measuring method. Tex is the weight (in grams) of 1,000 meters of thread. The higher value the Tex has, the thicker the thread is.*

Parameters of stitch

The parameters of stitch and quality requirements are shown in the Table 5.

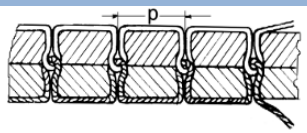
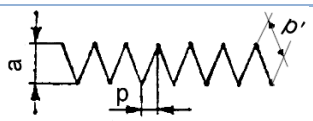
Stitch parameters	Meaning
Step	 The distance between two successive holes in the direction of the stitch
Stitch density	The number of steps per one cm of the seam length
Amplitude of stitching *(in the case of the zig-zag seam)*	 The distance measured in the transverse direction to the stitch direction
Thread tension	The thread tension is a parameter that determines the correct binding loop of thread in the middle of the joined materials
Stitching speed	The speed affects the appearance of the seam and the position of interlacing nodes. Also, it could affect the stitch steps length.
Quality requirements: • Uniformity of the stitch steps length • Parallelism of the seam lines to the edge of the parts; • Parallelism of stitch lines in case of multiple seams; • Proper selection of needle and thread, in correlation with the nature and properties of materials which combine.	

Table 5: Stitch parameters and quality requirements

Calculating the seam allowances

Technological allowances are calculated according to the following parameters: the number of stitches, the distance from the edge of the piece to the first stitch, the distance between stitches, the diameter of the decorative perforations (if any). As example, the recommended calculation of norms for the overlapping allowance is shown in Table 6.

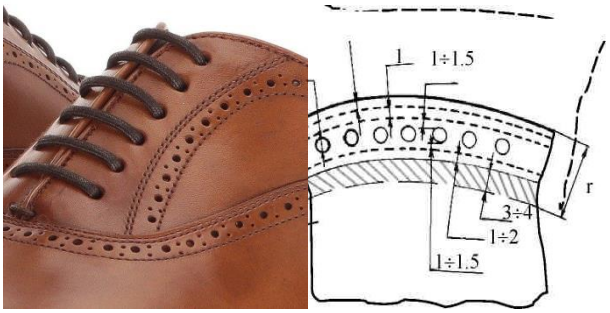
Parameter	Distance (mm)
Distance from the edge of the piece to the first stitch • Leather - **0.8÷1.5 mm** • Non leather material - **1.5÷2 mm** Distance between 2 rows of stitches • Without holes - **1÷4 mm** • With holes of diameter - ***d*+(2÷3) mm**	
Distance between the last row of stitch and the skived edge - **1÷2 mm**	 *Source: www.esquire.com/style/mens-fashion/a55401/made-in-england-shoes-british/*

Table 6: Example of calculation of allowances for the overlapping seam

2.2. Sewing machines for uppers

In the footwear sector three types of **sewing machines** are used:

- Flat bed machine - with a single needle, with 2 needles, with a single needle and trimming device, zig-zag;

Photo credit: Dürkopp Adler AG

- Post bed machine - with a single needle, with 2 needles, with a single needle and trimming device;

Photo credit: Dürkopp Adler AG

- Cylinder arm machine

Photo credit: Dürkopp Adler AG

- Automatic sewing machines develop specific operations in a complete cycle. An example of how a programmable machine operates is presented in the following video. www.youtube.com/watch?v=EoWxsm2x4h0

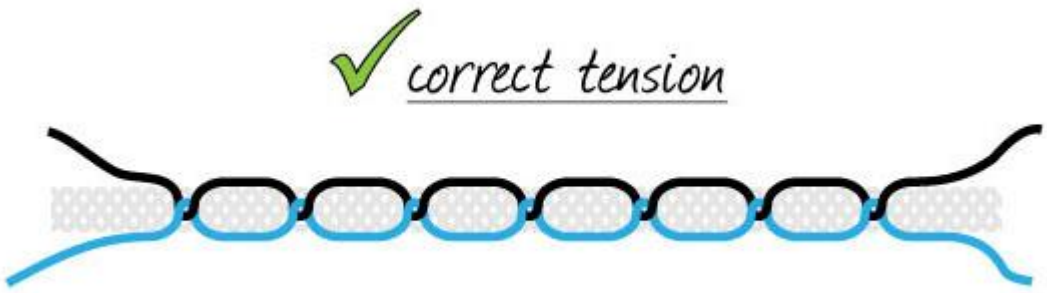
Photo credit: HighTex

Before performing any sewing operation, the machine has to be checked and properly prepared:

- Settings and adjustments to be made according to the instructions manual of the machine manufacturer.
- Threads are selected according to the technical specifications that accompany the sample.
- Needles are checked and changed, if necessary.
- Stitch length and tension of the treads are set and tested against specifications.
- Testing operations are made each time when an adjustment, change or replacement of the machine parts is necessary.

The machine operator has to identify any stitching fault that may occur due to the poor machine performance. Also, he/she has to check the sample (joined pieces) to ensure that the quality requirements are met.

2.3. Stitch and seam defects



For the normal stitch, the interlacing between upper tread and the hook tread should be positioned at the middle of the sewing joint. Table 7 presents several defects most commonly identified in stitching the uppers.

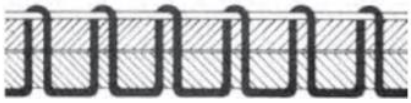
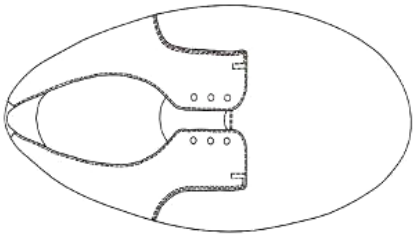
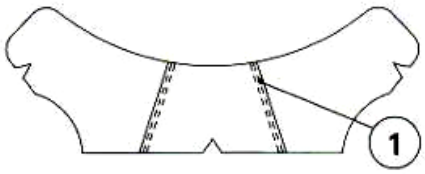
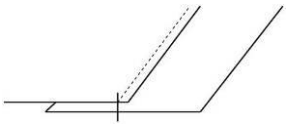
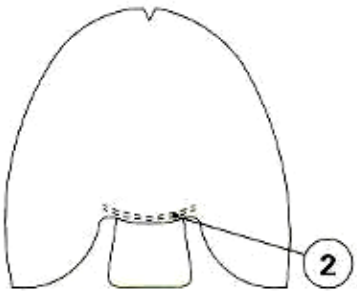
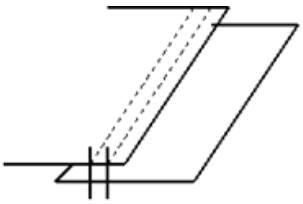
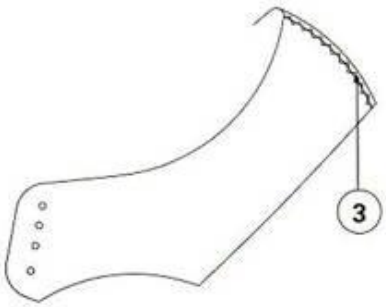
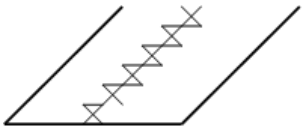
Defect		Causes and possible solutions
Skipped and loose stitches	 *Source: www.styleforum.net/threads/brogue-quality-allen-edmonds-strands.439502/ https://sewsweetness.com/2014/12/sew-faux-leather.html*	Excessively tight tension of the hook thread.  Excessively tight tension of the upper thread.  Depending on what thread is tensioned, adjustments on feeding mechanisms of the upper or hook threads are necessary.
Uneven stitching	 *Source: http://impactiva.com/uneven-stitching-case-016/*	On the top or bottom side, the irregular stitching density can be observed. This defect is caused by improper rubbing and flattening of the material.
Wavy stitching	 *Source: http://impactiva.com/wavy-stitching-case-576/*	The line stitching could be wavy because the feeding roller used is too wide.
Visible stitching holes	 *Source: http://impactiva.com/visible-stitching-holes-case-641/, http://impactiva.com/visible-needle-holes-case-224/*	The stitching holes are visible when stretching the material for upper lasting. In this cases, a reinforcement of the area is necessary. Also, the proper correlation between tread, needle and material has to be checked.

Table 7: Common stitching defects

2.4. Sequential process of stitching operations for a sample

Table 8 shows an example of the stitch operations process for the uppers parts of a Derby type shoe.

Derby Shoe		Parts: Uppers: vamp, tongue, quarters, counter Linings: vamp lining, counter lining, quarters lining

Name of operation	Stitch position on the product		Seam type
1. Joint lining parts by stitching together the counter lining and quarter lining		overlap seam, 1 stitch	
2. Stitch the vamp lining and tongue		overlap seam, 2 stitches	
3. Close the quarters on the back line		zig-zag stitch	

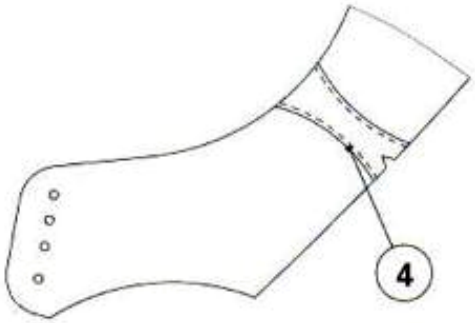
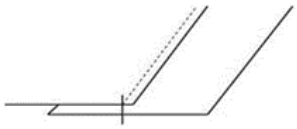
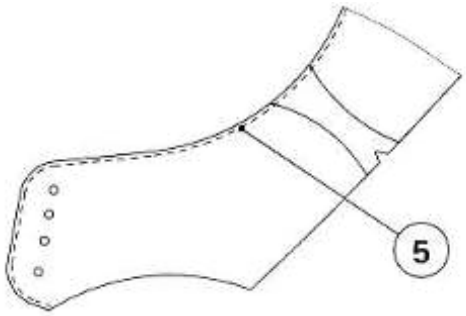
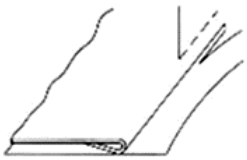
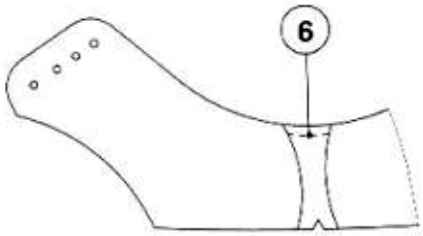
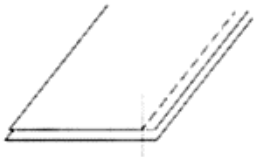
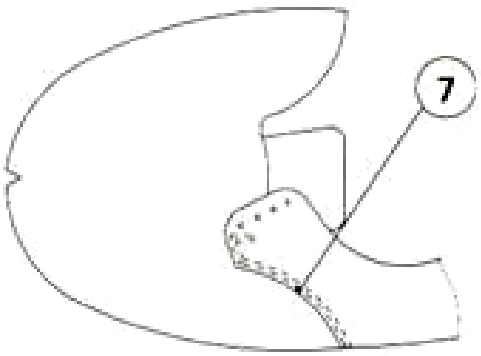
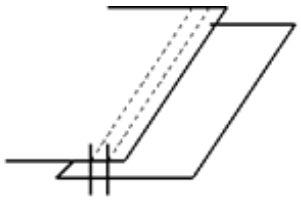
4. Stitch the back strip/counter		overlap seam, 1 stitch	
5. Stitch the quarters and the lining on top line		overlap seam, followed by cutting the lining allowances	
6. Make the reinforcement stitch at the top of the counter/back strip		overlap seam, 1 stitch	
7. Close the vamp and quarters. Make the reinforcement stitch		overlap seam, 2 stitches	

Table 8: Sequence of stitching operations for a Derby shoe

3. Assessment/ Feedback template

3.1. Introduction to feedback sheet

Unlike learning in formal environments as in classrooms or workshops, learning outcomes (LO) from work-based learning (WBL) in a learning station (LS) depend strongly on the actual equipment of the production line and the models and makes, which a shoe factory manufactures. If the shoe models produced do not require certain work tasks of a whole sphere (in stitching or assembly, for example), then it is simply not possible to acquire skills in this production line related to this method.

A systematic and transparent communication on concrete LOs acquired via WBL by a learner/apprentice between tutors, supporting the learner in the various departments, and the head of training, being responsible for the entire training programme, is of great importance in WBL.

With the intend to provide a concise and handy communication tool, we recommend using the matrices as shown below: They allow tracking the achievements of each trainee in each department in a quick and easy way. The matrices do not refer to any formal assessment; they simply state the degree of autonomy each trainee was able to reach within the given timeframe in each Sphere of Activity.

The matrices list the main work tasks (in bold) and the performance that can be acquired in each department. The work tasks refer to the acquired skills; to indicate that they include key competencies and knowledge the underlying elements for some of the work task are listed.

How to use the matrices: In order to give feedback on the learning progress of each trainee, please tick off the level of autonomy the learner has reached for each work task (choosing between needs assistance / needs instruction / needs supervision / completely independent).

If the work task in the matrix was not part of the training, you can leave it out or erase the work task; if additional work tasks were trained, please feel free to continue the list of work tasks according to your training goals.

In the end, the matrices will document what each learner has been able to acquire and which level of autonomy she/he has reached. And again, although this has already been said: Please bear in mind that you may have to adapt the matrices according to the processes and to the operations in your department.

Sphere of Activity: Stitching

Work task:	Stitching

Reading & understanding work ticket (such as: model, number of pairs, pieces, sizes, materials, technical information);

Picking the right parts to be stitched from the batch box;

Checking whether the previous stitching or pre-stitching operations have been performed correctly, such as:

- marking
- assembling by gluing
- application of reinforcements
- thread cutting
- eyeleting
- lacing
- trimming the linings
- etc.

Adjusting the stitching machine applying the safety measures;

Performing the stitching operation applying the safety measures;

Controlling own work and identifying possible defects;

Re-grouping pieces in batch box;

Asking for help if needed.

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Work task:	Other stitching operations with different stitches (e.g. chain stitch, lock stitch, zigzag) and on different machines (e.g. flatbed, post bed, cylinder arm)

[Please set up the criteria in this section in line with your evaluation needs according to the example given above]

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Final evaluation (in this department)

Stitching; including all work tasks above

Evaluation

Needs further training	Can perform all work tasks (almost) independently
☐	☐

Place, Date Signature

4. List of tables