International Labour Organization

Line balancing

Sewing room operations

Factory Improvement Toolset

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Factory Improvement Toolset

The Factory Improvement Toolset (FIT) is an innovative self-facilitated, activity-based learning approach designed by the International Labour Organization (ILO) to create more decent and sustainable employment. FIT supports manufacturers in global supply chains to improve productivity, competitiveness and working conditions by upgrading production systems and factory practices.

FIT has been developed to be a sustainable, time- and cost-efficient option for supporting factories to enhance productivity through improved business practices and working conditions. FIT focuses on areas of production improvement and actions to be taken specific to each participating factory. It can be utilized as stand-alone learning tools or to complement other training programmes.

With each module lasting no more than 2.5 hours, FIT enables factories to train personnel, whilst minimizing interference with production realities. The easy-to-use methodology makes it possible to rapidly scale the implementation to reach a large cohort of trainees across multiple production facilities.

Working in small groups, participants review real-life situations and engage in discussions to determine improvements to be made in factory without an external trainer or specialist. This self-facilitated, activity-based and highly participatory learning approach positions participants as both student and teacher and makes the toolset self-tailored to the needs and interests of each group.

About this module

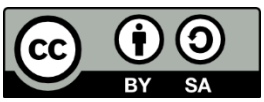
This FIT module on Line balancing is a training for garment manufacturers to improve sewing room operations. Participants will work on identifying bottlenecks and balancing the line. This module takes about 2.5 hours to complete.

Upon completion of the training, participants should have:

- Understood the purpose, meaning and importance of line balancing.
- Learnt how to identify imbalances, find bottlenecks and analyse their causes.
- Discussed how to select solutions for balancing the line based on concrete information.

The **Factory Improvement Toolset** of the **International Labour Organization (ILO)** are developed and provided by the ILO's **Enterprises Department**.

Authors: Alix Machiels, Sara Andersson, Charles Bodwell, Jayantha R. de Silva.



Guidelines for successfully using the training tool

Read out-loud

The FIT tool is designed for participants to take turns reading the instructions in the modules out loud to the group. At least one member of the group should be selected in the beginning of the session to take this responsibility.

Work as a group

Always work in groups of 5-7 during a FIT session. The programme will not be successful if participants work independently or do not collaborate with each other.

Be active

Encourage everyone in the group to actively contribute to the discussion. Ensure that no group member dominates the discussion or does not participate at all.

Monitor the time

Select one member of the group to monitor the time for each activity and remind the group when it is time to move to the next exercise.

Complete the action plan

Complete the action plan at the end of the session. This will help ensure that FIT results in improvements in the factory. Review the plan a while after the session to make sure that actions in the plan has been completed accordingly.

Icons

A set of icons is used throughout the modules to provide easy to recognize reference points for different tasks within each session and activity.

Read out loud

One member of the group should read out loud to the rest of group.

Knowledge link

Knowledge and skills are linked to other FIT learning resources and support.

Time allotted

Indicates how much time each sessions and activity should take.

Supplies needed

Indicates that supplies may be necessary to complete the session.

Begin step-by-step instructions

Indicates that the step-by-step instructions for an activity are beginning.

Think about it

Indicates additional information for the participants to think about.

Measuring your performance

Measuring operational efficiency is a key aspect of running a productive factory. The box(es) below guides you in understanding which measurement indicator(s) can be used to measure and evaluate the performance of your factory in relation to the topics covered by the FIT sewing room series.

Indicator 1	**Target achievement (%)**
Definition	The percentage of the daily production target that was achieved (that was actually sewn in terms of good production). It can be calculated separately for each line, or for all lines together. The closer to 100%, the better.
Purpose	To understand how efficiently each sewing line operates, how realistic production targets are, and begin to identify how to improve efficiency in the sewing room.
Calculation	(# pieces produced today / daily production target) x 100% Notes: The daily target should be based on the SMV, and line efficiency discounted. Target = (working hours x 60 / SMV) x line efficiency %
Frequency	Calculate daily (for each line or all lines), then calculate a monthly average.
Responsible	Sewing room manager, Line supervisors

Indicator 2	**Work-in-progress (WIP)**
Definition	The amount of pieces that have not been completed yet, and are being sewn or waiting in between two work stations. It is calculated separately for each line, or for all lines together. Very low and very high WIP are both signs that lines are not well balanced.
Purpose	To understand how efficiently your sewing lines operate and how well the lines have been balanced, and begin to identify how to better balance sewing lines and improve their efficiency.
Calculation	Total # of pieces fed to the line – Total # of pieces sewn by the line Notes: Total # of pieces fed or sewn refers to the total # of pieces fed or sewn for one specific order, in one specific line.
Frequency	Calculate daily (for each line or all lines), then calculate a monthly average.
Responsible	Sewing room manager & line supervisors

Session 1

Business case study

Goals

Preparing you for the type of discussions you will have with other group members throughout the learning module and understanding the benefits of being exposed to different perspectives.

Understanding better why line balancing is important in the factory.

Session 1

Overview

One member should read the full session out loud to the rest of group

15 minutes

Learning manual, pens, markers and poster paper

A business case study presents a real-life situation for learners to reflect on and discuss with other group members. By discussing the case, students learn from others' ideas and perspectives, and develop an understanding of the topic at hand within the workplace.

One group member reads the case study out loud

The whole group discusses the case study

Everyone develops a deeper understanding of the topic

Activities

Activity

1

15 minutes

Case study review and respond

The case study below presents a situation that could happen in real life.

Instructions:

1) As a group, listen to one member read the case study below while following along in your learning module.

Sopheak is a new sewing room manager at the HS garment factory. She finds out line supervisors do not balance the line during production to remove bottlenecks and ensure targets are met. They calculate capacity and assign operators so as to reach hourly targets, but once production starts, they do not make any changes. As a result, work-in-progress (WIP) accumulates at some stations, while other operators sit idle waiting for bundles. Operators try to work faster, the quality drops, and re-works are added to the line, so WIP levels get even higher. Production slows down because of the bottlenecks, and daily targets are rarely met.

To solve these issues, Sopheak consults with the line supervisors, then provides them with simple tips for identifying bottlenecks, then selecting solutions to balance the line based on production and WIP levels for each operation. They record this information every two hours, so the line is regularly balanced, and problems are identified as soon as possible.

Thanks to these changes, WIP doesn't pile up too much, which avoids bundle damage or loss. Hourly and daily targets are reached most of the time, and orders are shipped on time. Line supervisors also get to know their operators and their performances better.

2) Together, discuss Sopheak's situation by answering the three questions in table 1 on the next page.

Table 1. Questions about Sopheak's situation
1. What problems has Sopheak identified? What impact do these problems have on the factory and its workers?
2. What does Sopheak do or change in order to solve these problems?
3. What are the results of Sopheak's solutions for the factory and its workers?

This page has been intentionally left blank and can be used for note taking.

Session 2

Learning about the topic

Goals

Understanding what line balancing is and why it is important for productivity.

Learning how to identify imbalances and understand bottlenecks in the lines based on production and WIP levels.

Learning how to identify the best solution to remove bottlenecks, and practice line balancing effectively.

Session 2

Overview

One member should read the full session out loud to the rest of group

105 minutes

Learning manual, pens, and markers

This training module helps you improve the way your sewing room operates by focusing on line balancing. Balancing the line systematically before and during production is crucial to help you reach maximum efficiency, be more productive, and meet production targets on time. Throughout this module, you will work on the three steps below.

Identifying imbalances

Finding bottlenecks

Balancing the line

First, you will discuss what line balancing is and why it is important. Then, you will learn more about bottlenecks and how to detect them based on production and WIP levels. Finally, you will practice selecting the best solution to balance the line.

Activities

Activity
2a

20 minutes

Line balancing

To work efficiently and avoid work-in-progress piling up in between stations, a line must be **balanced**. In this activity, you will learn more about line balancing and its importance.

Instructions:

1) Have a participant read aloud the text in table 2, then discuss the three questions in the table.

2) Together, discuss: Do you balance the lines in your factory? If so, how, and who is responsible for it?

3) Together, look at the list of steps for balancing a line in table 3, then put them in the correct order by writing a number from 1 to 8 on the right. Solutions are at the bottom of the page.

Line balancing is a constant process, which begins during planning, and ends when a style order is completed. During production, line supervisors should perform line balancing every day, every hour.

Table 2. Line balancing

Balancing a line means making it more productive by removing and preventing bottlenecks and re-assigning operators so that…

- Hourly production targets are met for each operation.
- There is a similar amount of work-in-progress at each work station.

There are **3 rules** for balancing:

1. Have at least ½ hour of WIP for each operation.
2. Solve problems as soon as possible.
3. Keep every operator working at their maximum capacity.

1. What happens when hourly production targets are not met for some operations? What happens when hourly production targets are exceeded for some operations?

2. What happens when there is too much WIP piling up at one operation? What happens when there is too little WIP at one operation?

3. Why is line balancing important to ensure and increase productivity? Explain.

Table 3. Line balancing

Steps	#
Make a line sample, establish an operation sequence (breakdown).	1
Select a solution to remove the bottleneck and balance the line.	
Identify the cause of each bottleneck, taking the whole line into account.	
Carry out a time study (calculating SMV for each operation).	
During production, track hourly production and WIP levels at each station, and compare with target production and normal WIP level.	
Identify problems and bottlenecks based on your comparison.	
Set hourly production targets based on # of operators.	
Assign a # of operators to each operation based on the time study.	

In this module, you will focus on steps 5 to 8. To learn more about steps 1 to 4, ask for the “Making an operation bulletin” and “Setting new lines” modules.

Solutions: 1, 8, 7, 2, 5, 6, 4, 3.

Activity

2b

15 minutes

Identifying imbalances (1)

Line balancing is done several times every day by line supervisors. A line is **imbalanced** when production and WIP levels are not stable across all operations, which means that there is a **bottleneck** in the line. In this activity, you will learn more about imbalances.

Instructions:

1) Together, look at table 4, then decide for each sign whether it indicates that the line is imbalanced by putting a ✓ / ✗ in the column on the right. Solutions are at the bottom of the page.

2) Have a participant read aloud the text box above table 5, then discuss the two questions in table 5. Solutions are at the bottom of the page.

Table 4. Imbalanced lines

Signs	Imbalance?
1. There is a lot of WIP piling up at one or more workstation(s).	✓
2. Hourly targets are met and exceeded.	
3. There is very little or no WIP at one or more workstation(s).	
4. Hourly targets are not met.	
5. All operators complete their operation in a similar amount of time.	
6. Some operators are idle and awaiting bundles from the previous one.	
7. WIP is much lower / higher at some work stations than at others.	
8. Many operators have been assigned to one same operation.	
9. Some operators are slower than others and cannot catch up.	
10. There are not enough garments to send to the finishing room.	

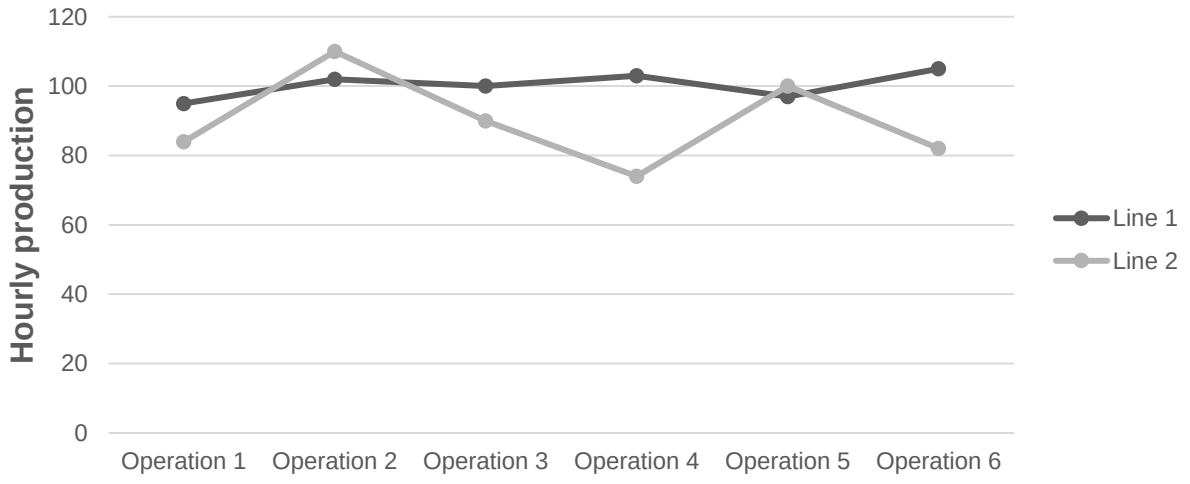
Solutions: ✓, ✗, ✓, ✓, ✗, ✓, ✓, ✗, ✓, ✗.

An **imbalance** happens when…

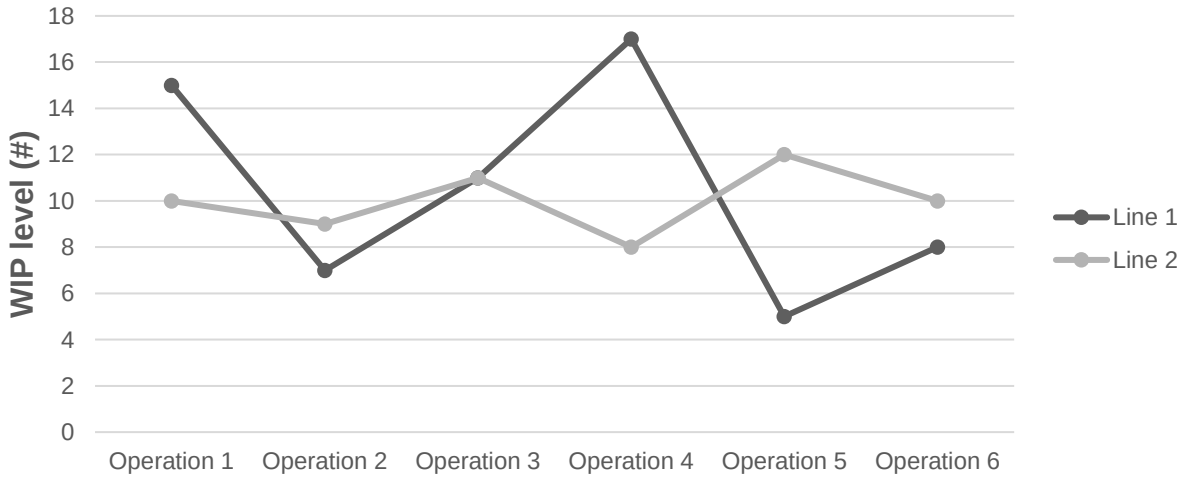
- Production is lower / higher than the target, **and / or**,
- WIP level is lower / higher than minimum / maximum WIP levels.

Table 5. Balanced or imbalanced?

1. Look at the chart below showing production for Lines 1 and 2 over the past hour. Target production is 100 pieces an hour. Which line is more balanced?



2. Look at the chart below showing WIP levels for Lines 1 and 2 over the past hour. Which line is more balanced?



Operators can help you keep track of their output and WIP hourly or bi-hourly by noting them down on a form attached to their work stations. Train your workers on filling them in, and provide them with pencils.

Solutions: 1. Line 1; 2. Line 2.

Activity

2c

25 minutes

Identifying imbalances (2)

The first step of line balancing during production is to **identify imbalances** by looking at production numbers and WIP levels for each operation. In this activity, you will learn more about how to detect them using production numbers and WIP levels.

Instructions:

1) Have a participant read aloud table 6 on WIP below and make sure everyone understands.

2) Together, discuss: In your factory…

- Do you track WIP for each line?
- Do you set a normal WIP level for each style? If so, how?

3) Together, look at the production report in table 7, and make sure everyone understands.

4) Have a participant read aloud the scenario in table 8, then discuss the three questions below. Solutions are at the bottom of the page.

Table 6. Calculating WIP

WIP for each sewing line or each station is calculated using this formula:

WIP = # garments fed (input) - # of garments sewn (output)

Example. Today, 800 pieces were fed to Line 3. There are also 20 pieces left from the day before. A total of 785 garments were sewn. WIP = 20 + 800 – 785 = 35 pieces.

The sewing room should set a **minimum** and **maximum** level of WIP per station depending on the style. It is also good to always leave one day of cut components (bundles) on the racks awaiting to be fed, to avoid sewing delays if there are any cutting room delays.

Example. Hourly target for Line 3 is 100. The line supervisor sets minimum work station WIP at 30min (50 pieces), and maximum WIP at 2 hours (200 pieces).

Table 7. Production report

Prepared by: Simran	**Date:** 20 March	**Style:** 47583	**Line:** 3	**Hourly target:** 100 pieces

#	Operation	Operator	08.00~09.00		09.00~10.00		10.00~11.00		11.00~12.00		13.00~14.00		14.00~15.00		15.00~16.00		16.00~17.00	
			Prod.	WIP	Prod.	WIP	Prod.	WIP	Prod.	WIP	Prod.	WIP	Prod.	WIP	Prod.	WIP	Prod.	WIP
1	Shoulder join	Sanjay	98	100														
2	Neck join	Rita	125	35														
3	Back neck binding	Ravi	95	160														
4	Front neck top	Mary	100	95														
5	Back neck top	Bob	102	90														
6	Sleeve hem	Lisa	93	100														
7	Sleeve join	Raj	80	155														
8	Side seam	Trang	80	40														
9	Sleeve tuck	Anjali	80	42														
10	Body hem	Khem	78	45														

Table 8. Finding imbalances

Scenario: Simran is a line supervisor for Line 3. Every hour, she records production (output) and WIP level at each work station. For style #4568, hourly target has been set at 100 pieces. Minimum WIP level is 30min (50 pieces), and maximum WIP level is 90min (150 pieces).

1. In the production report, circle outputs (Prod.) that are much higher or lower than the set hourly target. Which operations are imbalanced?

Operations: _____

2. In the production report, circle WIPs that are higher than the maximum WIP level, or lower than the minimum WIP level. Which operations are imbalanced?

Operations: _____

3. Are there currently any bottlenecks in Line 3? If so, where?

Operations: _____

Solutions: 1. Operations 2, 7, 8, 9, 10. 2. Operations 2, 3, 7, 8, 9, 10. 3. Operations: 2, 7.

Activity

2d

25 minutes

Finding bottlenecks

Once imbalances have been identified in the lines, it is important to analyse the causes of the imbalance and find the **bottleneck(s),** in order to select the best solution to balance the line. In this activity, you will practice analysing information to find bottlenecks in the line.

Instructions:

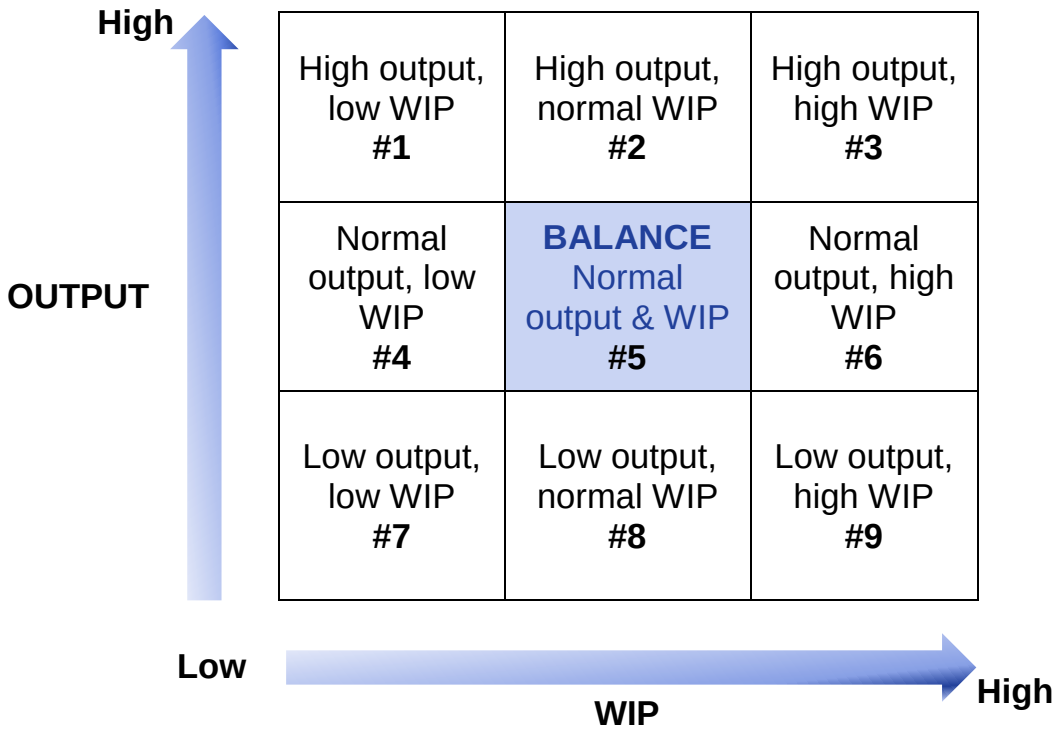
1) Together, look at the matrix below showing different situations of imbalance, and make sure everyone understands.

2) Together, for each imbalanced operation from table 7 listed in table 9, write down the type of imbalance (box# from the matrix). Solutions are at the bottom of the page.

3) Together, discuss for each operation in table 9: What could be the cause(s) of each imbalance? Write down your ideas in table 9.

4) Together, discuss: Which operations caused a bottleneck in this line, and why? Solutions are at the bottom of the page.

Matrix



High output, low WIP **#1**	High output, normal WIP **#2**	High output, high WIP **#3**
Normal output, low WIP **#4**	**BALANCE** Normal output & WIP **#5**	Normal output, high WIP **#6**
Low output, low WIP **#7**	Low output, normal WIP **#8**	Low output, high WIP **#9**

Table 9. Analysing causes		
Operation #	**Box #**	**Possible causes**
Operation 2	#1 (high output, low WIP)	
Operation 3		
Operation 7		
Operation 8		
Operation 9		
Operation 10		

Solutions 3): #1, #6, #9, #7, #7, #7.
Solutions 4): Bottlenecks are at operation 2 and 7. The operator at operation 2 is working faster, which creates a high WIP level at operation 3. The operator at operation 7 is working more slowly, which is slowing production and causing low WIP levels at operations 8, 9, 10.

Activity

2e

20 minutes

Balancing the line

Once you have identified bottlenecks and their cause(s), you can move on to selecting solutions to **balance the line**, meaning that you both remove and prevent bottlenecks to reach a normal WIP level while attaining target production at each work station. In this activity, you will learn how to select the best solution.

Instructions:

1) Together, look at the list of common causes of bottlenecks in table 10. Then, look at the list of measures in table 11, and match each cause with measures that could address it by writing down their number(s) on the right. Solutions are at the bottom of the page.

2) Have a participant read aloud the two scenarios in table 12, and discuss the question to remove the bottleneck and balance the line.

Table 10. Balancing the line

Common causes	Measures #
1. An operator lacks training and/or experience and is working slowly, slowing down production at the next stations.	
2. An experienced operator is working much faster than other operators, creating higher WIPs at the next station.	
3. A skilled operator is absent and was replaced by a slower operator.	
4. The line was not balanced properly before production started, and an operations takes longer than others.	
5. The line was not balanced properly before production started. Too many operators were assigned to one operation and are sitting idle.	
6. A machine breakdown slowed down production and created high WIP at the station where the breakdown occurred.	

Solutions: 1) 2-4-6-8, 2) 5-6, 3) 2-4-6-8, 4) 3-8, 5) 1-3-5, 6) 2-6-7.

Table 11. Balancing the line
Solutions
1. Remove an operator from the current operation.
2. Temporarily transfer an operator to a station that is reducing production.
3. Ensure good line balancing based on capacity and skills before production starts.
4. Train the operator causing the bottleneck.
5. Ask a fast-working operator to slow down the work pace.
6. Ask a fast-working operator to assist a slower operator after the target is achieved.
7. Quickly repair machinery or change the machine.
8. Add an operator to the current operation.

Tips: Think of the following.

- If you add an operator, from where should he/she be transferred? What will he/she need? How to select him/her?
- If you remove an operator, do you transfer him/her somewhere else? If so, where?

Table 12. Balancing the line
Scenario 1: Line supervisor Som has identified a bottleneck at operation #2 (high output, low WIP). A skilled, experienced operator is producing more than the hourly target, which is creating high WIP levels at the next operation. If you were Som, what would you do to remove this bottleneck?
Scenario 2: Line supervisor Som has identified a bottleneck at operation #7 (low output, high WIP). There was a machine breakdown at this station, so production was reduced and the operator is struggling to meet the target. This has slowed down production at the next operations. If you were Som, what would you do to remove this bottleneck?

Session 3

Action items

Goals

Summarizing and revising the new knowledge gained.

Identifying concrete applications of the new knowledge that benefit your factory.

Session 3

Overview

One member should read the full session out loud to the rest of group

20 minutes

Learning manual, pens, and markers

Throughout this module, you gained new knowledge on how to identify bottlenecks in the lines, find out their causes, and select solutions to balance the line.

Identifying imbalances

Finding bottlenecks

Balancing the line

In this session, you will think of ways to apply your new knowledge to improve line balancing in your sewing room by reviewing best practices and drafting your own action plan.

A production report form template is available online for you to print out and use in your own factory. To obtain it, contact your factory's FIT coordinator!

Activities

Activity

3a

5 minutes

Best practices checklist

In this activity, you will review best line balancing practices as a next step for evaluating your own and implementing improvements.

Instructions:

1) Together, look at the list of best practices in table 13, and put a ✓ in the column on the right if you use these practices in your factory.

Table 13. Line balancing

Best practices	✓
1. Line balancing is done by line supervisors systematically, before production through planning, and during production, daily.	
2. During production, line balancing is carried out regularly (hourly or bi-hourly).	
3. Hourly targets and minimum / maximum WIP levels are set before production starts.	
4. Imbalances are identified based on recorded production and WIP levels and their causes analysed to find bottlenecks.	
5. Bottleneck are systematically identified, then solutions selected to best address the causes.	

Activity

3b

15 minutes

Your action plan

In this activity, you will think of ways to apply your new knowledge to improve line balancing in your factory by drafting your own action plan.

Instructions:

1) Together, fill in the action plan (table 14) on the next page. Identify a key problem that you want to solve and write down the solutions you identified while working on this module.

Table 14. Line balancing – Action Plan

Problem identified				
Solutions identified	**Action(s) to be taken**	**Person responsible**	**By when?**	**How will improvements be measured?**

Line balancing

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FIT is being piloted in Asia under the regional Decent Work in the Garment Sector Supply Chains in Asia project funded by the Government of Sweden.

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