Annex I- Current Structure of Model Factories

1. Current Structure of Model Factories

1.1. ANKARA MODEL FACTORY PRODUCTION SHOPFLOOR

Ankara Chamber of Industry Applied Capability and Digital Transformation Centre-Model Factory (henceforth "ASO MF"), has the layout displayed in Figure 1 and Figure 2 and digitalization will be implemented on this layout.

ASO MF has two lines: Machine and assembly. Machines shown by numbers in both figures constitute the machine line, and the remaining stations and stores belong to the Assembly Line. The work order between production and assembly lines is fulfilled through the production leveling board.

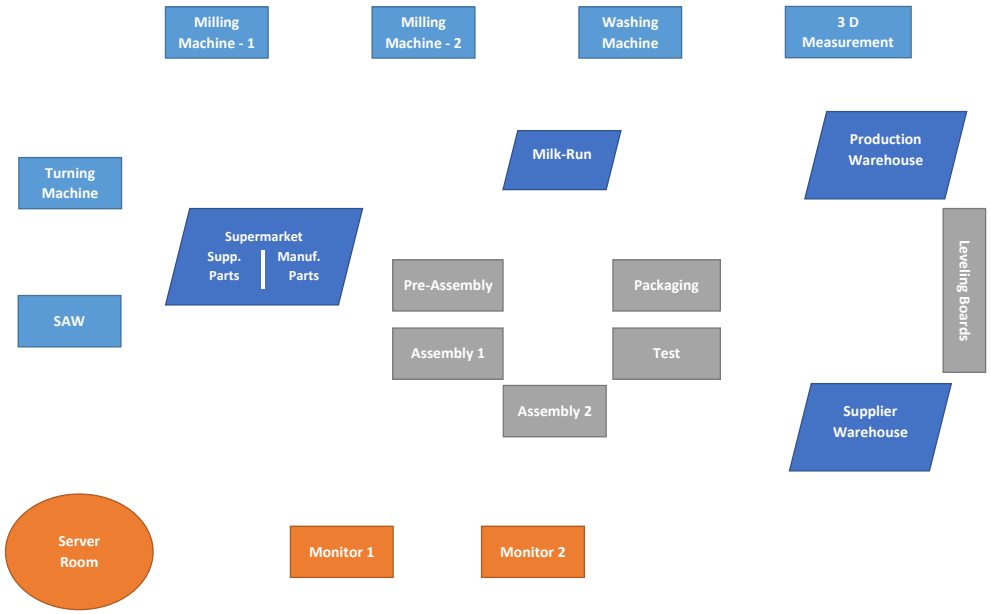
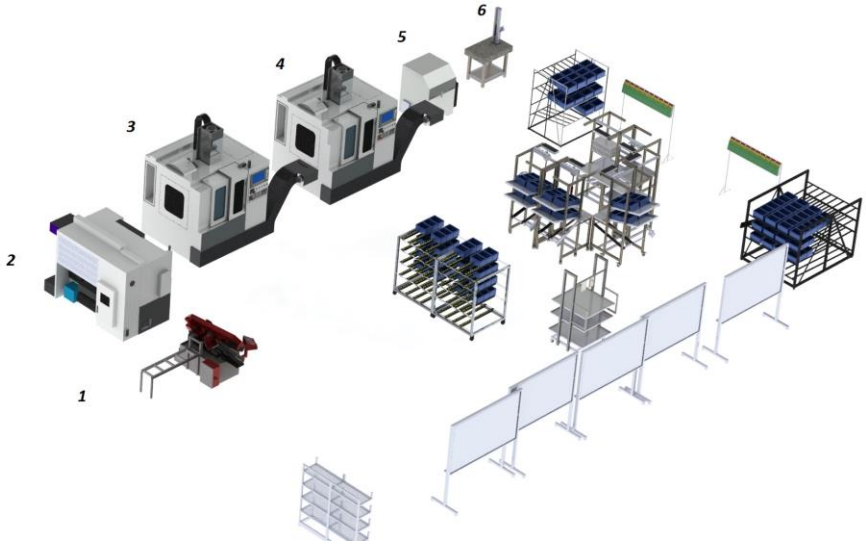


Figure 1 Two-Dimensional Layout

Table 1. Machines/Devices in the Ankara Model Factory

TR-orijinal	EN-translation
ASO Model Fabrika Yerleşimi	**ASO Model Factory Layout**
Freze-1	Milling machine-1
Freze-2	Milling machine-2
Yıkama Ünitesi	Washing Unit
Kurutma	Drying
Dijital mihengir	Digital marking gauge
Milk-run vagonu	Milk-run vehicle
Raf	Rack
Torna	Lathe
Süpermarket **Tedarikçi(Hammadde) /Yarı Mamül**	Supermarket Supp. Parts / Manuf. Parts
Ön montaj	Pre-assembly
Paketleme	Packaging
Montaj-2	Assembly-2
Test	Test
Depo	Warehouse
Testere	Saw
Montaj-2	Assembly-2
Sunucu odası	Server room

Ekranlar	Screens



1. SAW
2. Turning Machine
3. Milling Machine – 1
4. Milling Machine - 2
5. Washing Machine
6. 3 D Measurement

Figure 2. Three-Dimensional Layout

Table 1. Machines/Devices in the Ankara Model Factory

Machine Type	Brand	Model
Saw	Karmetal	KMT300 OSA ENC
Lathe	Spinner	TC400
Milling Machine- 1	Spinner	VC750
Milling Machine- 2	Spinner	VC750
Washing Unit	Dolfin	PYM950
Dimensional Measurement	Mitutayo	LH600E

Machine Line

ASO MF has 1 washing unit, 1 Saw (Cutting-Mill) machine, 1 dimensional measurement machine, 1 CNC lathe, and 2 milling machines. The brands and models of the machines are presented in Table 1.

Based on the production order received by Lathe and Milling stations, the (kanban/e-kanban) operator picks up the relevant part from the saw semi-finished goods warehouse. After the picked-up part in the container is machined, it is placed in the "machined part container". The empty container is left in the empty container area in the saw semi-finished goods warehouse.

D25 & D40 Pneumatic Cylinder Bottom Cover Life Cycle (For Machine Line)

1. The bottom cover is cut by the saw. The cut part is placed in the saw semi-finished goods warehouse together with the container. A total of 8 D25 Bottom Covers and 4 D40 Bottom Covers are placed in a container.
2. The container containing the materials to be machined in line with the work order received by the Milling station 1 is taken from the saw semi-finished goods warehouse.

3. The container taken is moved to the WIP area at the entrance of Milling station 1. Parts are removed in the order from the container to be machined.
4. The parts machined are placed in the container located in the WIP area between Milling station 1 and Milling station 2. The empty container is moved to the empty container area in the Saw Semi-Finished Goods Warehouse.
5. The processes at Milling station 2 are the same as the work steps at Milling station 1. The part machined is placed in the "Machined Part" area in the same container and moved to the FIFO line.
6. The parts in the container coming from the FIFO line are placed in special bins for washing, and are washed in the washer. The empty container is moved back to the Milling station 2 WIP area.
7. The products taken from the washer are subject to dimensional measurement. The products of good quality, whose measurement is completed, are placed in the containers coming from the warehouse, and sent to the warehouse.

100-150 FEMALE & MALE Mil Life Cycle

1. The part to be machined is cut by saw and placed in the saw semi-finished goods warehouse. Each container will contain 4 parts.
2. The part is taken from the saw semi-finished goods warehouse in line with the production order (Kanban/e-kanban) received by the Lathe station and placed in the Lathe station WIP area.
3. Each part is machined at the Lathe station in order, and the machined parts are placed in the machined part container on the WIP at the Lathe station.
4. The empty container is left in the empty container area in the saw semi-finished goods area. After machining, the full container is moved to FIFO in front of the washing unit.
5. The parts in the container coming from the FIFO line are placed in special bins for washing, and are washed in the washer. The empty container is moved back to the Lathe station WIP area.
6. The products taken from the washer are subject to dimensional measurement. The products of good quality, whose measurement is completed, are placed in the containers coming from the warehouse, and sent to the warehouse.

Assembly Line and Milk-Run

At ASO MF, the entire process for the Assembly line starts from the Hejunka board. The operator starts product assembly on the pre-assembly line according to the work orders received from the Hejunka board. The product goes through Pre-Assembly, Assembly 1, Assembly 2, Testing and packaging stations in order. At Pre-Assembly, Assembly 1 and Assembly 2 stations, the relevant parts are taken from the containers, followed by the performance of assembly. When the parts in containers are finished, they are left on the empty container shelf under the relevant station. Then, the Milkrun Operator picks up empty containers and leaves them on the empty container shelf of the relevant supermarket and feeds the U Assembly Line by picking up the full containers.

In the next step, the Milkrun Operator replaces the empty containers in the Supermarket with full ones.

Production Tracking

The production processes shall be tracked using RFID and QR Code. In the following, how the system is expected to work is described.

Supplier Supermarket

When the purchased material/part arrives at the factory, a proper "inspection order" is created by the system. The inspector processes this order by logging to the system on a terminal (e.g. tablet) in the supermarket. After the lot is inspected and accepted, the system generates and assigns a lot ID to track this lot. A QR code containing all the relevant information (date, time, supplier, SKU ID, lot ID, etc.) is printed by the inspector. Then, the lot is placed on its designated shelf at the supplier supermarket and the QR code is affixed to the shelf. The system closes the inspection order and the inventory level is updated.

When the operator of the first machine starts working on an order through an interface, the system shall automatically warn the logistics operator via an interface (e.g., smartwatch, tablet, andon boards). The logistics operator will go to the supplier supermarket. The system shall create a replenishment order for the machine. When the logistics operator starts processing the replenishment order at the supplier supermarket using an interface (e.g., the smartwatch), he/she will read the QR code affixed on the shelf to send the lot information to the system. The operator will take the raw material to the machine and place it in the transport box.

Upon completion of the task, the system shall automatically detect when the box passes the first RFID reader, the replenishment order shall be closed and the inventory level of the material shall be updated.

When a shelf at the semi-finished supermarket is empty, the system shall create a replenishment order automatically and warn the logistics operator via an interface (e.g., smartwatch, tablet, andon boards). The logistics operator will go to the supplier supermarket. When the logistics operator starts processing the replenishment order at the supplier supermarket using an interface (e.g., the smartwatch), he/she will read the QR code affixed on the shelf to send the lot information to the system. The operator will take a full box of semi-finished product to the semi-finished product supermarket.

Upon completion of the task, the system shall automatically detect when the box is placed on the shelf, the replenishment order shall be closed and the inventory level of the semi-finished product shall be updated.

Machine Line

According to the materials flow in the digitalized Model Factory, it should be possible to track when and into which machines the materials go in for processing and come out; the production orders executed, being executed and waiting in queue for execution at the machines. In that context, RFID readers should be planned to meet the needs. This can be achieved by installing RFIDs at the inlet and outlet of the machines in the machine line. For that purpose, RFID should be defined for each box and the processing proceed on these boxes.

Since materials are transferred to various boxes at certain stages and thereby carried, the system should match the materials with the production orders. When we check back, we should see the materials in a specific production order have been processed at which machine(s), at what date and time, and by which Operator.

Assembly Line And Milk-Run

At ASO MF, it must be recorded where and how long the containers are pending for the machine line, assembly line, supermarket and warehouses as well as where and when they come in and out. RFID readers must be positioned accordingly. In addition, the assembly time for the parts on the Assembly Line and the start and end times of a product in the work order should be observed. These data should be able to be used in processes such as Yamazumi, and the assembly time achieved by the Operator for each phase should be viewed. Additionally, the Digital SOP should function consistently throughout the

system. The production order should be issued to the machining line automatically according to the missing parts, and their priority should be modifiable depending on the conditions. In addition, the Hejunka board shall be digitalized.

1.2. BURSA MODEL FACTORY PRODUCTION SHOPFLOOR

The production process of 'Track-type Robot Carrier' in the Bursa Model Factory (BMF) is described below. The production layout and the machines/devices in the Bursa Model Factory are given in Figure 3 and Table 2, respectively.

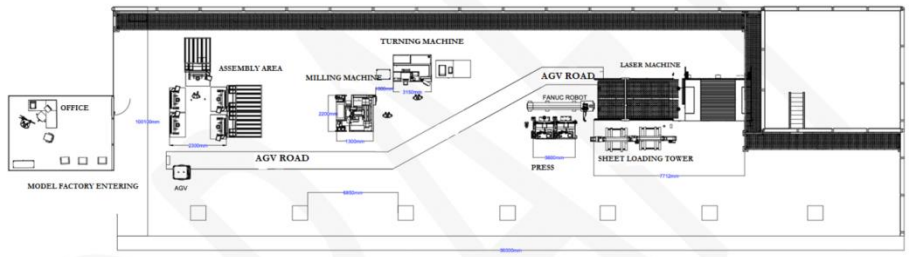


Figure 3. Layout of the Bursa Model Factory

Table 2. Machines/Devices in the Bursa Model Factory

TR-orijinal	EN-translation		
Makine	**Machine Type**	**Machine Type**	**Model**
Lazer Kesme Makinesi	Laser Cutting Machine	Durmazlar	HD-F 3015
Endüstriyel Robot	Industrial Robot	FANUC	R30-ib
Bükme Makinesi	Bending Machine	Durmazlar	AD-S 30135
Otomatik Yönlendirmeli Araç	Automatic Guided Vehicle (AGV)	PERLA	
Freze	Milling machine	SPINNER	VC-750
Torna	Lathe	DRINNS	DCNC-2
~~**Akıllı gerdirici**~~	~~Smart Tighteners~~	~~BOSCH~~	

Production Process

Machine Line

First, galvanized sheet of 2mm thickness is loaded onto Durmazlar HD-F 3015 Laser Cutting Machine. The side sheets, flat and gear wheels, and top sheet of the Track-type Robot Carrier are cut.

When the cutting process is finished, the cut side sheets, which the machine automatically extracts, are lined up by the FANUC R30-ib industrial robot as 12 right and 12 left side sheets respectively. The sheets moving over the 7th axis are transferred to Durmazlar HDF Bending Machine for bending processes. After the zeroing and bending processes are finished, the robot, again, places the 12 right and 12 left bended side sheets in separate boxes and moves near to the AGV autonomous vehicle next to the laser machine. The side sheets, wheel parts, and top sheets are loaded into the AGV vehicle by the operator.

~~The aforementioned processes (such as the number of parts, cutting time, losses, etc.) can be monitored on the screens of the 2 touch KIOSK devices, which are located next to the Laser Cutting Machine and the Bending Machine.~~

AGV on its route waits for 1 minute in front of the SPINNER VC-750 Milling machine as previously

programmed, and continues on its way after the 12 mm diameter shaft and coupling shaped in the Lathe and Milling machines are loaded into it by the operator. ~~These processes can be followed on the KIOSK screen located next to the milling machine in terms of data (milling time, number of pieces, stoppages, etc.). No data can be obtained from the lathe and it has no KIOSK.~~

AGV autonomous vehicle, which finishes its operation near the Milling machine, moves towards the Production Supermarket as its next target. The MILKRUN personnel carries out transportations to the supermarket section, and the empty boxes are loaded onto the AGV. AGV returns to the place in front of the laser cutting machine, following the return route and waits until a new work order is delivered.

Assembly Line

There are 5 benches on the assembly line. On the 1st bench, wheels are mounted. On the 2nd bench, side sheets and wheels are joined. On the 3rd bench, the assembly of the track and conduit box of the robot is made with the help of fixtures. On the 4th bench for test, electrical and mechanical controls are held. On the 5th bench, packaging process is carried out.

~~Joining processes on the assembly line are performed by means of the BOSCH Smart Gunss. The work order is loaded to the smart gunsystem by having the barcode scanned, and thereby tightening more or less than specified is prevented during the wheel assembly and side sheet assembly processes. These operations can be followed as data on the assembly line KIOSK screen and through the smart gunsbarcode system that prevents over/under-tightening. Also, the smart tightener system warns the operator with an audible alarm if a new work order is opened after incomplete tightening operations.~~

There is a supplier and semi-finished product supermarket, and a FIFO application on the production line. Also the parts that are supplied from outside such as robot track, bolts, nuts, bearings, steel material, conduit box, dc motor, spacer, plexiglass, etc. are put in the supplier supermarket.

~~All the data mentioned above (number of parts, losses, unexpected stoppages, production times), that is, a~~All data regarding total performance and efficiency (e.g., number of parts, losses, unexpected stoppages, production times, total efficiency analysis, activity-inactivity status) at the machine and assembly line ~~from the Laser Cutting machine, Bending Machine, Milling machine and the assembly line can be~~shall be monitored ~~monitored~~ through ~~the~~ 2 Andon boards to be installed in Bursa Model Factory ~~which show the total performance and efficiency~~. ~~On these Andon screens, total efficiency analysis, efficiency percentages, planned and unplanned stoppages, and activity-inactivity status can be monitored.~~

To summarize:

- LASER CUTTING (DURMAZLAR HDF 3015 2 kW) has a PLC ~~and KIOSK (through which stoppage-restart-intervention times-maintenance-OEE, etc. can be monitored)~~. Operations performed on the Laser Cutting Machine consist of wheel, gear wheel, side sheet and main sheet cutting.
- BENDING MACHINE (DURMAZLAR AD-S 30135) has a PLC. Right and Left side sheet bending operations are carried out at the bending machine.
- ~~and a KIOSK (through which stoppage-restart-intervention times-maintenance-OEE, etc. can be monitored).The side sheets of the product is twisted here after being cut in the laser cutting machine.~~
- ~~Operations performed on the Bending Machine: Right and Left side sheet bending operations~~
- MILLING MACHINE (SPINNER VC750) has a PLC ~~and a KIOSK (through which stoppage-restart-intervention times-maintenance-OEE, etc. can be monitored)~~.
- LATHE (DRINNS DCNC-2) has a PLC~~, but KIOSK is not available (no data can be obtained).~~
- ~~Wheel shafts and couplings are machined on the lathe and milling machine~~.

- Operations performed on the assembly line comprise the following units: Flat wheel assembly, gear wheel assembly, main sheet assembly, side sheet assembly, track assembly, conduit box assembly and final control.

~~**MES System:**~~

~~The system, which was developed by Mert Yazılım, works in integration with the ERP throughout the processes from the input of the order to the output, enabling the data such as quality, maintenance, malfunction, working times, production numbers, downtimes to be collected from the field through the KIOSKs connected to the machines and to be processed. These data can also be monitored instantaneously. It is possible (1) to instantaneously monitor all workstations of our production line on the basis of personnel and work order, (2) to make the production planning on machine basis automatically thanks to the real-time data, (3) to retrieve the capacity and efficiency reports on workstation, machine and personnel basis in detail from the system, (4) to retrieve retrospectively all the acquired data, (5) to fully trace the order, product, workstation, work center, machine and personnel with this system.~~

~~The current system shall be replaced with the new MES software and integrated with the other systems.~~

~~**DİNAMO ERP Program:**~~

~~DİNAMO ERP Program is used to carry out all our processes such as Purchasing, Order, Stock tracking, and Production.~~

~~The current program shall be replaced with the new ERP program and integrated with the other systems.~~

Robot Technology

Semi-finished product transfer operations are carried out between the Laser cutting machine and the Bending machine by means of the 7-axis Fanuc R30ib robot.

Autonomous Vehicle Technology:

AGV vehicle works between stations (laser-cutting and bending machines, milling and assembly stations). It carries out semi-finished product transportation operations. It finds its way through its own magnetic sensors which are on a special magnetic strip, detects the obstacles coming its way and stops.

Smart Glasses:

The flat wheel assembly process on the assembly line is performed using the Microsoft Hololens 2 virtual reality glasses that facilitates the installation by guiding the operator in a virtual environment.

AGV and industrial robot shall be integrated with the IOT network. Moreover, AGV and industrial robot shall collaborate to carry out the assigned tasks without the intervention of the operator.

~~**Smart Gun Technology System:**~~

~~The "Smart Station" project was started up with 4 stations in the BMF Assembly Unit. As a part of the project, operations to be carried out during the assembly process are managed by Smart Stations.~~

~~In the operations carried out by the Smart Stations, the equipment used is commanded by communicating through the Digital I/Os of the stations with two charged tighteners through a barcode system. Regarding the errors that occur during the operation process, the operator can enter the errors defined for the operation through the touch screen of the Smart Station. In this way, the aim is to establish an infrastructure that can analyze and improve the errors that occur.~~

~~AGV, Industrial Robot, and smart tightener systems do not have ERP and MES integration.~~

~~Industrial Robot cannot perform loading onto the AGV without human intervention.~~
~~No work safety system was created around industrial robot.~~
~~No data can be obtained from CNC Lathe.~~

Production Tracking

Production tracking shall be achieved via RFID system and QR code as in the other Model Factories.

1.3. KAYSERI MODEL FACTORY PRODUCTION WORKSHOP

Kayseri Model Factory produces a battery-powered spice grinder. The machine layout plan in the Factory is shown in Figure 4 and Figure 5. Table 3 presents the brand and model of the machines and devices.

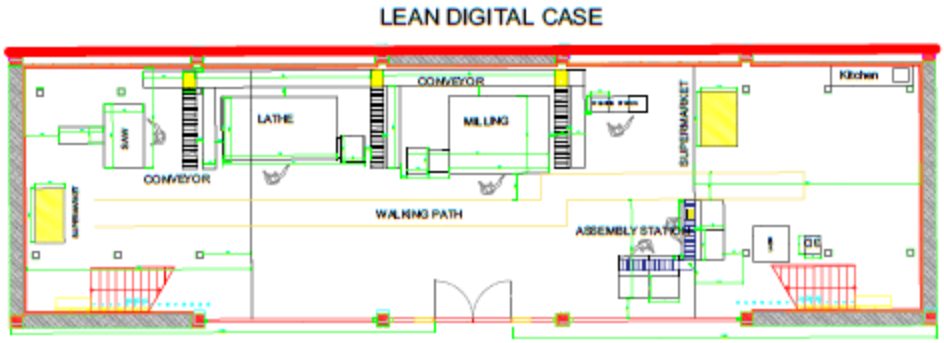


Figure 4. Layout of Kayseri Model Factory

Table 3. Machines/Devices in the Kayseri Model Factory

TR-orijinal	ENG-translation		
Makine	**Machine/Device**	**Brand**	**Model**
Otomatik Testere	Automatic Saw Machine	Karmetal	
CNC Torna Makinesi	CNC Lathe Machine	DNR, Taksan	ETH-LC8
CNC Freze Makinesi	CNC Milling Machine	DNR, Taksan	SMV-L100
Yıkama Ünitesi	Washing Unit	HY Teknoloji	Ultrasonic Machine
3 Boyutlu Yazıcı	3D Printer	Zortrax	M300 Dual
Fiber Lazer İşaretleme Makinesi	Fiber Laser Marking Machine	Laser	XM-20D

Figure 5. Digital Layout of Kayseri Model Factory

Production Process and Tracking

In general, production consists of the manufacture and assembly of metal and plastic parts. Metal raw material is processed by saw, lathe machine, milling machine, and washing station sequentially in order to produce parts such as button, main body, outer chamber, button housing, grinder cover, and shaft slot. All metal parts move through the same machine line sticking to the order of stations; however, not all parts need to be processed at all stations. The parts continue on their way on the machine line bypassing the stations where they will not be treated. Parts whose operations in the machine line are completed are transported to the semi-finished product supermarket. The plastic bottom cover used in the grinder is printed in the 3D printer and transported to the semi-finished product supermarket. Finally, the required type and quantity of semi-finished products and outsourced components are drawn from the semi-finished product supermarket and raw material supermarket, respectively, and transported to the assembly station comprised of 5 benches in order to assemble the final product.

Transport between stations in the machine line is implemented by a conveyor system as shown in Figure 9. In the following, the production process and production tracking approach are described in detail.

Supplier Market

When the purchased raw material arrives at the factory, a proper "raw material inspection order" is created by the system. The inspector processes this order by logging to the system on a terminal (e.g. tablet) in the raw material supermarket. After the lot is inspected and accepted, the system generates and assigns a lot ID to track this lot. A QR code containing all the relevant information (date, time, supplier, SKU ID, lot ID, etc.) is printed by the inspector. Then, the lot is placed on its designated shelf at the raw material supermarket and the QR code is affixed to the shelf. The system closes the inspection order and the inventory level is updated.

When the operator of the first machine starts working on an order through an interface, the system shall automatically warn the logistics operator via an interface (e.g., smartwatch, tablet, andon boards). The logistics operator will go to the raw material supermarket. The system shall create a replenishment order for the machine. When the logistics operator starts processing the replenishment order at the raw material supermarket using an interface (e.g., the smartwatch), he/she will read the QR code affixed on the shelf to send the lot information to the system. The operator will take the raw material to the machine and place it in the transport box.

Upon completion of the task, the system shall automatically detect when the box passes the first RFID reader, the replenishment order shall be closed and the inventory level of the material shall be updated.

Metal raw material first comes to the sawing machine. The parts cut by the sawing machine are placed in transport boxes in certain batches. The saw operator places the box with the cut materials on the driven conveyor. When the box moving on the driven conveyor reaches the cross conveyor between the saw and the lathe, it moves on to the idler conveyor feeding the lathe if the lathe is in the route of the box. Otherwise, it moves along the line to the cross conveyor between the lathe and the miller. If the miller is in the route of the box, the box reaches the idler conveyor feeding the miller. If not, the box moves along the line to the cross conveyor between the miller and the washing machine. Similarly, if the washing station is in the route of the box, the box reaches the idler conveyor feeding the washing machine. If not, the box reaches the production supermarket. The parts reaching the machines in a box are put into the same box after being processed and put on the driven conveyor.

Machine Line

The detailed flow in the machine line for metal parts is as follows:

Flow of button part of battery powered spice grinder:

1) The aluminum raw material bar with a diameter of 30 mm and a length of 1 m is firstly sized by the saw.
2) The part whose operation is completed in the saw is transmitted to the driven conveyor. (RFID reader is expected to read the tag attached to the box at this point.) In order to decide whether to go to the next process (lathe) or not, the part moves up to the cross conveyor at the beginning of the lathe.
3) The cross conveyor, deciding that the part needs to be processed in the lathe, guides the part towards the lathe using idler conveyor.
4) The button does not need to be processed at the milling and washing stations. This situation is controlled by the RFID readers, which will be placed at the beginning of the miller and washing station.
5) The button is directed to the semi-finished product supermarket directly.

The flow of main body and outer chamber parts of the battery powered spice grinder:

1) Aluminum pipe with a diameter of 50 mm and a length of 1 m is sized by the saw.
2) The part whose operation is completed in the saw is transmitted to the driven conveyor. (RFID reader is expected to read the tag attached to the box at this point.) In order to decide whether to go to the next process (lathe) or not, the part moves up to the cross conveyor at the beginning of the lathe.
3) The cross conveyor, deciding that the part needs to be processed in the lathe, guides the part towards the lathe using idler conveyor.
4) The part whose operation is completed in the lathe must continue to the milling machine for a nail drilling operation.
5) When the part reaches the cross conveyor located at the beginning of the miller, the cross conveyor decides that the part needs to be processed at the miller and directs the part to the miller.
6) The part is directed using idler conveyor at the beginning of each machine and using driven conveyor at the end of each machine.
7) The main body does not need to be processed at the washing station but the outer chamber must be processed. The cross conveyor at the beginning of the washing station makes these decisions and finally directs the parts to the semi-finished supermarket.

Flow of button housing part of battery powered spice grinder:
1) Aluminum pipe with a diameter of 50 mm and a length of 1 m is sized by the saw.
2) The part whose operation is completed in the saw is transmitted to the driven conveyor. (RFID reader is expected to read the tag attached to the box at this point.) In order to decide whether to go to the next process (lathe) or not, the part moves up to the cross conveyor at the beginning of the lathe.
3) The cross conveyor, deciding that the part needs to be processed in the lathe, guides the part towards the lathe using idler conveyor.
4) When the part reaches the cross conveyor located at the beginning of the miller, the cross conveyor decides that the part needs to be processed at the miller and directs the part to the miller.
5) The button housing that does not need to be processed at the washing station is directed to the semi-finished product supermarket with the decision of the RFID at the beginning of the washing station.
The flow of the grinder cover part of the battery powered spice mill:
1) Delrin rod or similar plastic material with a diameter of 50 mm and a length of 1 m is sized by the saw.
2) The part whose operation is completed in the saw is transmitted to the driven conveyor. (RFID reader is expected to read the tag attached to the box at this point.) In order to decide whether to go to the next process (lathe) or not, the part moves up to the cross conveyor at the beginning of the lathe.
3) The cross conveyor, deciding that the part needs to be processed in the lathe, guides the part towards the lathe using idler conveyor.

4) When the part reaches the cross conveyor located at the beginning of the miller, the cross conveyor decides that the part needs to be processed at the miller and directs the part to the miller.
5) Cross conveyor at the beginning of the washing station directs the part to the washing station.
6) After the washing operation is completed, the part is directed to the semi-finished product supermarket through the RFID system.

Flow of spindle part of battery powered spice grinder:
1) A square bar with 5 × 5 dimensions and a length of 1 m is sized by the saw.
2) The part whose operation is completed in the saw is transmitted to the driven conveyor. (RFID reader is expected to read the tag attached to the box at this point.) In order to decide whether to go to the next process (lathe) or not, the part moves up to the cross conveyor at the beginning of the lathe.
3) The cross conveyor, deciding that the part needs to be processed in the lathe, guides the part towards the lathe using idler conveyor.
4) The spindle does not need to be processed at the milling station. When the part reaches the cross conveyor located at the beginning of the miller, the cross conveyor makes this decision through the RFID system and forwards the part to the washing station using the idler conveyor.
5) When the part reaches the cross conveyor located at the beginning of the washing station, the cross conveyor decides that the part needs to be processed at the washing machine and directs the part to the washing machine.
6) After the washing operation is completed, the part is directed to the semi-finished product supermarket through the RFID system.

Assembly Station

The assembly station consists of 5 (five) assembly benches (). The parts are transferred from bench to bench and assembly steps are carried out in accordance with the Kanban system. Each assembly bench will have an andon light that the operator can turn on with the button whenever necessary.

The assembly process (for training purposes) is implemented in two different ways. In the first case, the process is as follows: The transparent pipe and inner chamber are assembled to the LED cable held by the fixed fixture on the first table and the grinder cover with rivets. The assembled parts are transferred to the second bench. On the second bench, the shaft is inserted into the shaft gap in the fixed fixture and the part coming from the first bench is passed through the inner chamber hole to complete the chamber part assembly. Following the chamber part assembly, the part is transferred to the third bench and the process continues in this way until the final assembly. There will be RFID readers at the beginning and at the end of each assembly bench to keep track of process times.

In the second case, the process is as follows The fixtures in the assembly benches are mobile; a single fixture travels around all assembly benches. Fixtures enable the transport of parts on the benches using plug-and-unplug conveyor. As the fixture proceeds forward, the RFID tag affixed to it will be read at each station. RFID system will track the part-fixture carriers on the assembly line. The assembly will take place directly on the carrier and the system will track single-piece flow production in real time.

In both cases, each assembly bench will have an andon light that the operator can turn on with a button whenever necessary. In case of faulty assembly, if the problem can be fixed quickly, the yellow light will be on and how long it takes to fix the problem will be tracked and reflected in the computations. If the problem cannot be fixed, the red light will be on and the part will be scrapped. The total process time up to that point will be disregarded.

In summary, RFID readers are required at the beginning and at the end of each bench for tracking process times at the assembly station. In addition, RFID tags are required for the moving fixture to be used in assembly tables. If the Model Factory deems necessary, it may make changes in two

aforementioned scenarios. However, in any case, genealogy tracking shall be made with RFID system at the assembly station and KPIs such as process time, cycle time, operator OEE, and equipment OEE shall be calculated automatically.

1.4. KONYA MODEL FACTORY PRODUCTION SHOPFLOOR

Production shopfloor of Konya Model Factory is the same as that of Ankara Model Factory. Machines and devices in the Model Factory are presented in Table 4.

Table 4. Machines/Devices in the Konya Model Factory

TR-orijinal	ENG-translation		
Makine	**Machine Type**	**Brand**	**Model**
Testere	Saw	İMAŞ CUTERAL PAR	280 PLC
CNC Torna	CNC Lathe	DNR TAKSAN	ETH LC8
CNC Freze 1	CNC Miller 1	DNR TAKSAN	EMV L850
CNC Freze 2	CNC Miller 2	DNR TAKSAN	EMV L850
Yıkama Ünitesi	Washing Unit	KSP Makine	WM1000
Boyutsal Ölçüm	Dimensional Measurement	YAMER	PHG-600