IIT KANPUR

Indian Institute of Technology Kanpur

Introducing Scheduling Dashboard of MCF

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User Interface

1. **First Page**

    First page of this Scheduling Dashboard is shown below. This page is having 8(eight) buttons i.e. Digital Twin, Real Time Monitoring, Analytics, Machine Details, Bill of Materials, Inventory, Job Schedule and Help. These push buttons correspond to different pages in the Dashboard (refer Section 2.1). Details are given as follows:

    1) Digital Twin – In this page, we have virtually represented real-time digital counterparts of all the Siemens, Fanuc machines, and materials tracking using RFID.
    2) Real Time Monitoring – In this page, we have trace of all the CNCs, Non-CNCs and materials and displayed on a single dashboard.
    3) Analytics – In this page, all the analytical part of manufacturing division will show here.
    4) Machine Details – In this page, all the list of machines from different shops will display here.

5) Bill of Materials – In this page, we can insert details of components, which will display in the material details table. These components if already in the inventory can be transferred to the inventory list of the scheduler, which will later help in reducing manufacturing time.
6) Inventory – All the materials moved from Bill of materials page to inventory list will show here.
7) Job Schedule – A job schedule can be made using this page. This also have Gantt chart and machine loading chart.
8) Help – This page will have documentation.
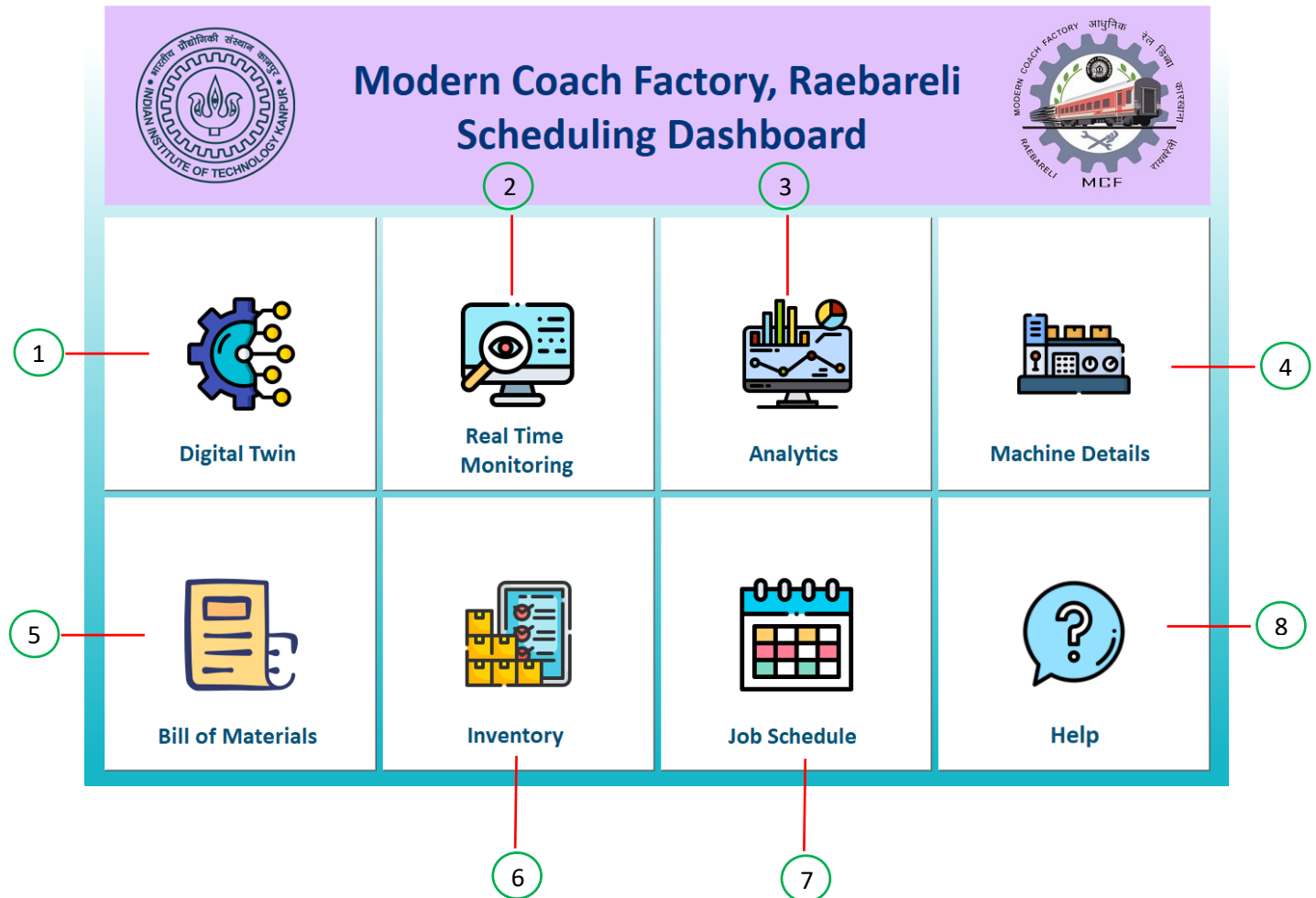
1. Digital Twin

Let us click on the *'Digital Twin'* push button on first page, we will reach Digital Twin tab in second page. We have virtually represented real-time digital counterparts of all the Siemens, Fanuc machines, and materials tracking using RFID.
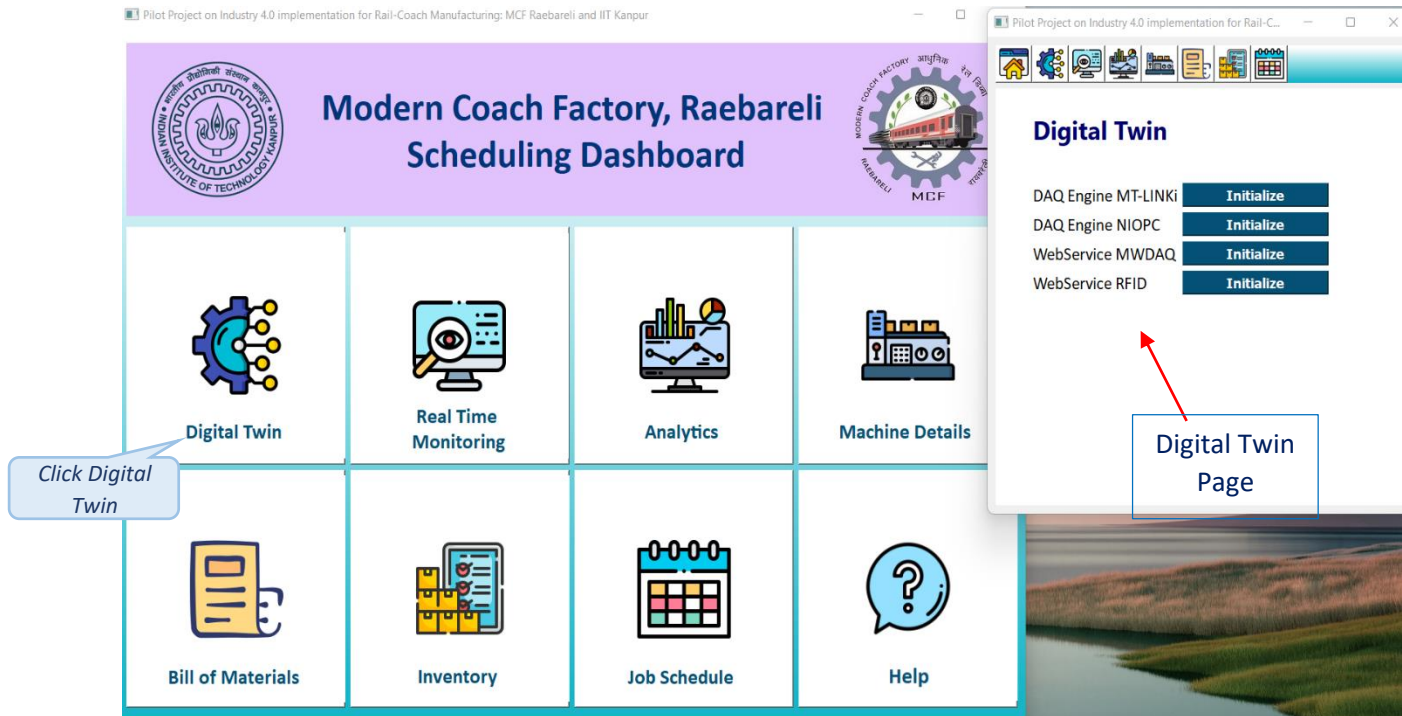
Figure 1.1
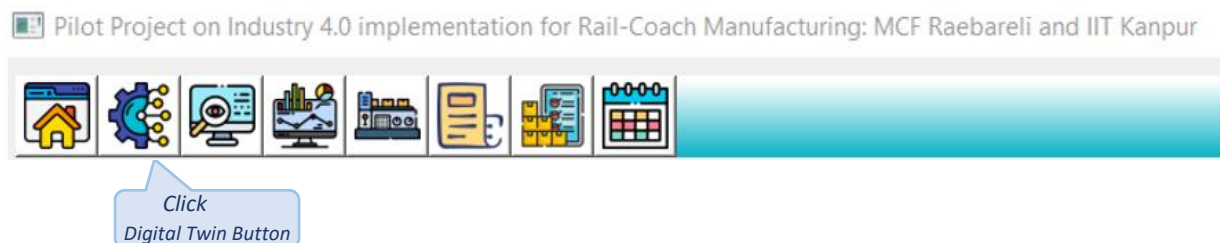
Figure 1.2
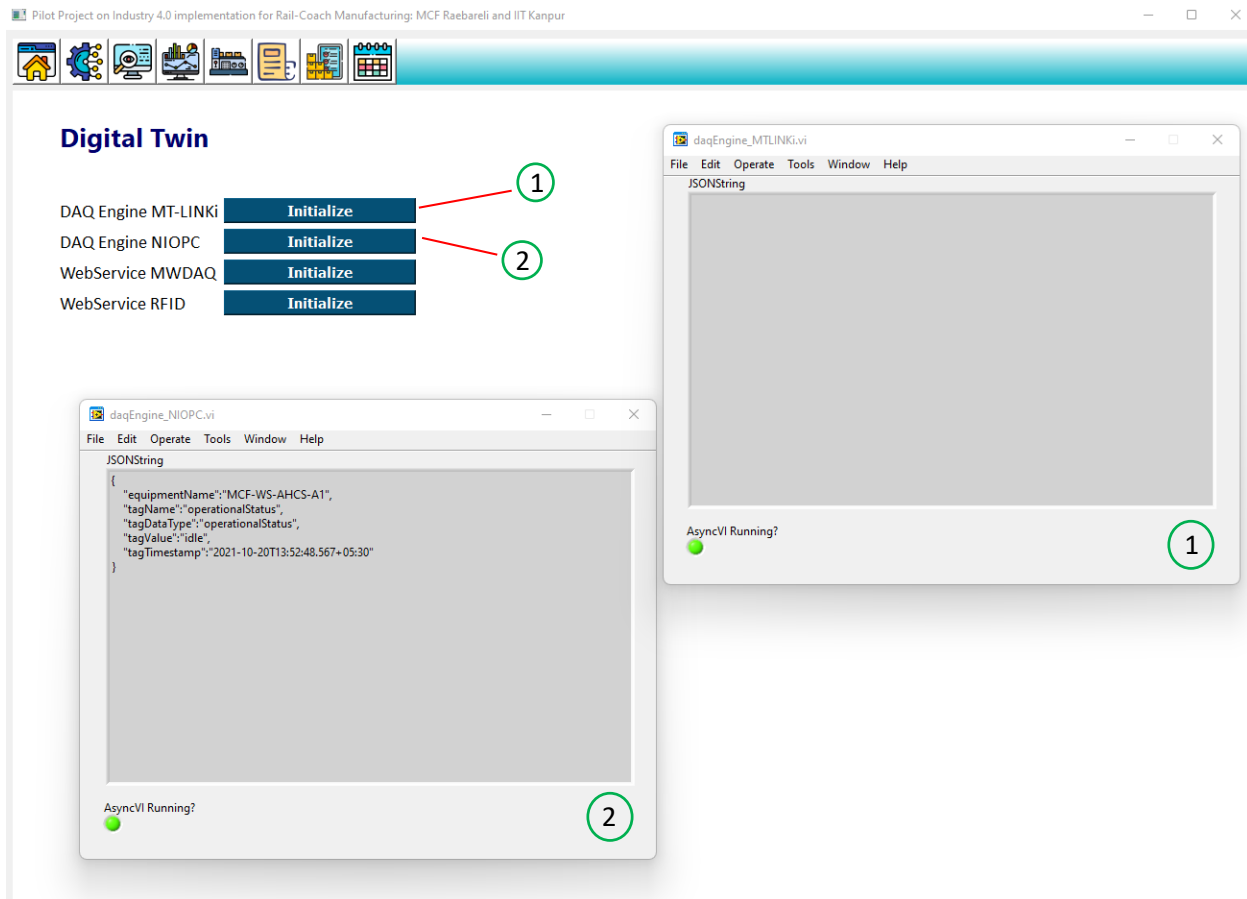
Figure 1. 3

DAQ Engine MT-LINKi will get all the data from Fanuc machines and packed it in the form of JSON packets. These JSON packets will then transfer to daq-panel to display the machine operational status. After clicking *'Initialize'*, a popup will display of NI runtime engine and all the received data will display here.

DAQ Engine NIOPC will get all the data from Siemens machine and packed it in the form of JSON packets. These messages will be used to display operational status of CNC machines to daq-panel. After clicking *'Initialize'*, a popup will display of NI runtime engine and all the received data will display here.

Webservices MWDAQ will be initialized after clicking the *'Initialize'* button.

Webservices RFID will be initialized after clicking the *'Initialize'* button. RFID will be used for acquiring data for materials tracking.

After initializing all the dependencies, we will get present state in the real time monitoring dashboard.

2. Real Time Monitoring

Let us click on the *'Digital Factory Environment'* push button on the first page or third icon on second page. A Real time monitoring page will displayed. An overall factory overview will be displayed in DAQ Panel initialize button (refer to fig 2.3, 2.4, 2.5 & 2.6).

Figure 2.1

Figure 2.2

Please click on the *'Initialize'* button, a daqPanel.vi will pop-up on the screen (please wait for a while if not popped-up). For this daqPanel.vi to be run, a LabVIEW runtime engine 2020 is required to be installed on you pc.

Refer to fig 2.3, an overall real time monitoring of MCF Factory is displayed. There are four tabs corresponding to different Shops in the factory. Here under Real Time Machine Status Label, all the icons resembles CNC machines in the shop floor. Icons different color gives the state of machines in factory. Significance of all different colors are shown below:
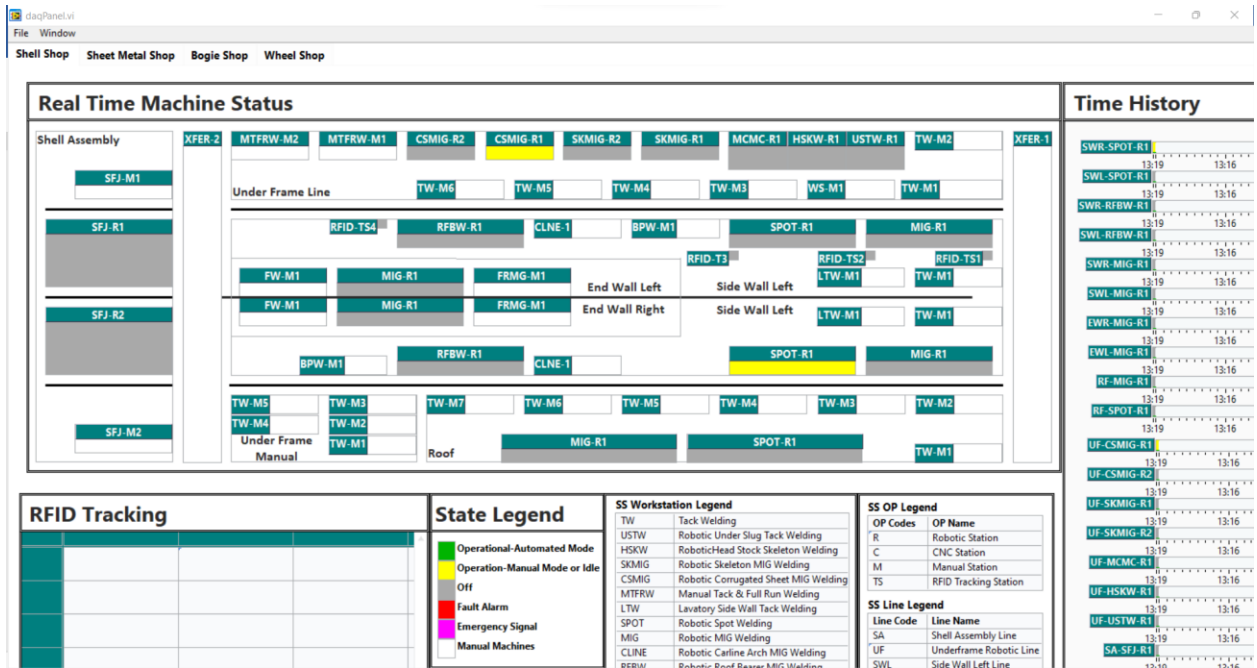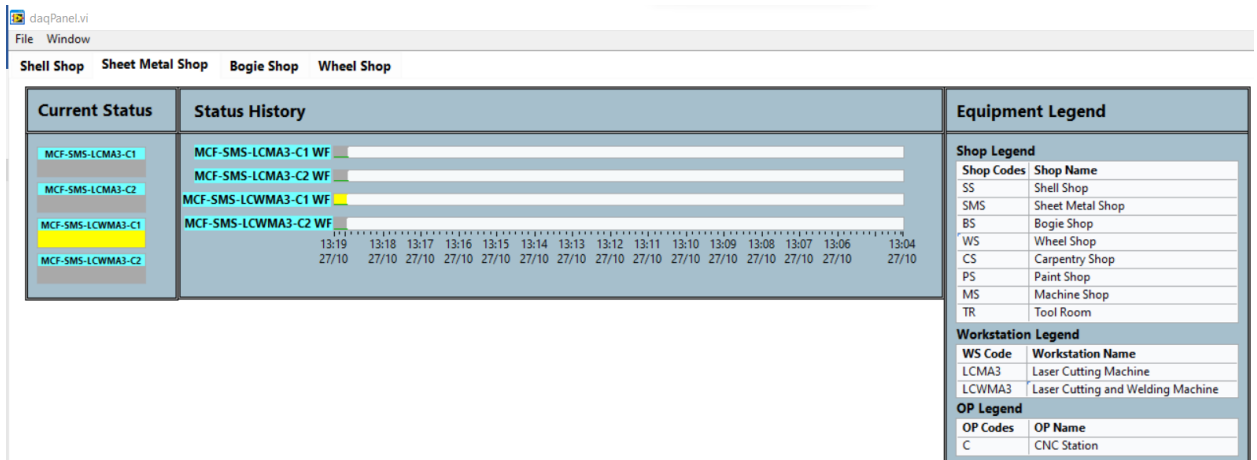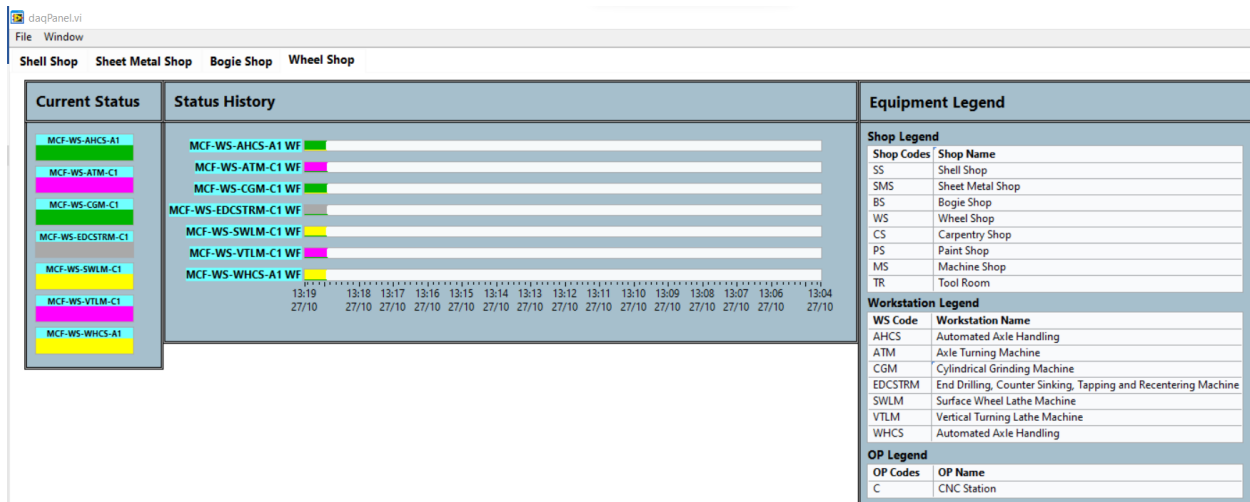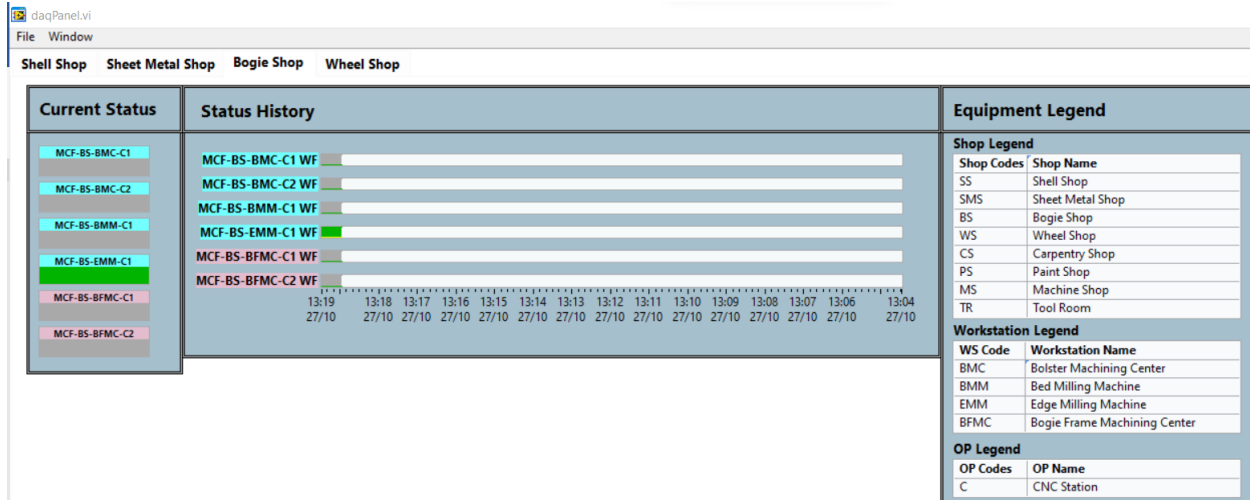
Real Time Machine Status

Shell Assembly | XFER-2 | MTFRW-M2 | MTFRW-M1 | CSMIG-R2 | CSMIG-R1 | SKMIG-R2 | SKMIG-R1 | MCMC-R1 | HSKW-R1 | USTW-R1 | TW-M2 | XFER-1

SFJ-M1

Under Frame Line   TW-M6   TW-M5   TW-M4   TW-M3   WS-M1   TW-M1

SFJ-R1

RFID-TS4   RFBW-R1   CLNE-1   BPW-M1   SPOT-R1   MIG-R1

RFID-T3   RFID-TS2   RFID-TS1
LTW-M1   TW-M1

FW-M1   MIG-R1   FRMG-M1   End Wall Left   Side Wall Left

FW-M1   MIG-R1   FRMG-M1   End Wall Right   Side Wall Left   LTW-M1   TW-M1

SFJ-R2

BPW-M1   RFBW-R1   CLNE-1   SPOT-R1   MIG-R1

TW-M5   TW-M3   TW-M7   TW-M6   TW-M5   TW-M4   TW-M3   TW-M2
TW-M4   TW-M2
Under Frame   TW-M1   Roof   MIG-R1   SPOT-R1
SFJ-M2   Manual   TW-M1

RFID Tracking

State Legend

- 🟩 Operational-Automated Mode
- 🟨 Operation-Manual Mode or Idle
- ⬜ Off
- 🟥 Fault Alarm
- 🟥 Emergency Signal
- 🟪 Manual Machines

SS Workstation Legend

TW	Tack Welding
USTW	Robotic Under Slug Tack Welding
HSKW	RoboticHead Stock Skeleton Welding
SKMIG	Robotic Skeleton MIG Welding
CSMIG	Robotic Corrugated Sheet MIG Welding
MTFRW	Manual Tack & Full Run Welding
LTW	Lavatory Side Wall Tack Welding
SPOT	Robotic Spot Welding
MIG	Robotic MIG Welding
CLINE	Robotic Carline Arch MIG Welding
RFBW	Robotic Roof Bearer MIG Welding

SS OP Legend

OP Codes	OP Name
R	Robotic Station
C	CNC Station
M	Manual Station
TS	RFID Tracking Station

SS Line Legend

Line Code	Line Name
SA	Shell Assembly Line
UF	Underframe Robotic Line
SWL	Side Wall Left Line

Time History

SWR-SPOT-R1   13:19   13:16
SWL-SPOT-R1   13:19   13:16
SWR-RFBW-R1   13:19   13:16
SWL-RFBW-R1   13:19   13:16
SWR-MIG-R1   13:19   13:16
SWL-MIG-R1   13:19   13:16
EWR-MIG-R1   13:19   13:16
EWL-MIG-R1   13:19   13:16
RF-MIG-R1   13:19   13:16
RF-SPOT-R1   13:19   13:16
UF-CSMIG-R1   13:19   13:16
UF-CSMIG-R2
UF-SKMIG-R1   13:19   13:16
UF-SKMIG-R2
UF-MCMC-R1   13:19   13:16
UF-HSKW-R1   13:19   13:16
UF-USTW-R1   13:19   13:16
SA-SFJ-R1   13:19   13:16

Figure 2.3

Current Status

MCF-SMS-LCMA3-C1
MCF-SMS-LCMA3-C2
MCF-SMS-LCWMA3-C1
MCF-SMS-LCWMA3-C2

Status History

MCF-SMS-LCMA3-C1 WF
MCF-SMS-LCMA3-C2 WF
MCF-SMS-LCWMA3-C1 WF
MCF-SMS-LCWMA3-C2 WF

13:19 13:18 13:17 13:16 13:15 13:14 13:13 13:12 13:11 13:10 13:09 13:08 13:07 13:06   13:04
27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10   27/10

Equipment Legend

Shop Legend

Shop Codes	Shop Name
SS	Shell Shop
SMS	Sheet Metal Shop
BS	Bogie Shop
WS	Wheel Shop
CS	Carpentry Shop
PS	Paint Shop
MS	Machine Shop
TR	Tool Room

Workstation Legend

WS Code	Workstation Name
LCMA3	Laser Cutting Machine
LCWMA3	Laser Cutting and Welding Machine

OP Legend

OP Codes	OP Name
C	CNC Station

Figure 2.4

daqPanel.vi

File Window

Shell Shop **Sheet Metal Shop** **Bogie Shop** **Wheel Shop**

Current Status	Status History	Equipment Legend

Current Status
- MCF-BS-BMC-C1
- MCF-BS-BMC-C2
- MCF-BS-BMM-C1
- MCF-BS-EMM-C1
- MCF-BS-BFMC-C1
- MCF-BS-BFMC-C2

Status History
- MCF-BS-BMC-C1 WF
- MCF-BS-BMC-C2 WF
- MCF-BS-BMM-C1 WF
- MCF-BS-EMM-C1 WF
- MCF-BS-BFMC-C1 WF
- MCF-BS-BFMC-C2 WF

13:19 13:18 13:17 13:16 13:15 13:14 13:13 13:12 13:11 13:10 13:09 13:08 13:07 13:06 13:04
27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10

Equipment Legend

Shop Legend

Shop Codes	Shop Name
SS	Shell Shop
SMS	Sheet Metal Shop
BS	Bogie Shop
WS	Wheel Shop
CS	Carpentry Shop
PS	Paint Shop
MS	Machine Shop
TR	Tool Room

Workstation Legend

WS Code	Workstation Name
BMC	Bolster Machining Center
BMM	Bed Milling Machine
EMM	Edge Milling Machine
BFMC	Bogie Frame Machining Center

OP Legend

OP Codes	OP Name
C	CNC Station

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daqPanel.vi

File Window

Shell Shop **Sheet Metal Shop** **Bogie Shop** **Wheel Shop**

Current Status	Status History	Equipment Legend

Current Status
- MCF-WS-AHCS-A1
- MCF-WS-ATM-C1
- MCF-WS-CGM-C1
- MCF-WS-EDCSTRM-C1
- MCF-WS-SWLM-C1
- MCF-WS-VTLM-C1
- MCF-WS-WHCS-A1

Status History
- MCF-WS-AHCS-A1 WF
- MCF-WS-ATM-C1 WF
- MCF-WS-CGM-C1 WF
- MCF-WS-EDCSTRM-C1 WF
- MCF-WS-SWLM-C1 WF
- MCF-WS-VTLM-C1 WF
- MCF-WS-WHCS-A1 WF

13:19 13:18 13:17 13:16 13:15 13:14 13:13 13:12 13:11 13:10 13:09 13:08 13:07 13:06 13:04
27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10 27/10

Equipment Legend

Shop Legend

Shop Codes	Shop Name
SS	Shell Shop
SMS	Sheet Metal Shop
BS	Bogie Shop
WS	Wheel Shop
CS	Carpentry Shop
PS	Paint Shop
MS	Machine Shop
TR	Tool Room

Workstation Legend

WS Code	Workstation Name
AHCS	Automated Axle Handling
ATM	Axle Turning Machine
CGM	Cylindrical Grinding Machine
EDCSTRM	End Drilling, Counter Sinking, Tapping and Recentering Machine
SWLM	Surface Wheel Lathe Machine
VTLM	Vertical Turning Lathe Machine
WHCS	Automated Axle Handling

OP Legend

OP Codes	OP Name
C	CNC Station

3. Analytics

Figure 3.1

In an Analytics page, first tab (Resource and Utilization) shows how effective and efficient different machines are being used during the completion of given order.

Figure 3.2

4. Machine Details

Figure 4.1

Figure 4.2

In the machine details page, details of different machines present on different shops are showing in the table. The machine details table is connected to the MS-Excel sheet and can be modify directly form MS-Excel sheet.

5. Bill of Materials

Figure 5.1

Already manufactured items and purchased items can be added in the Inventory using material details table by pressing the *'Save'* button given in Bill of Materials page. All the details can be clear using clicking *'Clear'* button. These items can be transferred to the inventory by pressing the *'Move to Inventory'* button.

These items can be saved separately in the MS-Excel sheet by clicking the *'Save to Excel'* button. Also, we can print the items of materials details table or generate a PDF file by clicking *'Print'* button. *'Refresh'* button clears all the data present inside the material details table.

If an item is purchased then we need to enable the *'check box'* in material details table for showing the purchased items in Inventory.

Figure 5.2

Bill of Material

Name	Roofwall Left complete
Drawing No.	LE16100f
Number Per Coach	1
Quantity	4
Machine Name	SH0130
Description	SH

Save **Clear**

Material Details

	Name	Description	Drawing No.	Number Per Coach	Quantity	Machine Name	Purchased	Availability
1	Side wall Left complete	SH	LE14101 e	1	2	SH0110	☑	Move to Inventory
2	End wall Left complete	SH	1.10113.0.20.120.001	1	3	SH0120	☑	Move to Inventory
3	Roofwall Left complete	SH	LE16100f	1	4	SH0130	☑	Move to Inventory

Click To add virtual components to scheduler inventory
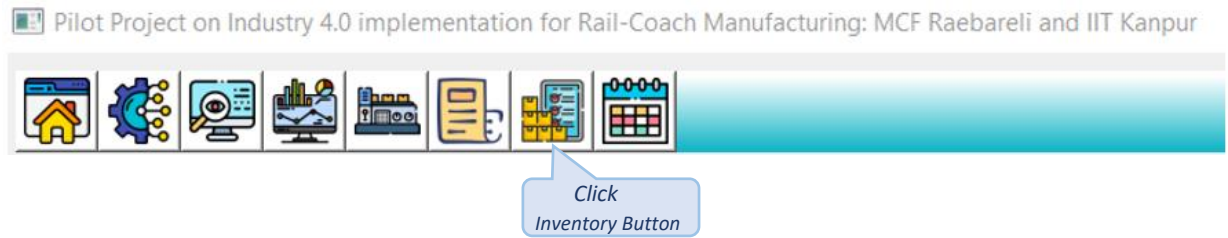
Figure 5.3

6. Inventory

Figure 6.1

Inventory page can be open by clicking the '*Inventory*' button as shown in figure (6.1).

Already manufactured and purchased items are added in the inventory as shown in figure (6.2). These inventories can be used to manufactured a component as per order.

Inventory Details

	Name	Description	Drawing No.	Number Per Coach	Quantity	Route	Purchased	Availability
1	Side wall Left ...	SH	LE14101e	1	2	SH0110	Yes	Available
2	End wall Left ...	SH	1....	1	3	SH0120	Yes	Available
3	Roof wall Left ...	SH	LE16100f	1	4	SH0130	Yes	Available

Inventory components

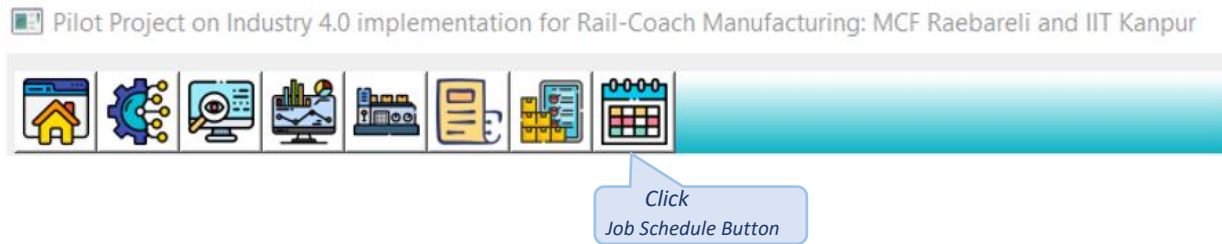**Figure 6.2**

7. Job Schedule

Figure 7.1

Job Schedule page will open by clicking the *'Job Schedule'* button as shown in figure (7.1). In this page schedule will be generated with different variant of coaches and presented by Gantt chart and Machine loading chart as shown in figure (7.4) and figure (7.5) respectively.

Oder details will be saved in the table by clicking '*Save*' button. Similarly, all the order details can be filled in the table and an awaited status will show in the table.
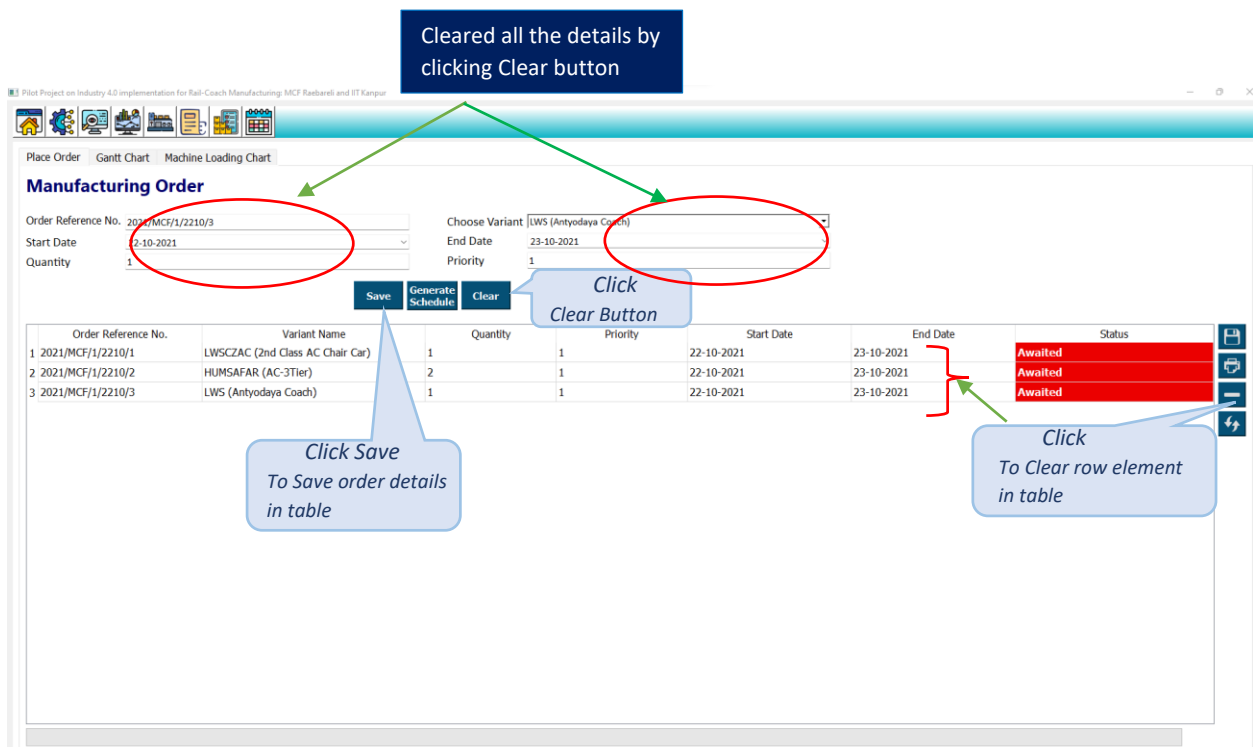

Figure 7.2

We can save the table details in the MS-Excel sheet by *'Save to Excel'* button and take print for the same page using *'Print'* button. Click *'Remove row'* button to remove any row from the table. We can clear all the order details from the table and items from inventory using *'Refresh'* button.

A schedule will be generated using provided data after pressing the *'Generate Schedule'* button. A popup message of chart updated and order completed status will show after successful generation of schedule.
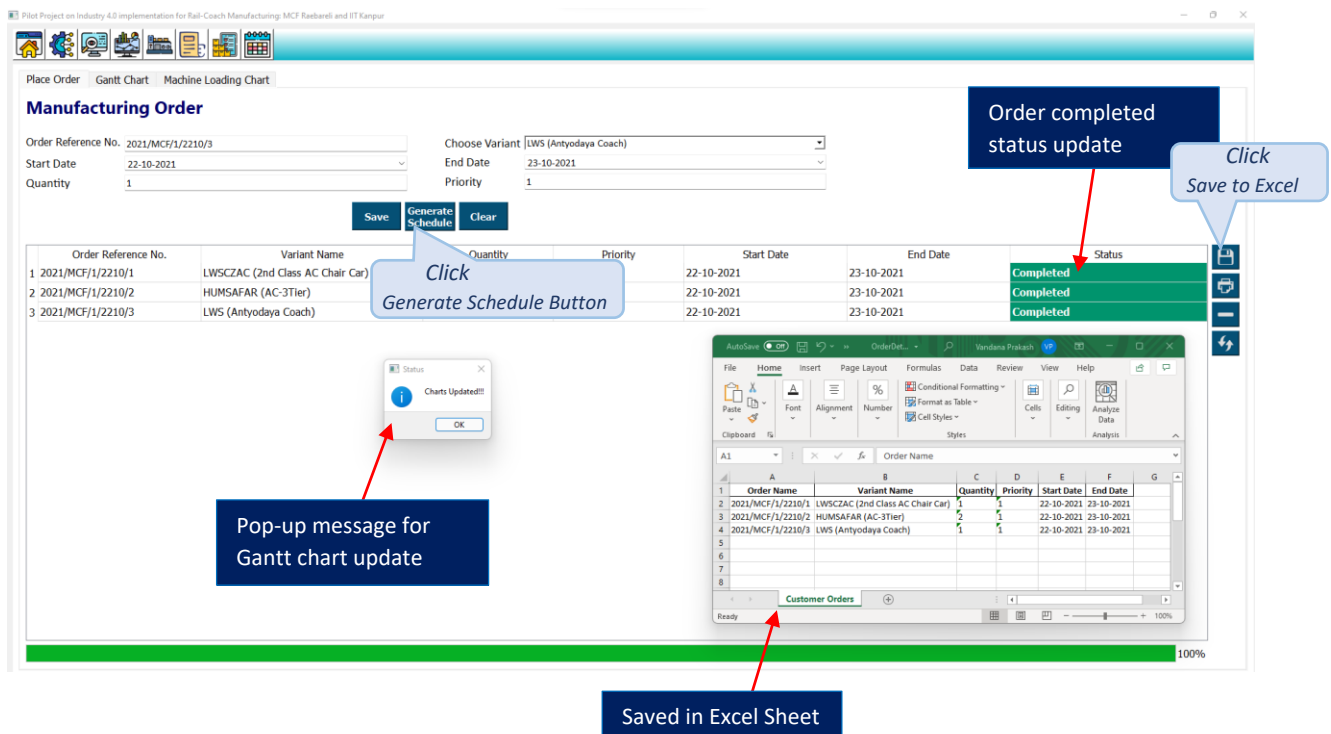

Figure 7.3

Generated schedule will provide Gantt chart and Machine loading chart. Gantt chart shows the operation details with time for different coach variants. On the other hand, Machine loading chart will show the operation on machine with time for different coach variants.
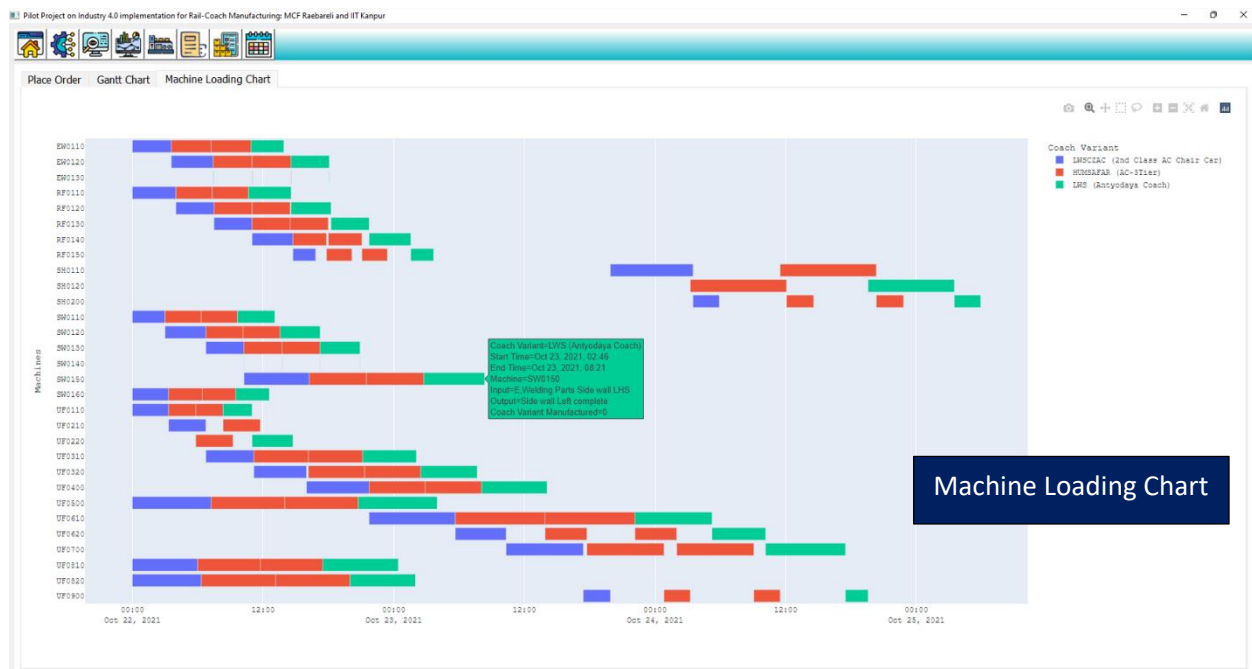
Figure 7.4

Figure 7.5