Adventure Works

29/08/2024

Title: Production Analysis of 2013 Data Analyst\ Maher Mahmoud

Glance on the results

AdventureWorks (2013) Year Glimpse ..

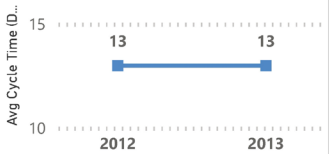
Behind the Scenes of Production

SetupTime Ratio
of total production time (2013)

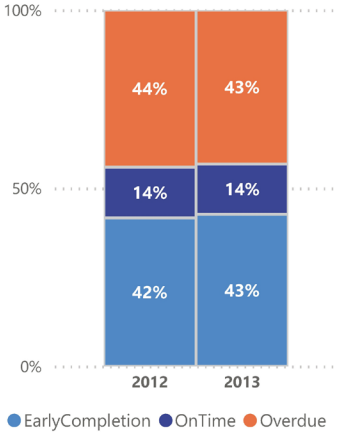
33% !

Acceptable ratio: 20% (+13%)

Did the Avg Manufacturing CycleTime Changed in year?



What is Overdue workorders proportion in each year??

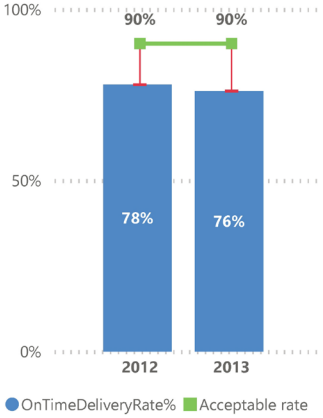


Scrap Rate
of Total Quantity Produced (2013)

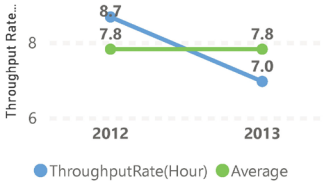
0.29%✓

Acceptable rate: 1% (-0.71%)

Did OnTimeDeliveryRate% got fixed ?



Did ThroughputRate improved over the year?



Production Efficiency Rate
Actual/Planned time (2013)

89%✓

Acceptable ratio: 85% (+4%)

Scrap cost Rate
of total production cost (2013)

0.19%✓

Acceptable rate: 0.5% (-0.31%)

- where these 5 Products have the Highest discrepancy in the records (Positive & Negative)

ProductID	ActualStocked	RecordedInventory	Difference
715	216	-6,592	6,808
708	324	-6,532	6,856
711	216	-6,743	6,959
870	252	-6,815	7,067
712	288	-8,311	8,599

ProductID	ActualStocked	RecordedInventory	Difference
3	1,352	911,890	-910,538
532	1,257	469,468	-468,211
316	1,361	236,002	-234,641
331	1,405	236,002	-234,597
324	1,629	234,734	-233,105

About the Company

A large, multinational manufacturing company
that produces and sells **bicycles** and **related products**.

Goal

Improve company production **performance**

Objectives

Extract **insights** and giving **recommendations** using company 2012/2013 production Data

Method

1. Schema **Metadata Exploration**
2. Define Analytical Goals and KPIs
3. Perform the needed **Data wrangling**
4. Exploratory Data Analysis (EDA)
5. Extract **insights** and giving **recommendations** (Go to)

Tools Used

- RDBMS / DatabaseEngine : MS SQLserver
- DB Management Tool : DBeaver
- Dashboard Editor : MS PowerBI
- Report Editor : PowerPoint2024

Note All Files and SQL Queries the got used in this Analysis are available on the analyst's GitHub repository

Prepare
Work Environment

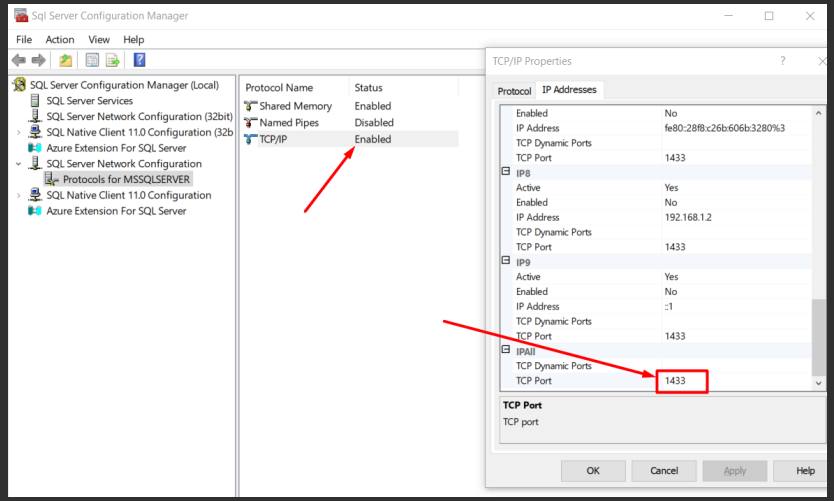
enabling SQLserver Port

To connect with DBeaver

SQL Server Configuration Manager >
SQL Server Network Configuration >
TCP/IP > **Enabled**

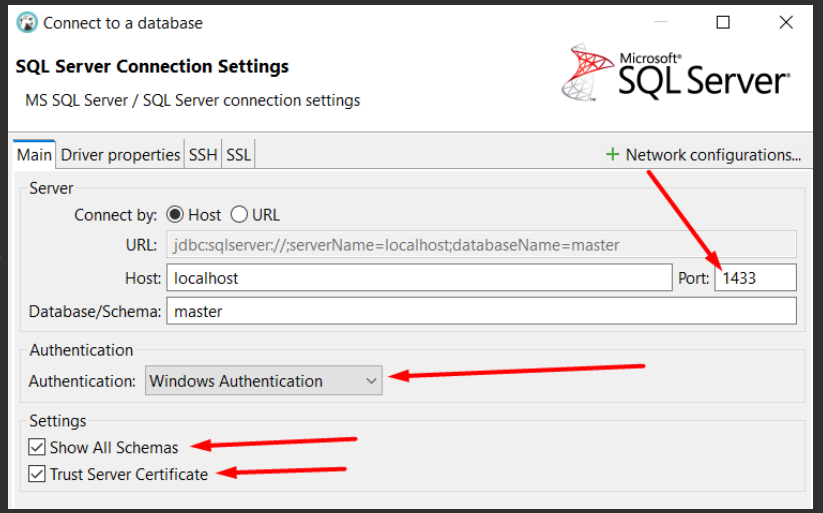
Knowing the used port

TCP/IP Properties > IP Addresses >
IPAll > TCP Port > **(1433)**



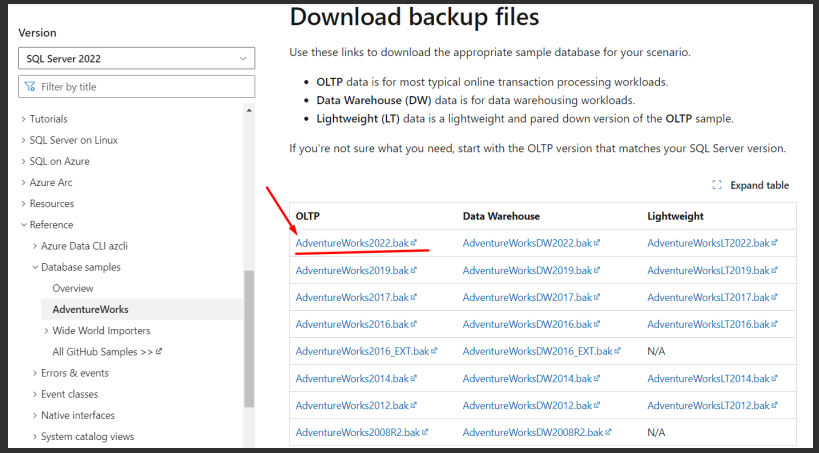
Connect DBeaver with SQLserver

Dbeaver > Connect Database > SQLserver
::Setting::
Local Host > Port:1433
Confirm Authentication
Trust Server Certificate (Enabled)



Data Source

learn.microsoft.com > SQL > Database Samples > AdventureWorks2022.bak (OLTP Version)



Import the Data

Using DBeaver

Viewing the list of files in .bak file

Restore step

Restore the database and files
Into selected path

```
-- Step 1: see the of List the logical file names contained in the first backup set
RESTORE FILELISTONLY
FROM DISK = 'C:\Users\Maher\Downloads\AdventureWorks2022\AdventureWorks2022.bak'
WITH FILE = 1;

-- Step 2: Restore the database from the second backup set
-- FILE = 1 specifies that the first backup set in the file should be used
-- MOVE specifies the new physical file locations for the data and log files
-- NOUNLOAD specifies that the tape drive is not to be unloaded (usually not needed for disk backups)
-- REPLACE specifies that the existing database should be overwritten
RESTORE DATABASE [AdventureWorks2022]
FROM DISK = 'C:\Users\Maher\Downloads\AdventureWorks2022\AdventureWorks2022.bak'
WITH FILE = 1,
MOVE 'AdventureWorks2022' TO 'D:\x\SQLserver\MSSQL16.MSSQLSERVER\MSSQL\DATA\AdventureWorks2022.mdf',
MOVE 'AdventureWorks2022_Log' TO 'D:\x\SQLserver\MSSQL16.MSSQLSERVER\MSSQL\Log\AdventureWorks2022.ldf',
NOUNLOAD,
REPLACE;
```

Statistics 1 | Output

Enter a part of a message to search for here

```
Processed 25376 pages for database 'AdventureWorks2022', file 'AdventureWorks2022' on file 1.
Processed 2 pages for database 'AdventureWorks2022', file 'AdventureWorks2022_log' on file 1.
RESTORE DATABASE successfully processed 25378 pages in 2.131 seconds (93.036 MB/sec).
```

Note Alternative method using Windows **PowerShell**

Schema Metadata Exploration

Schema Metadata Exploration

```sql
--What Tables in Production Schema ??
--and How Many BaseTables ??
SELECT TABLE_NAME
        ,COUNT(TABLE_NAME) over() TablesCount
FROM information_schema.tables
WHERE TABLE_SCHEMA='Production'
    AND TABLE_TYPE='BASE TABLE'
```

How Many BaseTables In Production Schema??

25 TotalTables

Note ViewsTables not included

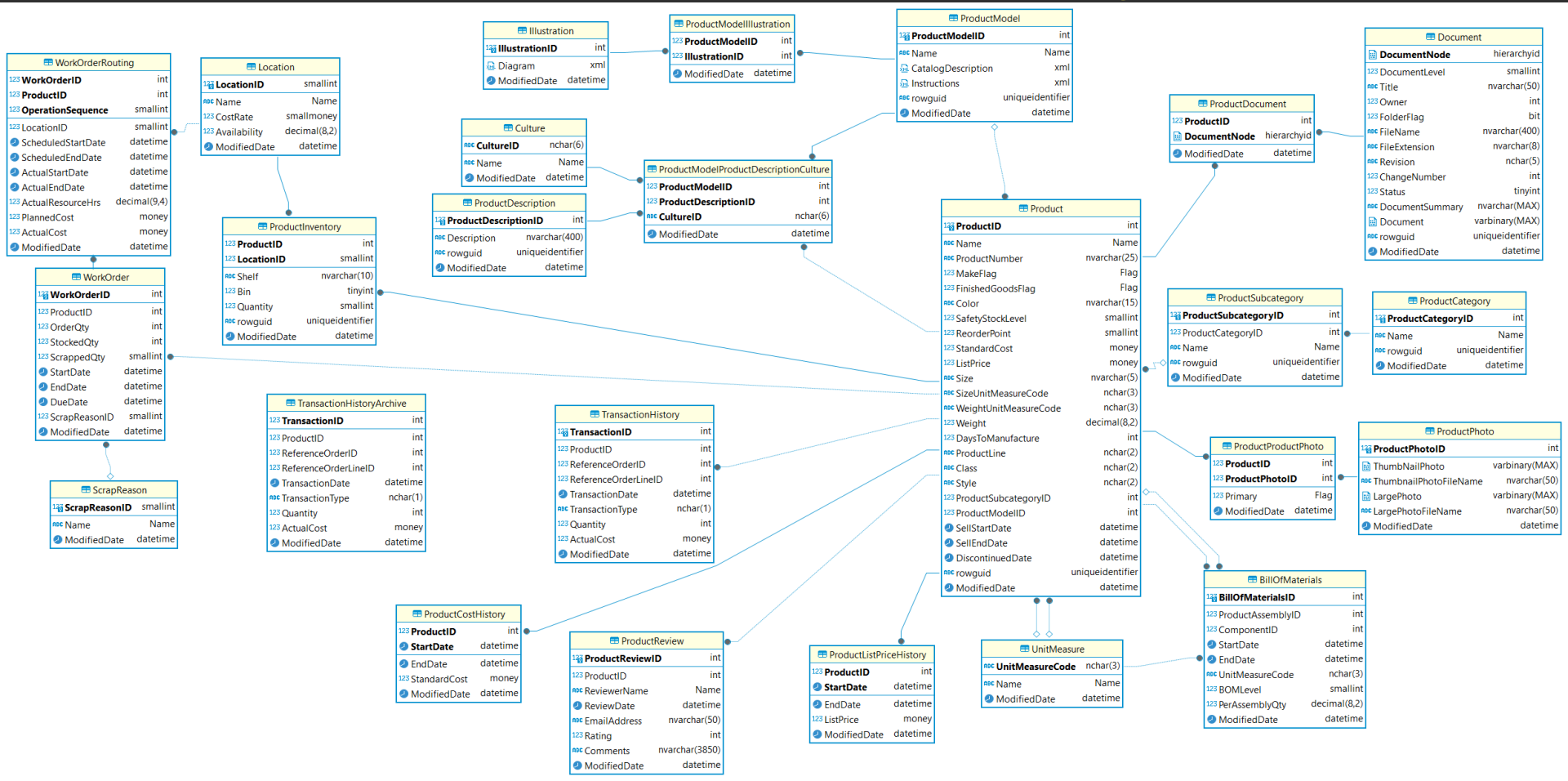
	TABLE_NAME	TablesCount
17	TransactionHistoryArchive	25
18	ProductSubcategory	25
19	UnitMeasure	25
20	WorkOrder	25
21	Culture	25
22	WorkOrderRouting	25
23	Document	25
24	Illustration	25
25	Location	25

- Columns details and count On each Table??

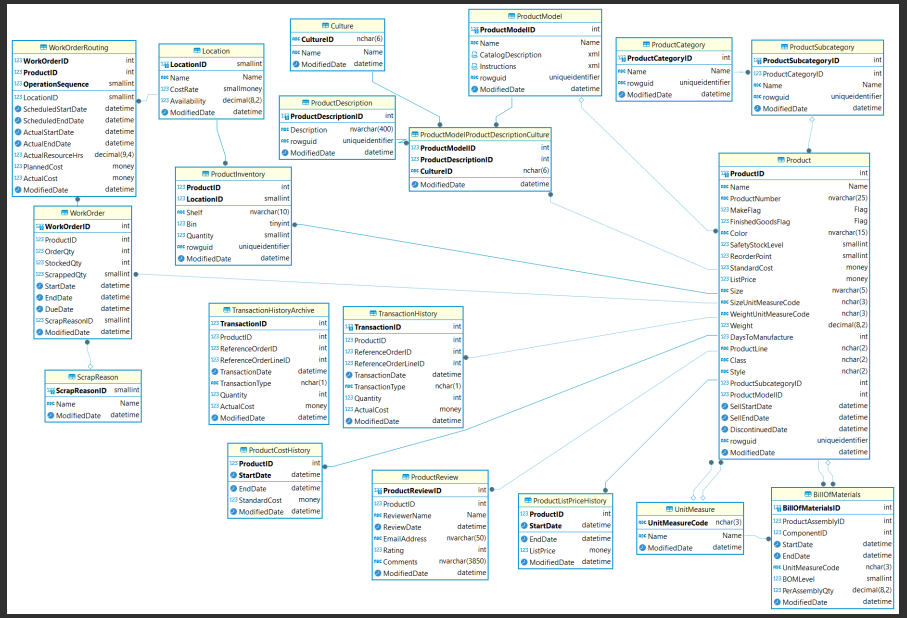
```sql
--Columns Details and Count in every Production schema Table
SELECT TABLE_NAME ,COLUMN_NAME ,ORDINAL_POSITION as Position
        ,DATA_TYPE ,IS_NULLABLE as [NULLABLE?]
        ,COUNT(TABLE_NAME) OVER(PARTITION by TABLE_NAME)
            AS ColumnsCount
FROM information_schema.columns
WHERE table_schema = 'Production'
ORDER BY TABLE_NAME, ORDINAL_POSITION
```

	TABLE_NAME	COLUMN_NAME	Position	DATA_TYPE	NULLABLE?	ColumnsCount
1	BillOfMaterials	BillOfMaterialsID	1	int	NO	9
2	BillOfMaterials	ProductAssemblyID	2	int	YES	9
3	BillOfMaterials	ComponentID	3	int	NO	9
4	BillOfMaterials	StartDate	4	datetime	NO	9
5	BillOfMaterials	EndDate	5	datetime	YES	9
6	BillOfMaterials	UnitMeasureCode	6	nchar	NO	9
7	BillOfMaterials	BOMLevel	7	smallint	NO	9
8	BillOfMaterials	PerAssemblyQty	8	decimal	NO	9
9	BillOfMaterials	ModifiedDate	9	datetime	NO	9
10	Culture	CultureID	1	nchar	NO	3

Production Schema Diagram



Tables Filtering



- **Eliminate** irrelevant Tables for this analysis

((Removed Tables))

- **Document** :
  reason: only contain .doc and file name data for each product
- **ProductDocument** :
  reason: Junction table for removed table from the analysis
- **ProductPhoto** :
  reason: only contain .gif and file name data for each product
- **ProductProductPhoto** :
  reason: Junction table for removed table from the analysis
- **Illustratuion** :
  reason: only contain XAML Export data for each product
- **ProductModelIllustration** :
  reason : Junction table for removed table from the analysis

Total Tables left 19 Table→

Manufacturing Data Landscape

1) From ProductCategory Table

ProductCategoryID	Name
1	Bikes
2	Components
3	Clothing
4	Accessories

There is 4 main categories

2) From ProductSubcategory Table .. There is 37 subcategories

3) From Product Table .. There is 504 Product

4) From ProductModel Table .. There is 128 product models

5) From Culture Table .. There is 8 cultural designs

6) From Location Table .. There is 14 production sector

7) From WorkOrder Table .. There is 72,591 completed workorder since June 2011

8) From ScrapReason Table .. There is 16 reasons for scraping a Production

Define Analytical Goals

KPIs AND Formulas

Define Analytical Goals

Target KPIs AND Its Formulas

1) Production Efficiency and Performance Metrics:

1- Production Schedule Adherence = Actual Production Duration - Scheduled Production Duration (for all orders)

2- Throughput Rate = Total Units Produced / Total Production Time

3- Cost of Poor Quality (COPQ) = Scrap Cost / Total Production Cost * 100

4- Setup Time Ratio = Total Setup Time / Total Production Time * 100

5- Production Efficiency Rate = (Actual Production Time / Planned Production Time) * 100

6- Scrap Rate = (Quantity of Scrapped Items / Total Quantity Produced) * 100

7- Manufacturing Cycle Time = Average(ActualEndDate - ActualStartDate) for all WorkOrders

2) Inventory and Resource Metrics:

8- Inventory Accuracy = (Total Correct Inventory Counts / Total Inventory Counts) * 100

3) Delivery Performance:

9- On-Time Delivery Rate = Percentage of orders delivered on or before the due date

Data wrangling

DataTypes / Missing Values / Duplicates / Outliers

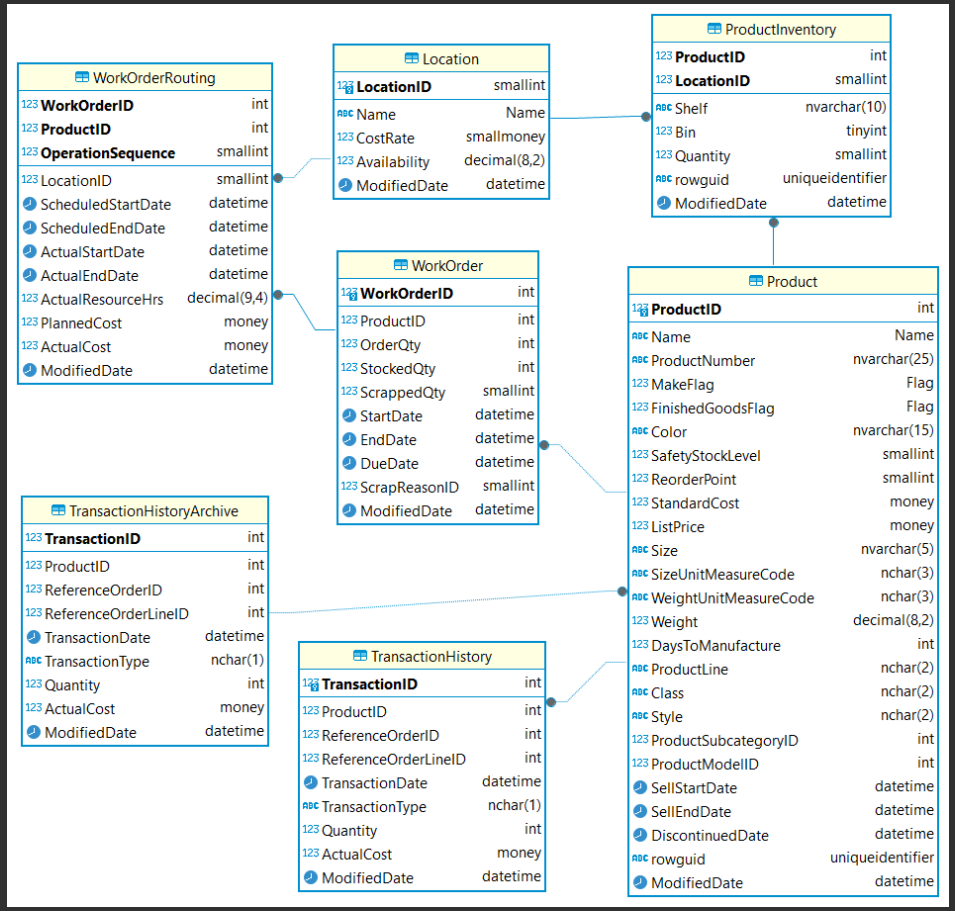
Data wrangling

1) DEFINE Target Tables:

- WorkOrder
- WorkOrderRouting
- Product
- ProductInventory
- TransactionHistory
- TransactionHistoryArchive
- Location
- ProductCostHistory

2) Checking Data types of each column

((All ARE CORRECT as SHOWN))



Data wrangling

- Checking Nulls and Duplicates

3) Checking Nulls / Missing Values (in WorkOrder table as example) :

```sql
SELECT *
FROM production.WorkOrder
WHERE OrderQty IS NULL
   OR ScrappedQty IS NULL
   OR StartDate IS NULL
   OR EndDate IS NULL;
```

((NO NULLs or Missing Values))

WorkOrderID	ProductID	OrderQty	StockedQty	ScrappedQty	StartDate	EndDate

4) Checking if there is any Duplicates (in WorkOrder table as example) :

```sql
SELECT WorkOrderID,
       COUNT(*) DupliCount
FROM production.WorkOrder
GROUP BY WorkOrderID
HAVING COUNT(*) > 1;
```

((There No Duplicates as SHOWN))

WorkOrderID	DupliCount

Data wrangling

- Checking Outliers

5) Checking if there are Outliers potential Using Zscore (on OrderQty in WorkOrder table as example) :

```
----1)) Compute mean and standard deviation
WITH Stats AS (
    SELECT
        AVG(OrderQty) AS MeanQty,
        STDEV(OrderQty) AS StdDevQty
    FROM production.WorkOrder
)
----2)) Select the potentials outliers
SELECT WorkOrderID,
        ProductID,
        StartDate,
        OrderQty,
        (OrderQty - Stats.MeanQty) / Stats.StdDevQty AS ZScore
FROM production.WorkOrder
CROSS JOIN Stats
WHERE YEAR(StartDate) IN (2012, 2013)
        AND (OrderQty > Stats.MeanQty + 3 * Stats.StdDevQty
         OR OrderQty < Stats.MeanQty - 3 * Stats.StdDevQty);
----3) Investigate the Outliers potentials
```

	WorkOrderID	ProductID	StartDate	OrderQty	ZScore
322	50,535	330	2013-11-02 00:00:00.000	2,800	4
323	50,536	398	2013-11-02 00:00:00.000	3,518	5.049
324	50,537	399	2013-11-02 00:00:00.000	4,492	6.472
325	50,539	401	2013-11-02 00:00:00.000	5,190	7.492
326	50,540	529	2013-11-02 00:00:00.000	3,518	5.049
327	50,541	532	2013-11-02 00:00:00.000	17,968	26.16
328	50,542	533	2013-11-02 00:00:00.000	4,492	6.472
329	50,543	534	2013-11-02 00:00:00.000	4,492	6.472
330	50,547	316	2013-11-02 00:00:00.000	8,984	13.035
331	50,548	331	2013-11-02 00:00:00.000	8,984	13.035
332	50,549	350	2013-11-02 00:00:00.000	4,492	6.472
333	50,550	531	2013-11-02 00:00:00.000	4,492	6.472
334	53,864	3	2013-12-03 00:00:00.000	17,150	24.965
335	53,865	324	2013-12-03 00:00:00.000	4,162	5.99
336	53,873	401	2013-12-03 00:00:00.000	2,590	3.693
337	53,875	532	2013-12-03 00:00:00.000	8,324	12.07
338	53,881	316	2013-12-03 00:00:00.000	4,162	5.99
339	53,882	331	2013-12-03 00:00:00.000	4,162	5.99

→ There are 339 Outliers Potential needs to be investigated

→ After Investigating we found out that these are normal OrderQty at the beginning of each month .. Thus there is No OUTLIERS

Data Analyzing

Exploratory Data Analysis (EDA)

Data Analyzing

1) Production Efficiency and Performance Metrics

1- Production Schedule Adherence:

Actual Production Duration - Scheduled Production Duration (for all orders)

```
--------------------------------------------------------------------------------------------
--1) Production Efficiency and Performance Metrics:
---1- Production Schedule Adherence = Actual Production Duration - Scheduled Production Duration (for all orders)
WITH src AS (
    SELECT YEAR(ScheduledStartDate) AS Year,
           WorkOrderID,ProductID,
           AVG(DATEDIFF(DAY,ScheduledStartDate,ScheduledEndDate)) Planned,
           AVG(DATEDIFF(DAY,ActualStartDate,ActualEndDate)) Actual,
           (AVG(DATEDIFF(DAY,ScheduledStartDate,ScheduledEndDate))
               -AVG(DATEDIFF(DAY,ActualStartDate,ActualEndDate))) as diff --Planned - Actual
    FROM production.WorkOrderRouting
    WHERE YEAR(ScheduledStartDate) in (2012,2013)
    GROUP BY YEAR(ScheduledStartDate), WorkOrderID, ProductID
)
SELECT YEAR,
    COUNT(src.WorkOrderID) TotalWorkOrders,
    COUNT(CASE WHEN diff=0 THEN 1 ELSE null END) AS OnTimeWorkOrders, -------Planned = Actual
    COUNT(CASE WHEN diff>0 THEN 1 ELSE null END) AS EarlyCompletionWorkOrders, --Planned > Actual
    COUNT(CASE WHEN diff<0 THEN 1 ELSE null END) AS OverdueWorkOrders, ----Planned < Actual
    COUNT(CASE WHEN diff<0 THEN 1 ELSE null END)*100/COUNT(src.WorkOrderID) AS [%% OverdueOrdersPercentage %%]
FROM src
GROUP BY YEAR
ORDER BY YEAR DESC;
--------------------------------------------------------------------------------------------
```

OverdueWorkOrdersRate in 2013

- decreased by 1%
- But still high at 43%

The standard acceptable rate of Manufacturing and Production is between 5%~10%

As OverdueWorkOrdersRate exceeds 10%
So we indicates major issue

	YEAR	TotalWorkOrders	OnTimeWorkOrders	EarlyCompletionWorkOrders	OverdueWorkOrders	%% OverdueOrdersPercentage %%
1	2,013	17,788	2,509	7,594	7,685	43
2	2,012	10,162	1,450	4,235	4,477	44

Data Analyzing

1) Production Efficiency and Performance Metrics

2- Throughput Rate:

Total Units Produced / Total Production Time

```sql
SELECT YEAR(wo.StartDate) AS Year,
    CAST(SUM(wor.ActualResourceHrs) AS INT) ActualResourceHrs,
    SUM(wo.OrderQty) TotalOrdersQty,
    SUM(wo.OrderQty) / SUM(wor.ActualResourceHrs) AS [ThroughputRate(Hour)]
FROM production.WorkOrder AS wo
JOIN production.WorkOrderRouting AS wor
    ON wo.WorkOrderID = wor.WorkOrderID
WHERE YEAR(wo.StartDate) IN (2012, 2013)
GROUP BY YEAR(wo.StartDate);
```

From 2012 to 2013 :

- Production increased significantly
- but labor efficiency decreased.

Year	ActualResourceHrs	TotalOrdersQty	ThroughputRate(Hour)
2,013	97,188	677,075	6.967
2,012	53,488	464,304	8.68

Data Analyzing

1) Production Efficiency and Performance Metrics

3- Cost of Poor Quality (COPQ):

Scrap Cost / Total Production Cost * 100

```
---3- Cost of Poor Quality (COPQ) = Scrap Cost / Total Production Cost * 100
SELECT YEAR(wo.StartDate) Year,
       SUM(wo.OrderQty) AS OrderQty, CAST(SUM(wo.OrderQty*pch.StandardCost) AS INT) ProductionCost,
       SUM(wo.ScrappedQty) AS StockedQty, CAST(SUM(wo.ScrappedQty*pch.StandardCost) AS INT) ScrappedCost,
       /*percentage*/ (SUM(wo.ScrappedQty*pch.StandardCost))*100/(SUM(wo.OrderQty*pch.StandardCost))
                      AS [%%ScrappedCost%%]
FROM Production.WorkOrder wo
join Production.ProductCostHistory pch on wo.ProductID=pch.ProductID
    AND wo.StartDate >= pch.StartDate
    AND (wo.StartDate <= pch.EndDate OR pch.EndDate IS NULL)
WHERE YEAR(wo.StartDate) in (2012,2013)
GROUP BY YEAR(wo.StartDate)
```

- From 2012 to 2013 the scrap cost% is Approximately the same
- In worldclass manufacturing operations standards is often below 0.5%
- As scrap cost% is below 0.5% we indicates top-tier performance

	Year	OrderQty	ProductionCost	StockedQty	ScrappedCost	%%ScrappedCost%%
1	2,013	285,236	64,547,335	579	120,151	0.1861
2	2,012	165,116	44,900,159	320	88,547	0.1972

Data Analyzing

1) Production Efficiency and Performance Metrics

4- Setup Time Ratio:

Total Setup Time / Total Production Time * 100

```sql
---4- Setup Time Ratio = Total Setup Time / Total Production Time * 100
SELECT YEAR(wor.ScheduledStartDate) Year,
       AVG(DATEDIFF(DAY, wor.ScheduledStartDate, wor.ActualStartDate)) AS [TotalSetupTime(AVG)],
       AVG(DATEDIFF(DAY, wor.ActualStartDate, wor.ActualENDDate)) AS [TotalProductionTime(AVG)],
       /*SetupTimeRatio*/ (AVG(DATEDIFF(DAY, wor.ScheduledStartDate, wor.ActualStartDate)))*100/
       (AVG(DATEDIFF(DAY, wor.ActualStartDate, wor.ActualENDDate))) AS [%%SetupTimeRatio%%]
FROM Production.WorkOrderRouting wor
JOIN Production.WorkOrder wo ON wor.WorkOrderID = wo.WorkOrderID
WHERE YEAR(wor.ScheduledStartDate) IN (2012,2013)
GROUP BY YEAR(wor.ScheduledStartDate)
ORDER BY YEAR(wor.ScheduledStartDate)
```

- From 2012 to 2013 the Setup Time Ratio is the same at 33%
- The acceptable Setup Time Ratio is often between 10%~20%
- As Setup Time Ratio is more than 20% we indicates High setup time

Year	TotalSetupTime(AVG)	TotalProductionTime(AVG)	%%SetupTimeRatio%%
2,012	4	12	33
2,013	4	12	33

Data Analyzing

1) Production Efficiency and Performance Metrics

5- Production Efficiency Rate:

(Actual Production Time / Planned Production Time) * 100

```sql
---5- Production Efficiency Rate = (Actual Production Time / Planned Production Time) * 100
SELECT YEAR(ScheduledStartDate) AS Year,
       SUM(DATEDIFF(DAY, wor.ScheduledStartDate, wor.ScheduledEndDate)) AS TotalPlannedProductionTime,
       SUM(DATEDIFF(DAY, wor.ActualStartDate,wor.ActualEndDate)) AS TotalActualProductionTime,
       /*ProductionEfficiencyRate*/ ((SUM(DATEDIFF(DAY, wor.ScheduledStartDate, wor.ScheduledEndDate)))*100/
       (SUM(DATEDIFF(DAY, wor.ActualStartDate,wor.ActualEndDate)))) AS [%%ProductionEfficiencyRate%%]
FROM production.WorkOrderRouting wor
WHERE YEAR(ScheduledStartDate) IN (2012,2013)
GROUP BY YEAR(ScheduledStartDate);
```

- From 2012 to 2013

  the Production Efficiency Rate% is Approximately the same at 89%

- The acceptable Production Efficiency Rate is typically between 85% to 95%.

- As Production Efficiency Rate is between that range

  So we indicates efficient performance

Year	TotalPlannedProductionTime	TotalActualProductionTime	%%ProductionEfficiencyRate%%
2,013	313,841	350,960	89
2,012	172,887	195,427	88

Data Analyzing

1) Production Efficiency and Performance Metrics

6- Scrap Rate:

(Quantity of Scrapped Items / Total Quantity Produced) * 100

```sql
---6- Scrap Rate = (Quantity of Scrapped Items / Total Quantity Produced) * 100
SELECT YEAR(wo.StartDate) Year,
       SUM(wo.OrderQty) AS OrderQty,
       SUM(wo.ScrappedQty) AS ScrappedQty,
       ((SUM(wo.ScrappedQty) * 100.0) / SUM(wo.OrderQty)) AS [%%ScrapRate%%]
FROM Production.WorkOrder wo
WHERE YEAR(wo.StartDate) in (2012,2013)
GROUP BY YEAR(wo.StartDate)
```

- From 2012 to 2013
  the Scrap Rate% is
  Approximately the same at avg 0.25%
- The standard acceptable rate of
  Manufacturing and Production
  is between 1%~3%
- As scrap rate% is below 1%
  we indicates high efficiency

Year	OrderQty	ScrappedQty	%%ScrapRate%%
2,013	1,909,963	5,496	0.288
2,012	1,304,350	2,962	0.227

Data Analyzing

1) Production Efficiency and Performance Metrics

7- Manufacturing Cycle Time:

Average(ActualEndDate - ActualStartDate) for all WorkOrders

```sql
---7- Manufacturing Cycle Time = Average(ActualEndDate - ActualStartDate) for all WorkOrders
SELECT YEAR(StartDate) YEAR,
    AVG(DATEDIFF(day, StartDate, EndDate)) AS AvgManufacturingCycleTime
FROM production.WorkOrder
WHERE YEAR(StartDate) IN (2013,2012)
GROUP BY YEAR(StartDate);
```

- From 2012 to 2013
  the AVG Manufacturing Cycle Time is still the same at 13 days
- Which tells no change happened

YEAR	AvgManufacturingCycleTime
2,013	13
2,012	13

Data Analyzing

2) Inventory and Resource Metrics

8- Inventory Accuracy:

(Total Correct Inventory Counts / Total Inventory Counts) * 100

```sql
--2) Inventory and Resource Metrics:
---8- Inventory Accuracy = (Total Correct Inventory Counts / Total Inventory Counts) * 100
--- After investigate turned out that Inventory Accuracy is being achieved on 6 products from 432 product
---- which mean we need to give a detailed table for the differences
WITH InventoryCounts AS (
    SELECT pi.ProductID,
           SUM(pi.Quantity) AS ActualStocked
    FROM production.ProductInventory AS pi
    GROUP BY pi.ProductID
),
Transactions AS (
    SELECT ProductID,
           SUM(CASE WHEN TransactionType = 'P' THEN Quantity ELSE 0 END) AS PurchasedProducts,
           SUM(CASE WHEN TransactionType = 'W' THEN Quantity ELSE 0 END) AS ProducedProducts,
           SUM(CASE WHEN TransactionType = 'S' THEN Quantity ELSE 0 END) AS QuantitySold
    FROM ( --combine the TransactionHistory table with its Archive
        SELECT ProductID, Quantity, TransactionType
        FROM production.TransactionHistory
        UNION ALL
        SELECT ProductID, Quantity, TransactionType
        FROM production.TransactionHistoryArchive
    ) AS th
    GROUP BY ProductID
),
RecordedInventory AS (
    SELECT t.ProductID,
           ((t.PurchasedProducts + t.ProducedProducts) - t.QuantitySold) AS RecordedInventory
    FROM Transactions t
)
SELECT ic.ProductID, ic.ActualStocked, ci.RecordedInventory,
    (ci.RecordedInventory - ic.ActualStocked) AS Difference
FROM InventoryCounts ic
JOIN RecordedInventory ci ON ic.ProductID = ci.ProductID
WHERE ic.ActualStocked != ci.RecordedInventory
ORDER BY ic.ProductID;
```

- As Inventory Accuracy is **1.4%** !!!
- only **6 products** has accurate count **matching** the records
- Which means **426 from 432 were mismatched**
- This suggests that there is a **substantial issue** with **inventory tracking** causing the discrepancy

	ProductID	ActualStocked	RecordedInventory	Difference
416	989	150	0	-150
417	990	153	0	-153
418	991	154	0	-154
419	992	164	0	-164
420	993	153	0	-153
421	994	814	40,770	39,956
422	995	816	26,956	26,140
423	996	970	22,542	21,572
424	997	153	0	-153
425	998	155	0	-155
426	999	194	0	-194

Data Analyzing

3) Delivery Performance

9- On-Time Delivery Rate:

Percentage of orders delivered on or before the due date

```sql
--3) Delivery Performance:
---9- On-Time Delivery Rate = Percentage of orders delivered on or before the due date
SELECT YEAR(StartDate) Year,
       COUNT(CASE WHEN DAY(EndDate) <= DAY(DueDate) THEN 1 END)*100.0
       /COUNT(*) AS [%%OnTimeDeliveryRate%%]
FROM production.WorkOrder
WHERE YEAR(StartDate) in(2012,2013)
GROUP BY YEAR(StartDate);
```

- From 2012 to 2013 the On-Time Delivery Rate% got Reduced by 2% from 78% to 76%
- As General Industry Standard is Between 90% to 95%
- Company rate indicated issues such as production bottlenecks, supplier delays, or order processing inefficiencies.

Year	%%OnTimeDeliveryRate%%
2,013	76.118
2,012	78.002

StoryTelling visualization

Charts and Graphs

Data Analyzing

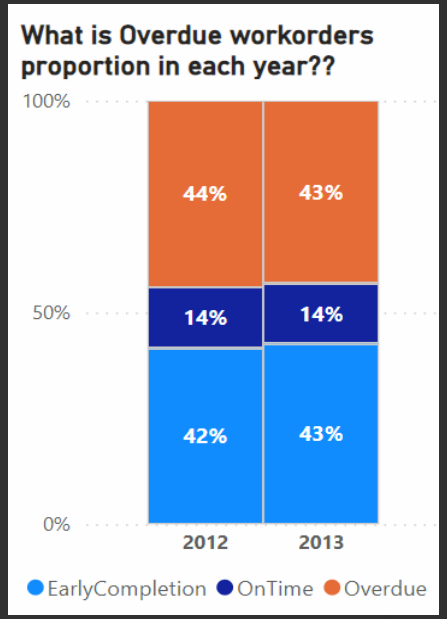
- ETL (Extract, Transform, Load)

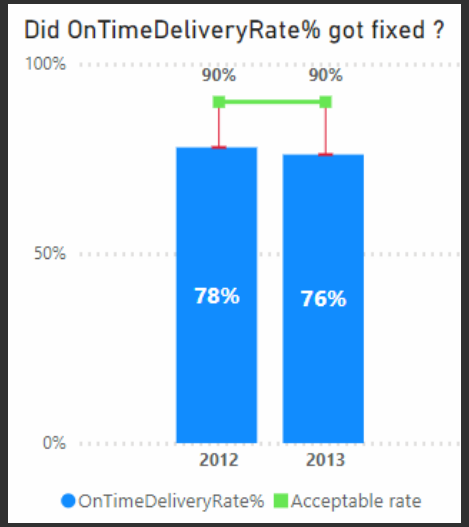
1) Export the All 9 Results to .CSV files
2) Data got Cleaned and Transformed into results already
3) Import the .CSV files to PowerBI
4) Using Suitable Charts & Graphs in best practices

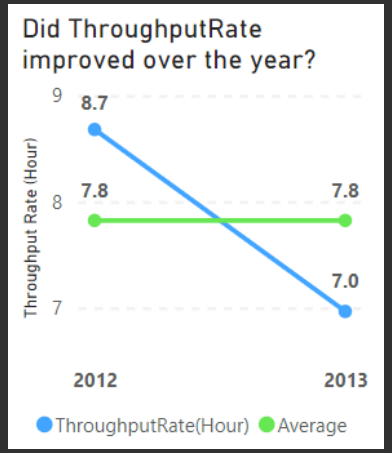
123	123 %%OnTimeDeliveryRate%%
2,013	76.118
2,012	78.002

123 YEAR	123 AvgManufacturingCycleTime
2,013	13
2,012	13

123 Year	123 ActualResourceHrs	123 TotalOrdersQty	123 ThroughputRate(Hour)
2,013	97,188	677,075	6.967
2,012	53,488	464,304	8.68







AdventureWorks (2013) Year Glimpse ..

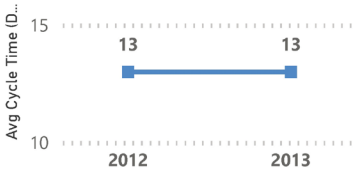
Behind the Scenes of Production

SetupTime Ratio
of total production time (2013)

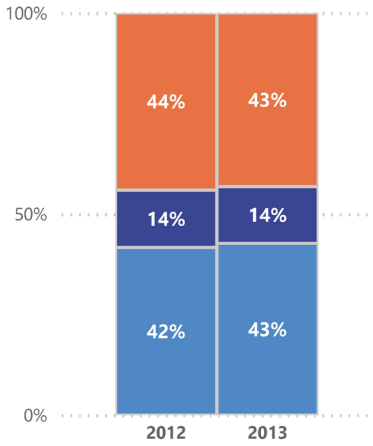
33%!

Acceptable ratio: 20% (+13%)

Did the Avg Manufacturing CycleTime Changed in year?



What is Overdue workorders proportion in each year??

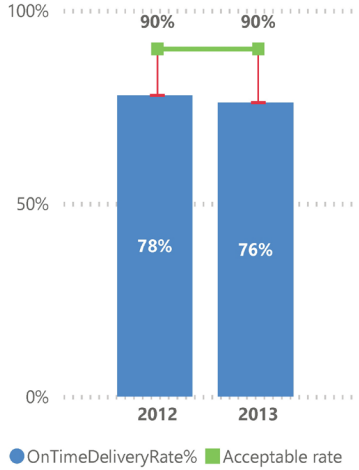


Scrap Rate
of Total Quantity Produced (2013)

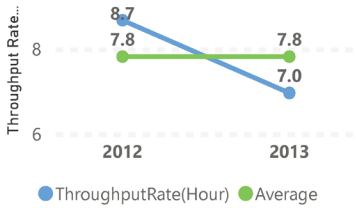
0.29%✓

Acceptable rate: 1% (-0.71%)

Did OnTimeDeliveryRate% got fixed ?



Did ThroughputRate improved over the year?



Production Efficiency Rate
Actual/Planned time (2013)

89%✓

Acceptable ratio: 85% (+4%)

Scrap cost Rate
of total production cost (2013)

0.19%✓

Acceptable rate: 0.5% (-0.31%)

- where these 5 Products have the Highest discrepancy in the records (Positive & Negative)

ProductID	ActualStocked	RecordedInventory	Difference
715	216	-6,592	6,808
708	324	-6,532	6,856
711	216	-6,743	6,959
870	252	-6,815	7,067
712	288	-8,311	8,599

ProductID	ActualStocked	RecordedInventory	Difference
3	1,352	911,890	-910,538
532	1,257	469,468	-468,211
316	1,361	236,002	-234,641
331	1,405	236,002	-234,597
324	1,629	234,734	-233,105

conclusions

Insights & Recommendations

Conclusions AND Insights

1- As **Overdue WorkOrdersRate** from 2012 to 2013 decreased by 1% but still high at 43%
And where standard acceptable rate of Manufacturing and Production is between 5%~10%
Which indicates potential issues within the production process

- **potential issues:** production bottlenecks, Poor Time Management, resource allocation issues Inadequate Scheduling and Quality Control Issues

2- As Production in 2013 increased significantly from 464,000 to 677,000 unit
but **Throughput Rate** in 2013 decreased from 8.68 to 6.96 from 2012
Which mean that labor efficiency got decreased

- **potential issues:** Increased Lead Times, Employee Fatigue and Turnover, Quality Issues Inefficient use of labor and Inability to Scale

3- As **Cost of Poor Quality (COPQ)** in 2013 is Approximately the same as 2012 at avg 0.18%
And where Worldclass standard of Manufacturing operations is below 0.5%
Which indicates top-tier performance

4- As **Setup Time Ratio** from 2013 to 2012 is the same at 33%
And where acceptable Setup Time Ratio is often between 10%~20%

- Which indicates High setup time **potentially caused by:** Poor Workflow Design or Inadequate Tools

Conclusions AND Insights

5- As **Production Efficiency Rate** from 2012 to 2013 remained Approximately the same at avg 89%
And where acceptable Production Efficiency Rate is typically between 85%~95%
Which indicates efficient performance

6- As **Scrap Rate** from 2012 to 2013 is Approximately the same at avg 0.25%
And where standard acceptable rate of Manufacturing and Production is between 1%~3%
Which indicates high efficiency

7- As avg **Manufacturing Cycle Time** from 2012 to 2013 for workorders is still the same at avg 13 days
Which tells no change happened

8- As **Inventory Accuracy** is 1.4% !!
where only 6 products has accurate count matching the records while 426 of 432 mismatched
Which suggests that there is a substantial issue with inventory tracking causing the discrepancy

9- As **On-Time Delivery Rate** from 2013 to 2012 got decreased by 1% from 78% to 76%
And where General Industry Standard is often between 90%~95%
Which indicates potential issues

- **potential issues:** production bottlenecks, supplier delays and order processing inefficiencies

Recommendations

1) Minimizing Overdue Work Orders Rate by:
   1- **Implement lean manufacturing principles** to streamline production processes and reduce bottlenecks
   2- **Using advanced scheduling software** to better manage production timelines and resource allocation
   3- **Time Management Training** for managers and staff on effective time management practices
   4- **Strengthen quality control** to reduce the number of defects and rework, which can contribute to delays

2) Maximizing Throughput Rate Output by:
   5- **Process Optimization** by Analyze and optimize production processes to reduce lead times
   6- **Employee Management** by Address employee fatigue and turnover by improving work conditions
   7- **Improve workflow design** by Implement systems to better manage and utilize labor resources
   8- **Invest in scalable production solutions** that can handle increased volumes without lowering efficiency

3) Reducing Setup Time Ratio by:
   9- **Redesign workflow processes** to minimize setup times. Consider implementing modular setups
   10- **Invest in better tools and equipment** that can reduce setup times and improve overall efficiency
   11- **Provide training for staff** on efficient setup practices and techniques

Recommendations

4) Addressing Inventory Accuracy issues by:
   12- **Implement inventory management system** to ensure better tracking and accuracy
   13- **Conduct regular physical audits** to identify and correct discrepancies and Archive the audits records history
   14- **Train staff** on proper inventory handling and record-keeping procedures

5) Improving On-Time Delivery Rate by:
   15- **Identify and address production bottlenecks** to improve overall production flow and reduce delays
   16- **Work closely with suppliers** ensure timely delivery of materials and reduce potential delays
   17- **streamlining procedures and using technology** to automate and track orders

About the Analyst

Maher Mahmoud

Bachelor of Commerce
Accounting and Finance
Mansoura University

Thanks

Do you have any questions?

maher.dataconsult@gmail.com
+20 111 655 1250
github.com/maher-dataconsult