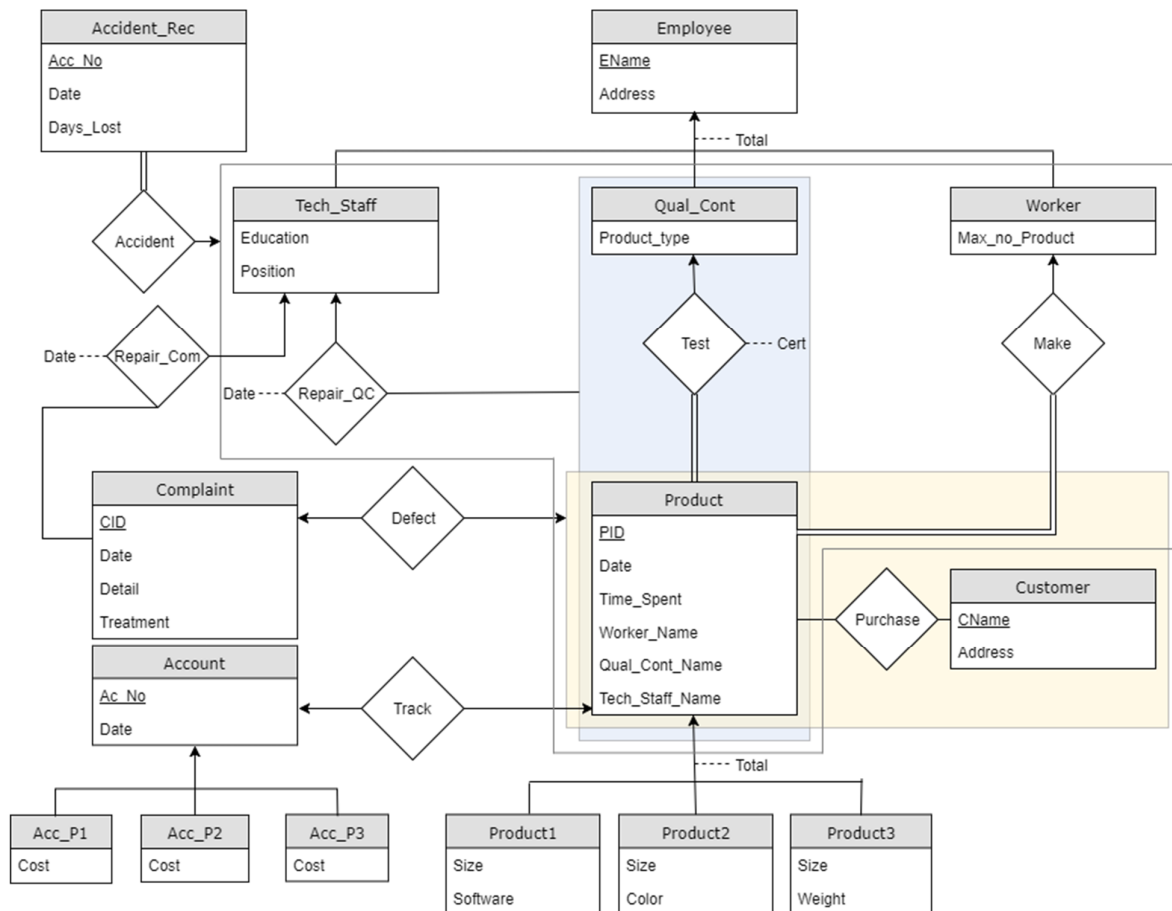


# 1. Task 1: ER Diagram and Relational Database

## 1.1 ER Diagram



- *Product1* can be repaired only by *Tech\_Staff* having graduate education. For other products, any technical staff can repair it: The constraint is implemented in the JAVA code and hence not shown in ER diagram.
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## 1.2 Relational Database

- **Employees** (EName, Address)
  - **Tech\_Staff** (EName, Education, Position)
  - **Qual\_Cont** (EName, Product\_type)
  - **Worker** (EName, Address, Max\_no\_Product)
  - **Product** (PID, Date, Time\_Spent, Worker\_Name, Qual\_Cont\_Name, Tech\_Staff\_Name)
  - **Product1** (PID, Size, Software)
  - **Product2** (PID, Size, Color)
  - **Product3** (PID, Size, Weight)
  - **Customer** (CName, Address)
  - **Account** (Ac\_No, Date)
  - **Acc\_P1** (Ac\_No, Cost)
  - **Acc\_P2** (Ac\_No, Cost)
  - **Acc\_P3** (Ac\_No, Cost)
  - **Complaint** (CID, Date, Detail, Treatment)
  - **Accident\_Rec** (Acc\_No, Date, Days\_Lost, EName, PID)
  - **Test** (PID, Qual\_Cont\_Name, Cert)
  - **Purchase** (PID, CName)
  - **Track** (PID, Ac\_No)
  - **Defect** (PID, CID, CName)
  - **Repair\_QC** (PID, Qual\_Cont\_EName, Tech\_Staff\_EName, Date)
  - **Repair\_Com** (CID, Tech\_Staff\_EName, Date)
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## 2. Task 2: Data Dictionary

Employees						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
Ename	Y	N	VARCHAR2(25 BYTE)	NO	NULL	1
Address	N	N	VARCHAR2(40 BYTE)	NO	NULL	2

Tech_Staff						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
Ename	Y	Y	VARCHAR2(25 BYTE)	NO	NULL	1
Education	N	N	VARCHAR2(10 BYTE)	NO	NULL	2
Position	N	N	VARCHAR2(10 BYTE)	NO	NULL	3

Qual_Cont						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
EName	Y	Y	VARCHAR2(25 BYTE)	NO	NULL	1
Product_type	N	N	INTEGER	NO	NULL	2

Worker						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
EName	Y	Y	VARCHAR2(25 BYTE)	NO	NULL	1
Address	N	N	VARCHAR2(40 BYTE)	NO	NULL	2
Max_no_Product	N	N	INTEGER	NO	NULL	3

Product						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
PID	Y	N	INT	NO	NULL	1
Date	N	N	DATE	NO	NULL	2
Time_Spent	N	N	INTEGER	NO	NULL	3
Worker_Name	N	Y	VARCHAR2(25 BYTE)	NO	NULL	4
Qual_Cont_Name	N	Y	VARCHAR2(25 BYTE)	NO	NULL	5
Tech_Staff_Name	N	Y	VARCHAR2(25 BYTE)	NO	NULL	6

Product1						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
PID	Y	Y	INTEGER	NO	NULL	1
Size	N	N	VARCHAR2(8 BYTE)	NO	NULL	2
Software	N	N	VARCHAR2(25 BYTE)	NO	NULL	3

Product2						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
PID	Y	Y	INTEGER	NO	NULL	1
Size	N	N	VARCHAR2(8 BYTE)	NO	NULL	2
Color	N	N	VARCHAR2(25 BYTE)	NO	NULL	3

Product3						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
PID	Y	Y	INTEGER	NO	NULL	1
Size	N	N	VARCHAR2(8 BYTE)	NO	NULL	2
Weight	N	N	INTEGER	NO	NULL	3

Customer						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
CName	Y	N	VARCHAR2(25 BYTE)	NO	NULL	1
Address	N	N	VARCHAR2(40 BYTE)	NO	NULL	2

Account						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
Ac_No	Y	N	INTEGER	NO	NULL	1
DATE	N	N	DATE	NO	NULL	2

Acc_P1						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
Ac_no	Y	Y	INTEGER	NO	NULL	1
Cost	N	N	FLOAT	NO	NULL	2

Acc_P2						
Coloumn Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
Ac_no	Y	Y	INTEGER	NO	NULL	1
Cost	N	N	FLOAT	NO	NULL	2

Acc_P3						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
Ac_no	Y	Y	INTEGER	NO	NULL	1
Cost	N	N	FLOAT	NO	NULL	2

Complaint						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
CID	Y	N	INTEGER	NO	NULL	1
Date	N	N	DATE	NO	NULL	2
Detail	N	N	VARCHAR2(40 BYTE)	YES	NULL	3
Treatment	N	N	VARCHAR2(25 BYTE)	YES	NULL	4

Accident_Rec						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
Acc_No	Y	N	INTEGER	NO	NULL	1
Date	N	N	DATE	NO	NULL	2
Days_Lost	N	N	INTEGER	YES	NULL	3

EName	N	Y	VARCHAR2(25 BYTE)	NO	NULL	4
PID	N	Y	INTEGER	NO	NULL	5

Test						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
PID	Y	Y	INTEGER	NO	NULL	1
Qual_Cont_EName	N	Y	VARCHAR2(25 BYTE)	NO	NULL	2
Cert	N	N	INTEGER	NO	NULL	3

Purchase						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
PID	Y	Y	INTEGER	NO	NULL	1
CName	Y	Y	VARCHAR2(25 BYTE)	NO	NULL	2

Track						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
PID	Y	Y	INTEGER	NO	NULL	1
Ac_No	N	Y	INTEGER	NO	NULL	2

Defect						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
PID	Y	Y	INTEGER	NO	NULL	1
CID	N	Y	INTEGER	NO	NULL	2
CName	N	Y	VARCHAR2(25 BYTE)	NO	NULL	3

Repair_QC						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
PID	Y	Y	INTEGER	NO	NULL	1
Qual_Cont_EName	N	Y	VARCHAR2(25 BYTE)	NO	NULL	2
Tech_Staff_EName	N	Y	VARCHAR2(25 BYTE)	NO	NULL	3
Date	N	N	DATE	NO	NULL	4

Repair_Com						
Column Name	PK	FK	Data_Type	Nullable	Data_default	Column_ID
CID	Y	Y	INTEGER	NO	NULL	1
Tech_Staff_EName	N	Y	VARCHAR2(25 BYTE)	NO	NULL	2
Date	N	N	DATE	NO	NULL	3

### 3. Task 3: Storage Structures

Table	Query	Type of function	Search Key	Frequency	File Organization
Employees	1	INSERT		2/month	<ul style="list-style-type: none"> <li>Infrequent Insertion</li> <li>Infrequent Random Search</li> </ul> <i>Static or Dynamic hashing with hash key EName</i>
	16	RANDOM SERCH	EName	1/3months	
	16	RANDOM SEARCH	EName	1/3months	
Tech_Staff	1	INSERT		2/month	<ul style="list-style-type: none"> <li>Infrequent Insertion</li> <li>Infrequent Random Search</li> </ul> <i>Static or Dynamic hashing with hash key EName</i>
	16	RANDOM SEARCH	EName	1/3months	
Qual_Cont	1	INSERT		2/month	<ul style="list-style-type: none"> <li>Infrequent Insertion</li> </ul> <i>Static or Dynamic hashing with hash key EName</i>
Worker	1	INSERT		2/month	<ul style="list-style-type: none"> <li>Infrequent Insertion</li> <li>Infrequent Random Search</li> </ul> <i>Static or Dynamic hashing with hash key EName</i>
	13	RANDOM SEARCH	EName	10/month	
Product	2	INSERT		400/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Frequent Random Search</li> </ul> <i>Static or Dynamic hashing with hash key EName</i>
	7	RANDOM SEARCH	PID	100/day	
	8	RANDOM SEARCH	EName	2000/day	
	14	RANDOM SEARCH	EName	5/day	
Product1	2	INSERT		400/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Frequent Random Search</li> </ul> <i>Static or Dynamic hashing with hash key Date</i>
	15	RANDOM SEARCH	Date	5/day	
Product2	2	INSERT		400/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Infrequent Random Search</li> </ul> <i>Static or Dynamic hashing with hash key Color</i>
	11	RANDOM SEARCH	Color	5/month	
Product3	2	INSERT		400/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> </ul> <i>Heap file</i>
Customer	3	INSERT		50/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Infrequent Random Search</li> </ul> <i>Static or Dynamic hashing with hash key CName</i>
	13	RANDOM SEARCH	CName	10/month	
	14	RANDOM SEARCH	CName	5/day	
Account	4	INSERT		40/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> </ul> <i>Heap file</i>
Acc_P1	4	INSERT		40/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Frequent Random Search</li> </ul>
	15	RANDOM SEARCH	Ac_No	5/day	

					<i>Static or Dynamic hashing with hash key Ac_No</i>
<b>Acc_P2</b>	4	INSERT		40/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Frequent Random Search</li> </ul> <i>Static or Dynamic hashing with hash key Ac_No</i>
	15	RANDOM SEARCH	Ac_No	5/day	
<b>Acc_P3</b>	4	INSERT		40/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Frequent Random Search</li> </ul>
	10	RANDOM SEACH	Ac_No	40/day	
	15	RANDOM SEARCH	Ac_No	5/day	<i>Static or Dynamic hashing with hash key Ac_No</i>
<b>Complaint</b>	5	INSERT		30/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> </ul> <i>Heap file</i>
<b>Accident_Rec</b>	6	INSERT		1/week	<ul style="list-style-type: none"> <li>Infrequent Insertion</li> <li>Infrequent Random Search</li> </ul>
	12	RANDOM SEARCH	EName	1/month	
	17	RANGE SEARCH	Date	1/day	<i>B+-tree with search key Date</i>
<b>Test</b>	2	INSERT		400/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Frequent Random Search</li> </ul>
	9	RANDOM SEARCH	EName	400/day	
<b>Purchase</b>	3	INSERT		50/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Infrequent Random Search</li> </ul>
	11	RANDOM SEARCH	PID	5/month	
<b>Track</b>	4	INSERT		40/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Frequent Random Search</li> </ul>
	10	RANDOM SEARCH	PID	40/day	
	15	RANDOM SEARCH	PID	5/day	<i>Static or Dynamic hashing with hash key PID</i>
<b>Defect</b>	5	INSERT		30/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> </ul> <i>Heap file</i>
<b>Repair_QC</b>	2	INSERT		400/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Frequent Random Search</li> </ul>
	9	RANDOM SEARCH	EName	400/day	
	10	RANDOM SEARCH	EName	40/day	<i>Static or Dynamic hashing with hash key EName</i>
<b>Repair_Com</b>	5	INSERT		30/day	<ul style="list-style-type: none"> <li>Frequent Insertion</li> <li>Infrequent Random Search</li> </ul>
	12	RANDOM SEARCH	EName	1/month	