The Manufacturing Engineering activity

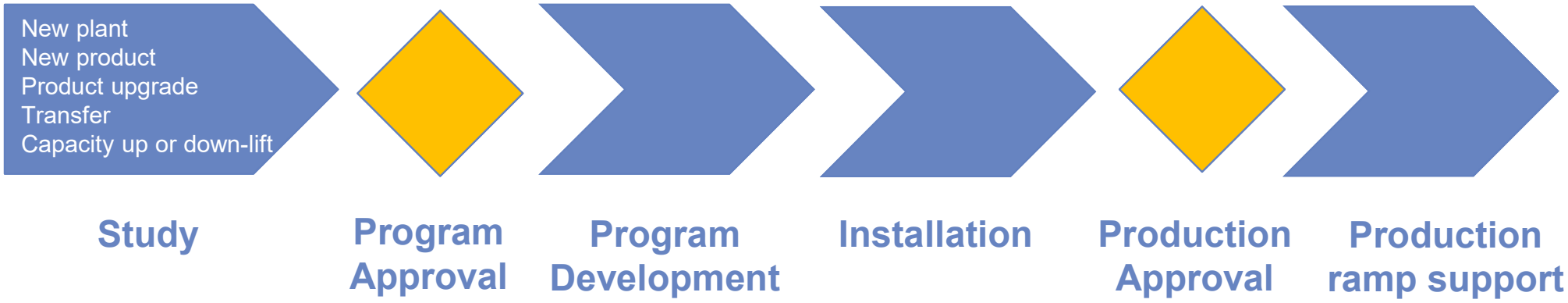
The Manufacturing Engineer role

The ME engineer, starting form a greenfield, develops all works..

The Manufacturing Engineer role

..necessary to build, tool and train a new plant

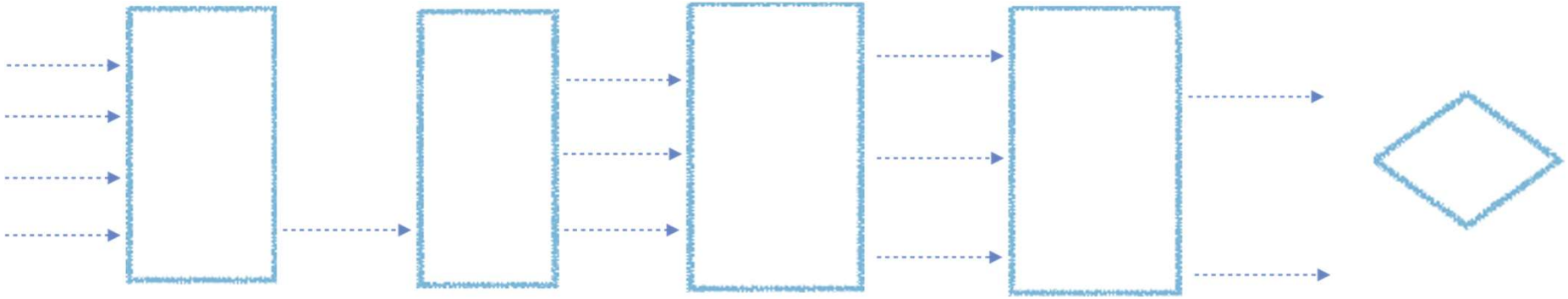
Phases of a complete ME Program



- **The study** is the first operation and **under a certain point of view the more complex** of the entire program since everything must be defined in a virtual way.
- All what will be implemented has to be deeply analyzed and evaluated in any single part in order to let the management take the right decision about the investment and in future let the Company to obtain the planned incomes.
- During implementation phases the sequence of operation executed inside the study are repeated with major precision to build the machinery and realize the planned process.
- The study phase will be investigated and the Input/action/output methodology will be used

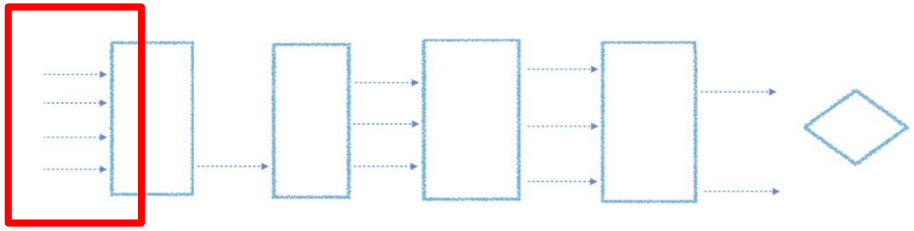
The Manufacturing Engineering Study

To introduce a student to the complex world of the Manufacturing Engineering, let's come into the brain of the Manufacturing Engineer during the development of an initial study.
The study flow is shown below and the discussion will be oriented to identify every item.



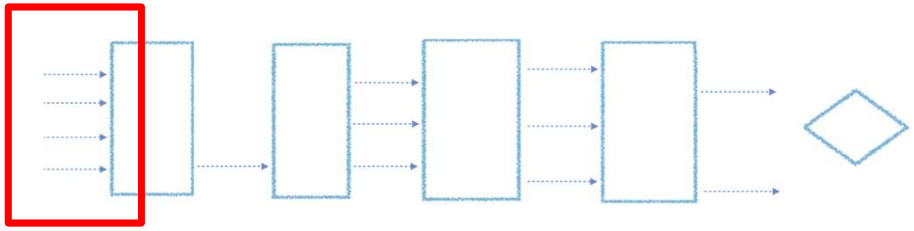
Manufacturing Engineering Study flow chart

The starting point



1° question: Which is the base input information of a Manufacturing Engineering Study?

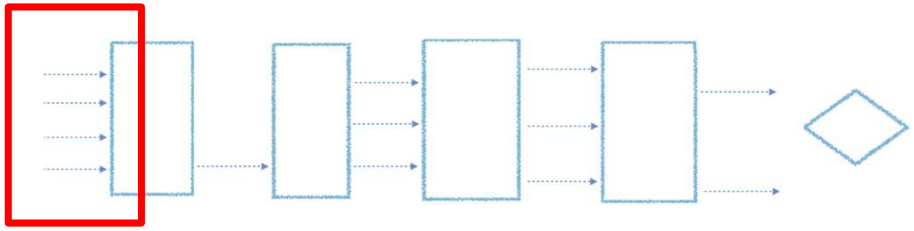
The starting point



1° question: Which is the base input information of a Manufacturing Engineering Study?

- **Product Bill of material and, for each part number, a technical drawing**

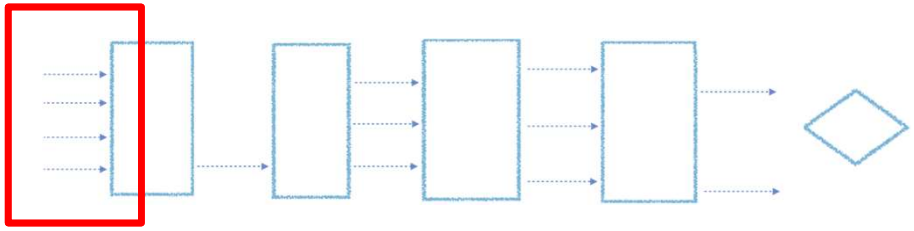
The starting point



1° question: Which is the base input information of a Manufacturing Engineering Study?

- **Product Bill of material and, for each part number, a technical drawing**
- **Volume to be produced**

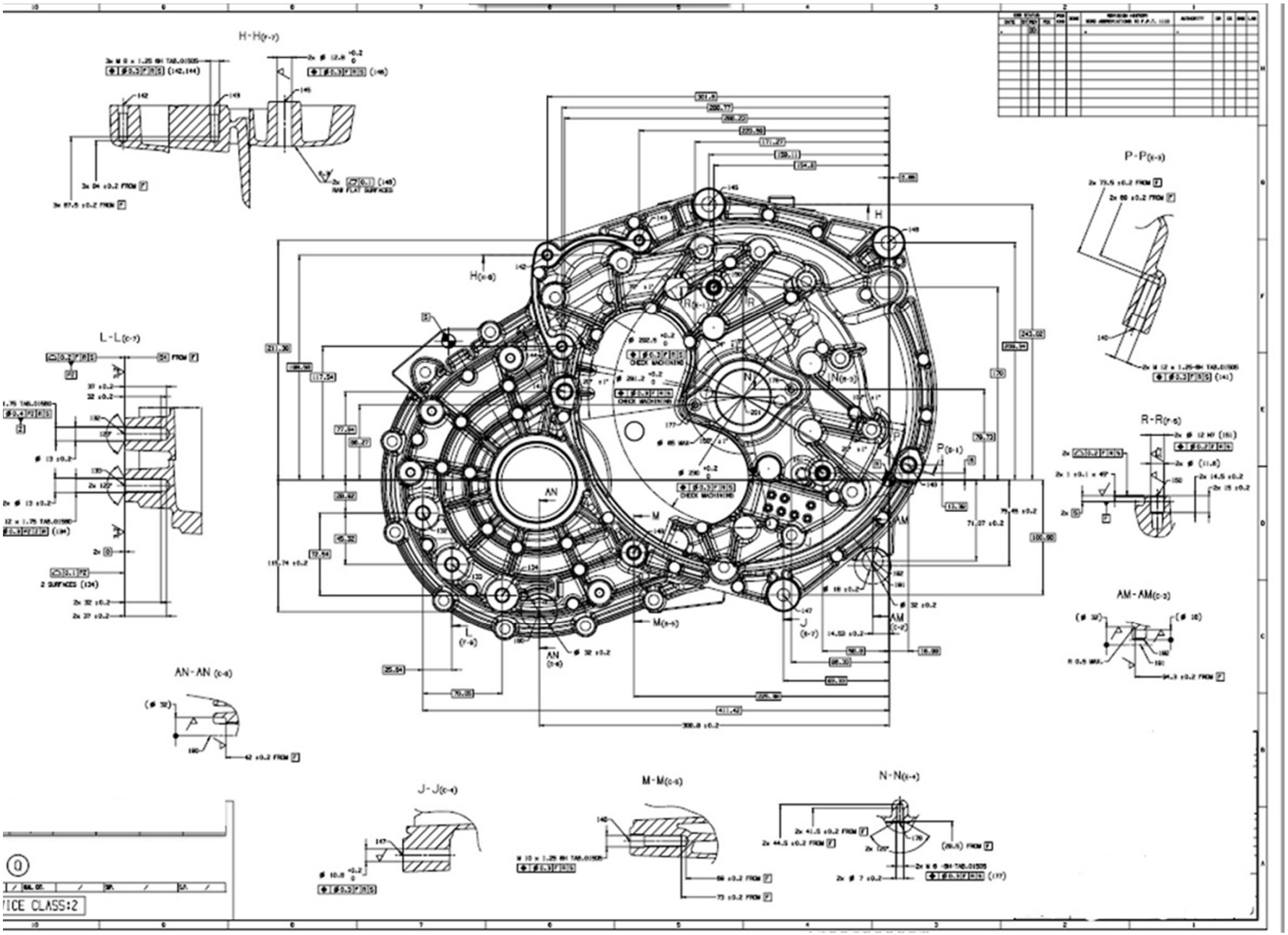
The starting point



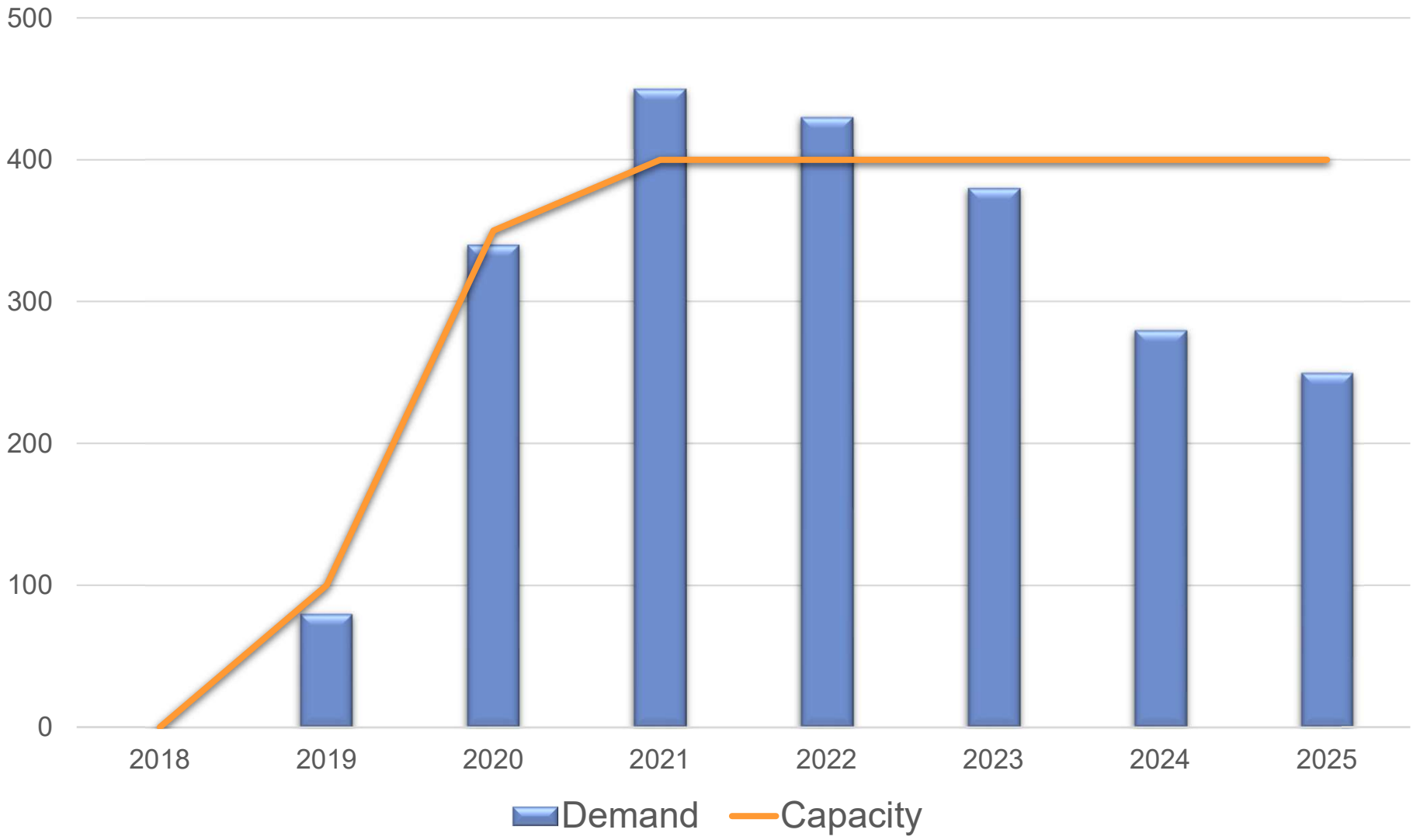
1° question: Which is the base input information of a Manufacturing Engineering Study?

- **Product Bill of material and, for each part number, a technical drawing**
- **Volume to be produced for each year of the plan**

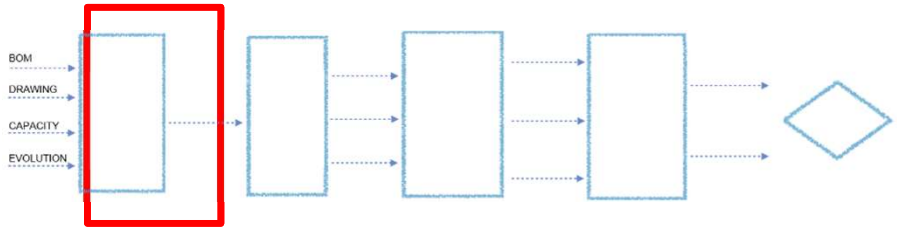
The part number (mechanical drawing)



The demand plan

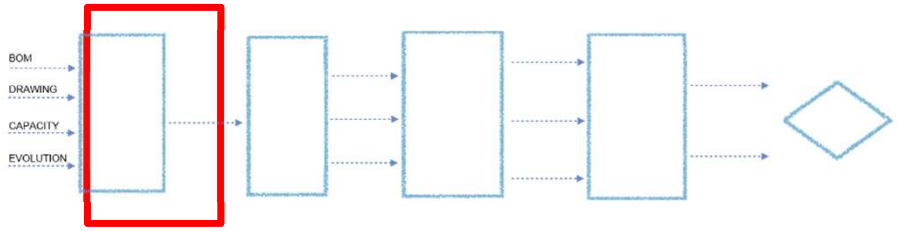


The analysis



2° question: what do we do with a "mechanical drawing"?

The analysis



2° question: what do we do with a "mechanical drawing"?

We get all the information about:

- **dimensions,**
- **references,**
- **tolerances,**
- **material,**
- **…**

Process design

Project data	
Capacity	200 k/y
Working pattern	280 d/y
	3 shifts/day
	7.5 hours/shifts
O.L.E.	85%
Daily availability	68850 s
Daily production	714 units/day
Takt time	**96.42 s**

On the basis of required operations and the line timing, the process cycle is defined

Op.	DESCRIPTION	Cyle time Op.	Machines Q.ty Required	Machines Q.ty needed	Total production output per year
10	MC20 - B - HSK100 - NEW	359,72	3,7	4	217.552
20	MC20 - B - HSK100 - NEW	300,44	3,2	4	262.684
30	MC20 - A - HSK63 - NEW	285,96	3,1	4	284.588
70	MC20 - AB - HSK100 - NEW	305,97	3,2	4	252.244
100	MC20 - B - HSK100 - NEW	182,46	1,9	2	218.338
120	CYL. BORE HONING - 2 SPINDLE W ROTARY TABLE	177,00	1,9	2	217.828
130	CRANKBORE HONING + POST-GAGE (CYL. BORE & CRANKBORE)	45,00	0,5	1	428.400
160	MC20 - A - HSK100 - NEW	198,80	2,1	3	315.624

The Process Cycle

For each operation is defined the type of machine, the number of machines, the tools…

OP.	DESCRIPTION	Q.ty
5	Laser Etch & Camera 2D D.M. & RFID Install	1
10	MC10 CNC (B) Front/Rear/bottom side machining	8
20	MC10 CNC (B) Top/Front/Rear side machining	6
30	MC10 CNC (A) Intake/Exhaust side machining	6
40	Intermediate Wash	1
50	Intermediate Leak test	1
60	Bed-plate assembly	1
70	MCH250 – APC – CNC (B) Top/Front/Rear side machining (finish)	6
80	MC10 CNC (AB) Intake/Exhaust side machining (finish)	2
90	Intermediate Wash	1
100	Torque-plate assembly	1

OP.	DESCRIPTION	Q.ty
110	MC10 CNC (B) Front/Rear/Top/bottom side machining	1
120	Cylinder bore honing	4
130	Crankbore honing. Post gage (classification)	1
140	Blow-off station	1
150	Torque-plate disassembly (wash bolts & T.P.)	1
160	MC10 CNC (B) Top side machining (2nd pass head deck finish)	3
170	Final wash	1
180	100% liner porosity check	1
190	Plug install & leak test	1
200	Visual inspection. Laser Etch & Camera 2D D.M. classification data	1

The Process Cycle

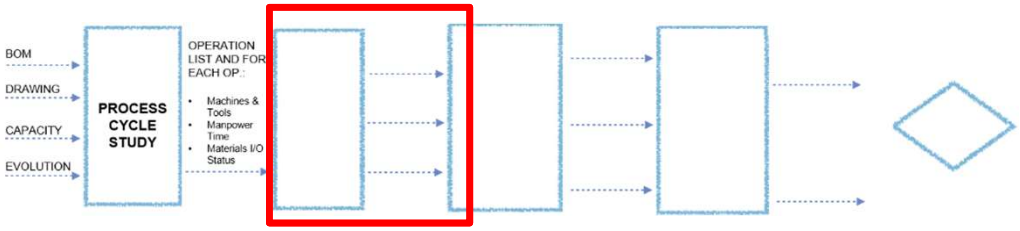
In case of manual assembly the operation is analyzed highlighting the time, the value added or non value added

NVA/SVA/VA | Activity Description | Duration

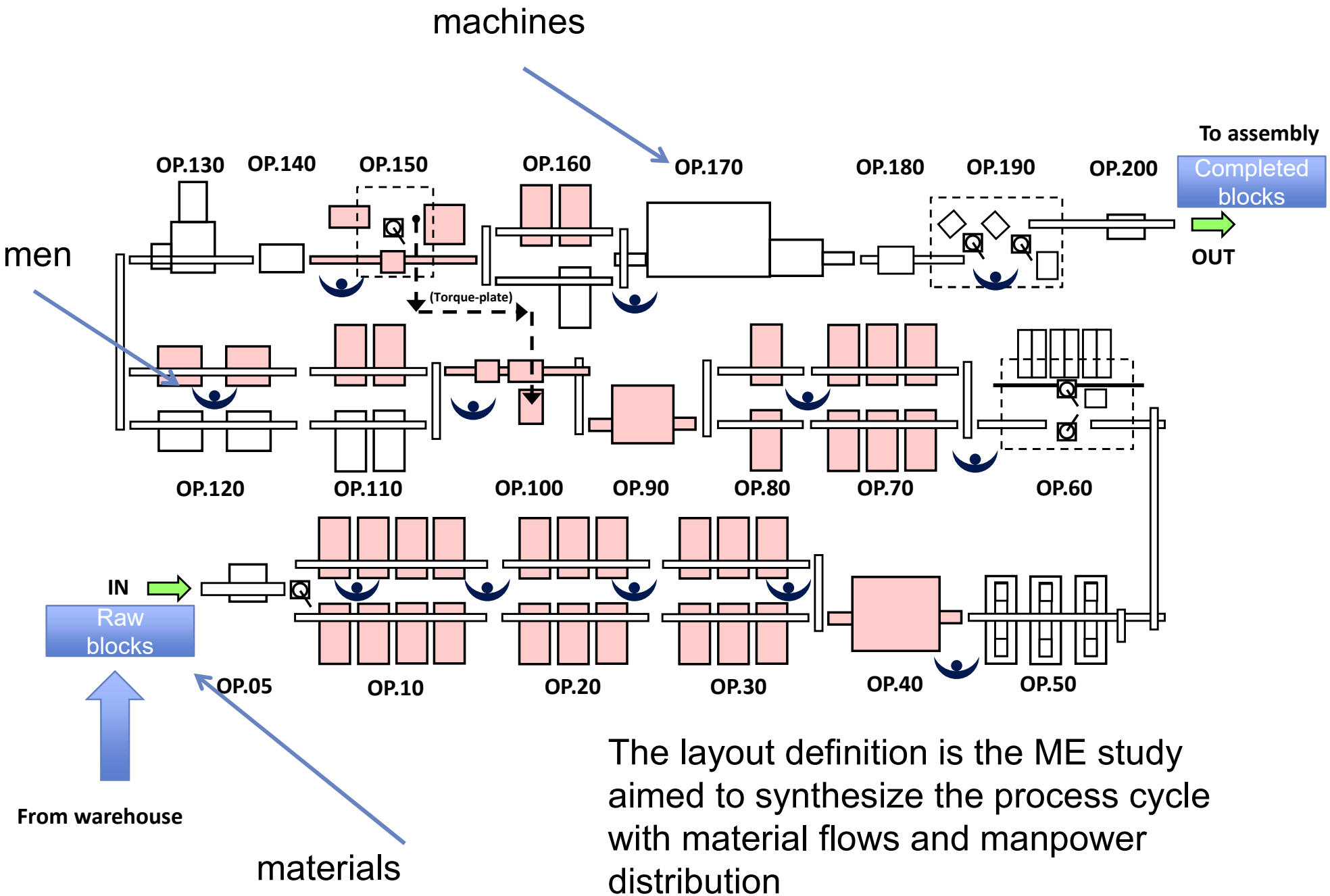
Activity	Orient	Element	Description	
			INSTALL PCV SEPARATOR AND OIL COOLER. ZERO TORQUE BOTH	**92.658**
			Operator Inside	
NVA	Rr Lead PRU EHX Facing	1	Engine Moves into Station	4.9
SVA		2	Obtain Oil Cooler Assy and Inspect Gasket	**1.8**
NVA		3	Pass Oil Cooler under 2D Scanner	**4.0**
SVA		4	Get (6) Fasteners	**2.8**
VA		5	Align Cooler to Block	**1.0**
SVA		6	Align 1st Bolt and Hand Start one turn	**1.8**
SVA		7	Hand start (2) additional turns	**1.8**
VA		8	Place next Bolt and hand start first turn. Repeat (2) additional times	**4.6**
SVA		9	Hand start (2) additional turns. Repeat (2) additional times	**5.4**
NVA		10	Obtain Hand start tool	**1.2**
SVA		11	Load bolt to tool, set to Oil Cooler, and hand start one turn. Repeat (1) additional time	**3.1**
SVA		12	Hand start (2) additional turns. Repeat (1) additional time	**3.6**
NVA		13	Aside Hand Start Tool	**0.6**
VA		14	Obtain Nutrunner and place to 1st Oil Cooler Fastener	**1.9**
SVA		15	Pull trigger to Zero Torque Oil Cooler Fastener	**2.1**
SVA		16	Move Tool to next Fastener. Repeat (4) additional times	**3.2**
SVA		17	Pull trigger to Zero Torque Cooler Fastener. Repeat (4) additional times	**10.3**

The juggler

3° question: what do we do once we have identified machinery, men and material lists?

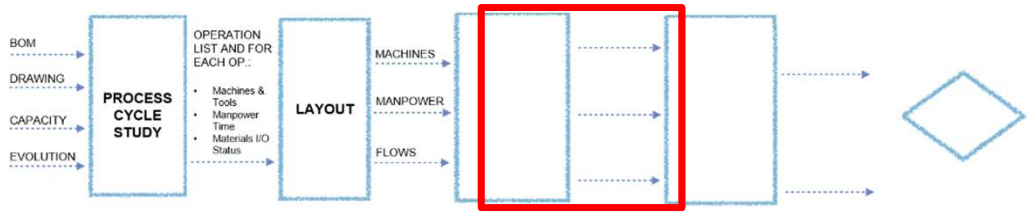


Concept Layout

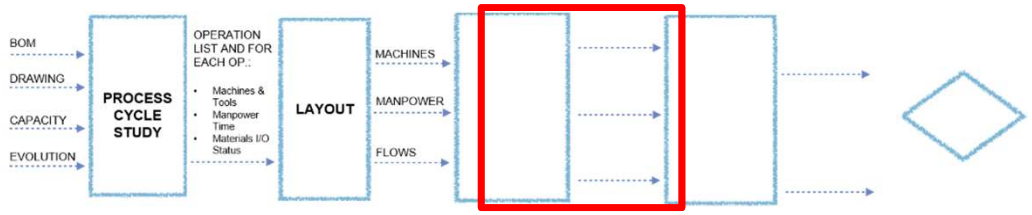


The layout definition is the ME study aimed to synthesize the process cycle with material flows and manpower distribution

After layout definition…



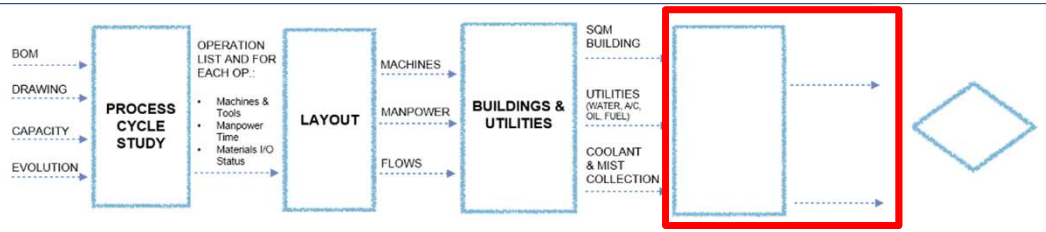
The Plant engineering design



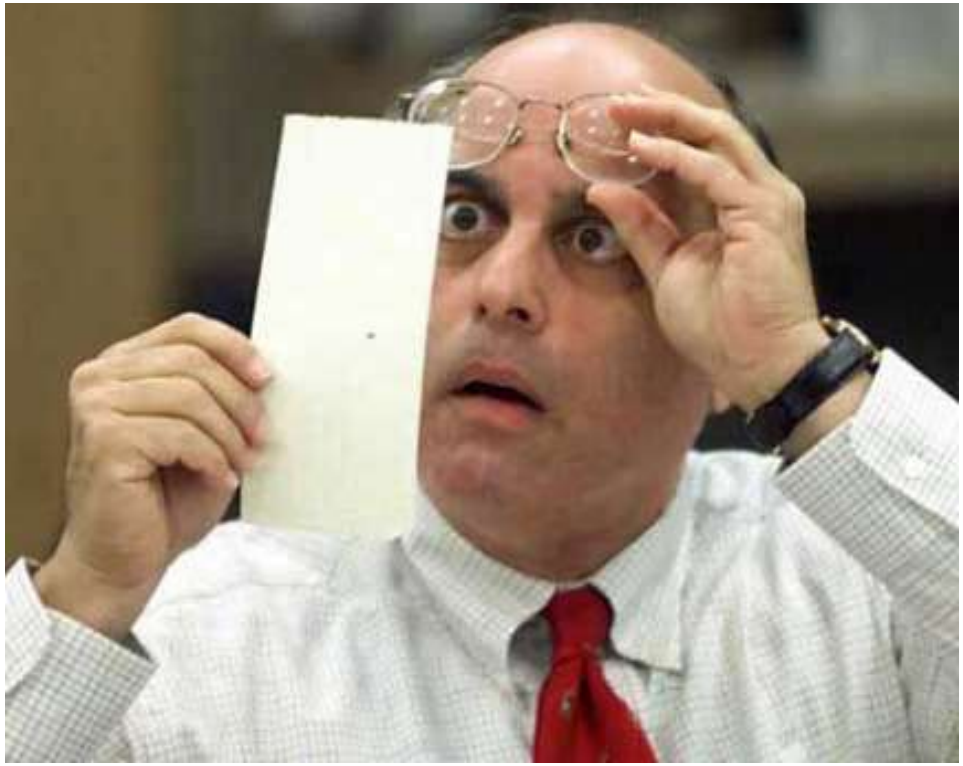
Buildings & Utilities

Building	Electric Utilities	Water Utilities	Coolant systems	Mist collections
Building Floors Roads Quality box & laboratory Offices, services & welcome area	Electrical Substations Distribution Network (AT, MT, BT) Lighting	Fire Protection System Technical Gases Oils & Fuels Compressed Air Water	Lubrication filtering systems Distribution Network Pneumatic conveying of shavings Shavings and briquettes	Suction System Suction pipelines and expulsion chimneys

The bill



It is time to do a summary. An economical summary.



Investments and Costs

The Program economic evaluation is aimed to define the investment to cover Building, Machinery and Equipment necessary to install/retool the required production capacity (e.g. for an engine)

Machinery	**Machining lines**	Cylinder Block
		Cylinder Head
		Crankshaft
	Assembly lines	Short Block
		Long Bock
		Cylinder Head pre-Ass'y
	Test area	Leak test
		Cold test
		Hot test

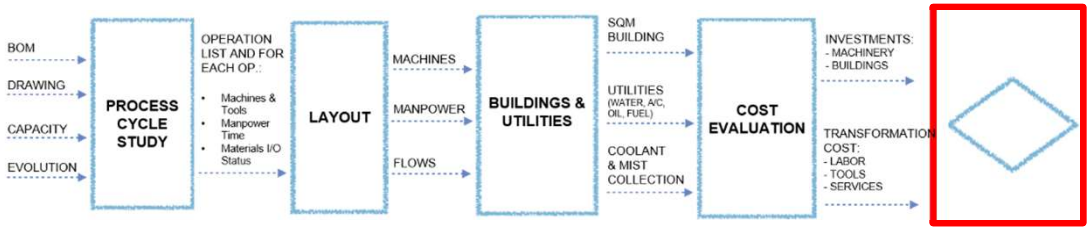
Equipment & Facilities	Building & Utilities
	Coolant & Mist collection
	Logistic & Packaging
	Quality and Presetting
	Traceability
	Try-out parts

ICT
Project M.E. expenses
Re-layout and re-location
Start-up and Training
Grand Total

	Var	Fix	Tot
Direct Labor	xx	-	XX
Indirect Labor	-	xx	XX
Blue collars Subtotal	**XX**	**xx**	**XX**
Salaried	-	**xx**	**XX**
Indirect Materials	xx	-	XX
Maintenance	xx	xx	XX
Energy	xx	xx	XX
Services	xx	xx	XX
Other Subtotal	**XX**	**XX**	**XX**
Burden Tot	**XX**	**XX**	**XX**

.. and to define the full transformation costs due to the Plant including Manpower, Material and Services

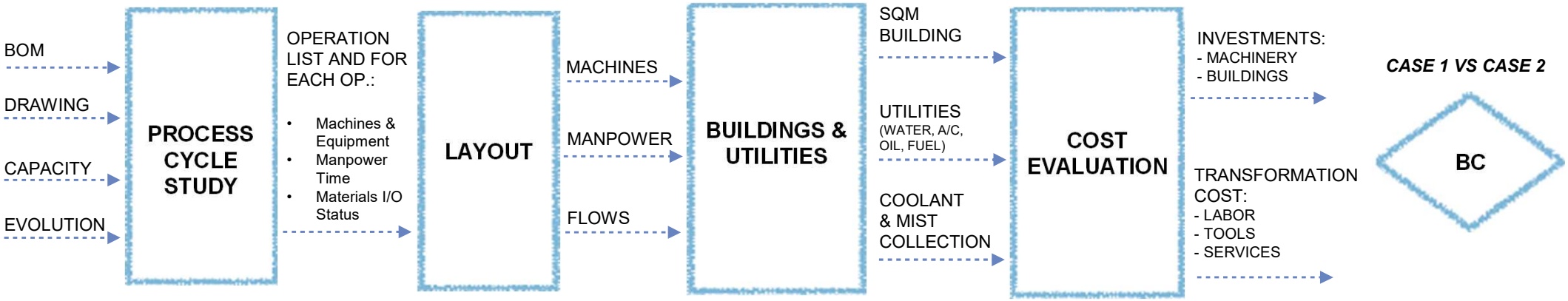
The alternatives evaluation



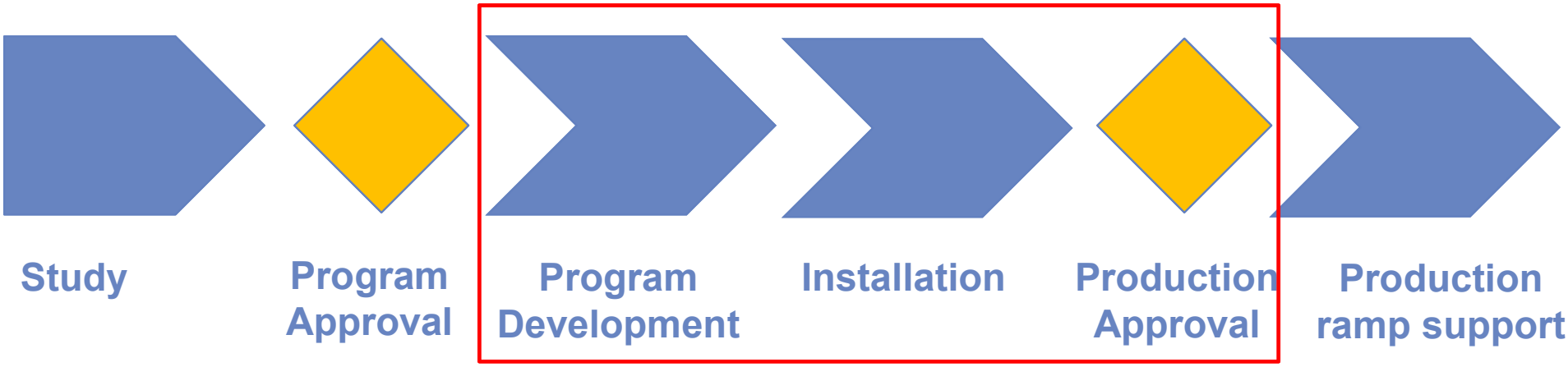
The alternatives evaluation

The full costs of the alternative are compared and evaluated under a strategic point of view

Process Cycle



The complete ME Program: next phases

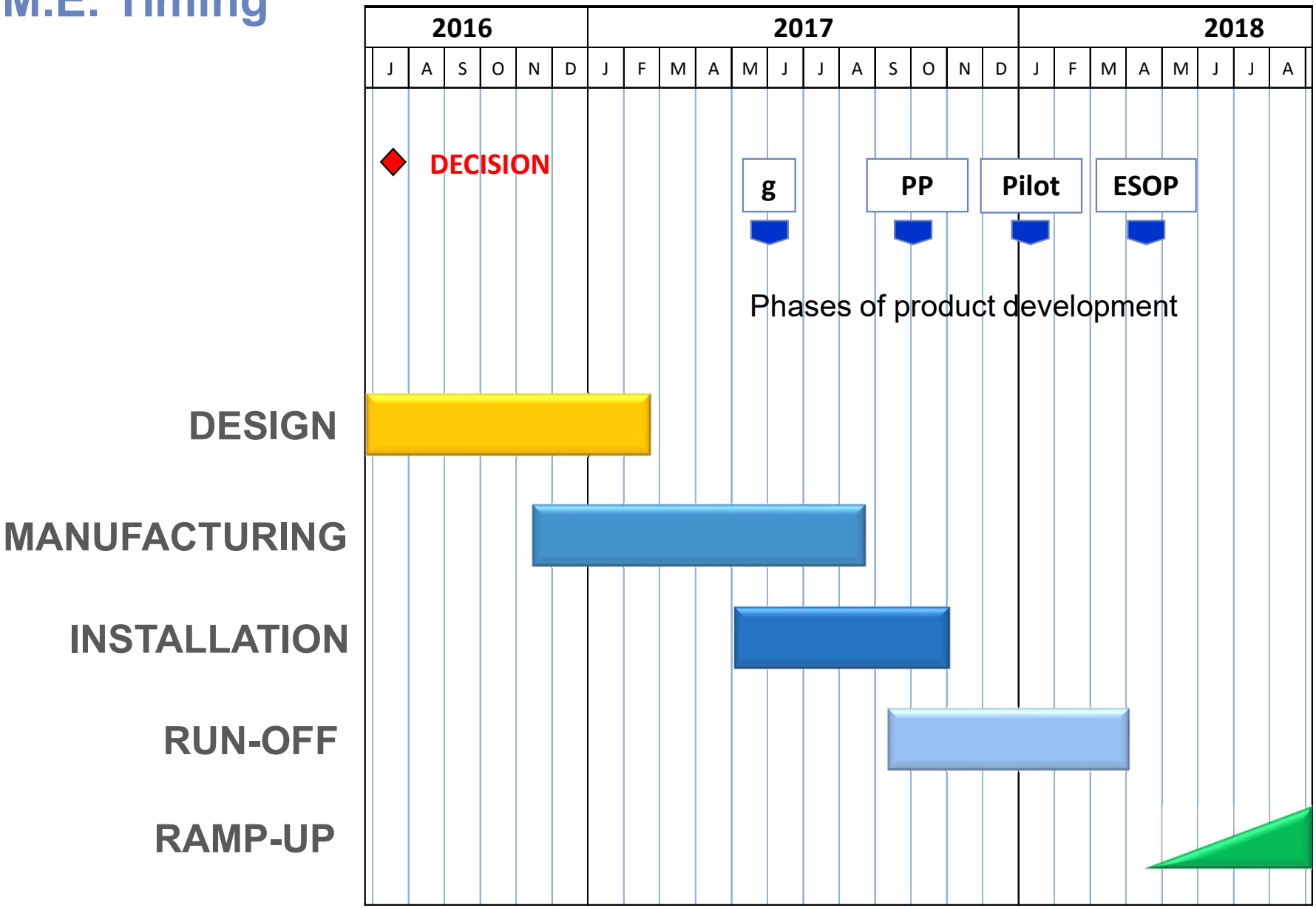


As said before, after Program Approval, the tasks mentioned in the study have to be defined with major precision to build the machinery and implement.

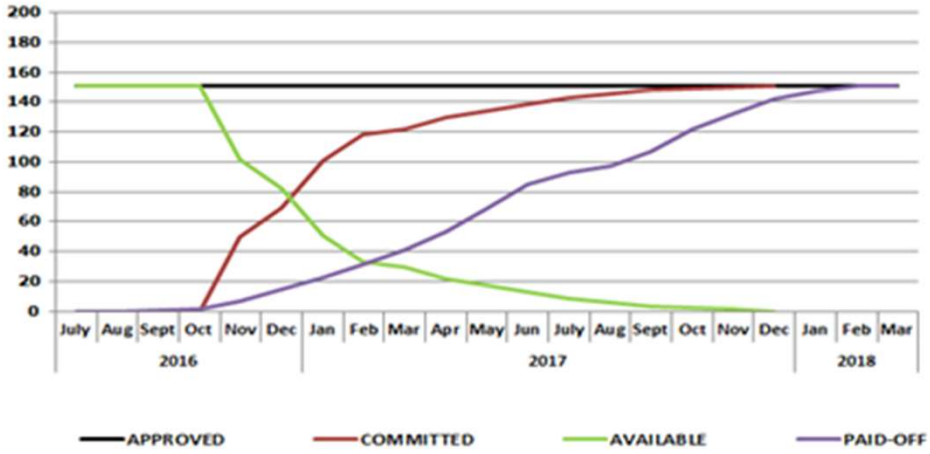
The main items are:

1. Prepare the Building
2. Design and install Machinery and Equipment
3. Train the Plant people to manage machinery and products
4. Certify the BUY parts and logistics process

M.E. Timing


2016
2017
2018
J A S O N D J F M A M J J A S O N D J F M A M J J A
DECISION
g
PP
Pilot
ESOP
Phases of product development
DESIGN
MANUFACTURING
INSTALLATION
RUN-OFF
RAMP-UP

Investment monitoring



The role of Program Management is coordinate the Program resource to meet the technical and time requirements without exceed the approved fund.
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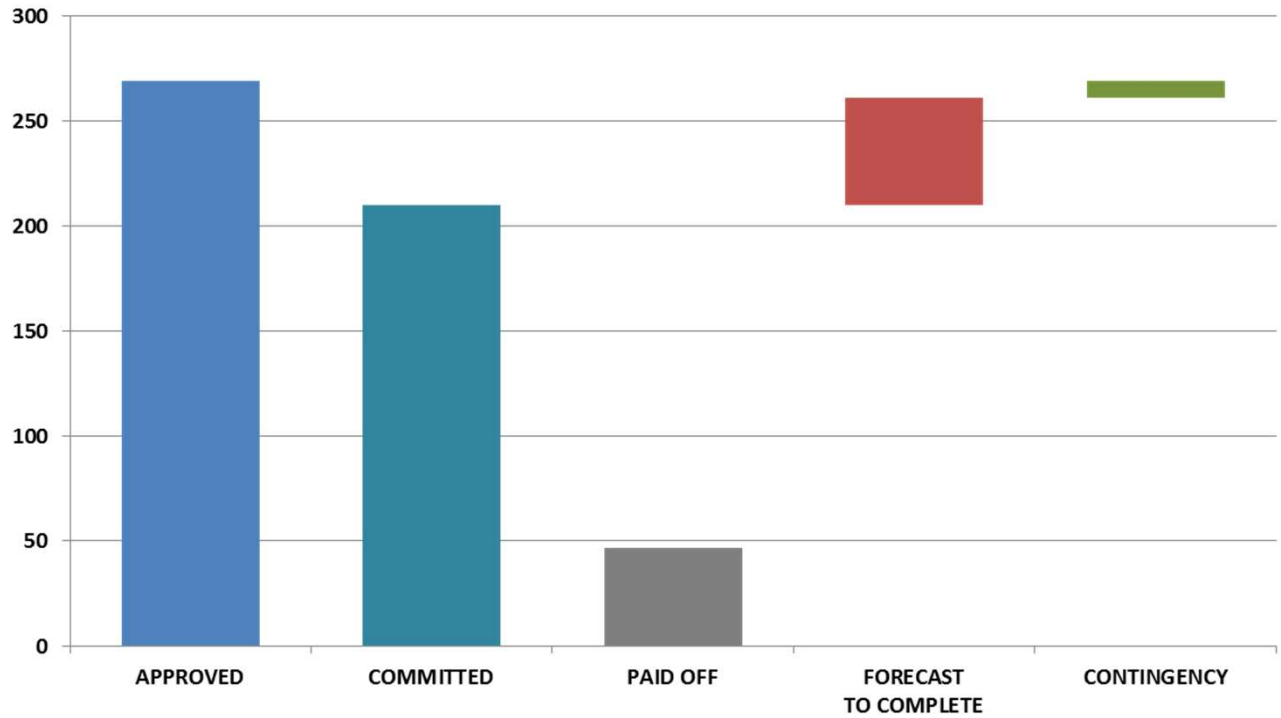


Backup

Industrial Floors

Resin coating system

Quality Box

Welcome Area

Electric Utilities

Electric Utilities – transformation MT/BT

Electric Utilities – internal distribution network

Electric Utilities – lighting

Water Utilities

Water Utilities – fire protection system

Water Utilities – technical gases

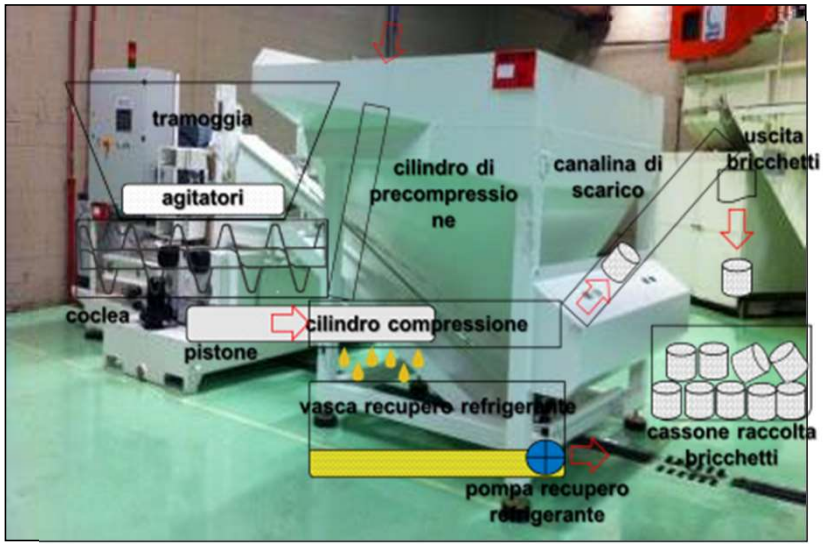
Water Utilities – Oils and Fuels

Coolant

Coolant –filtration

Coolant – shavings removal systems

Coolant – shaving and briquettes



Mist Collection

Mist Collection

Mist Collection