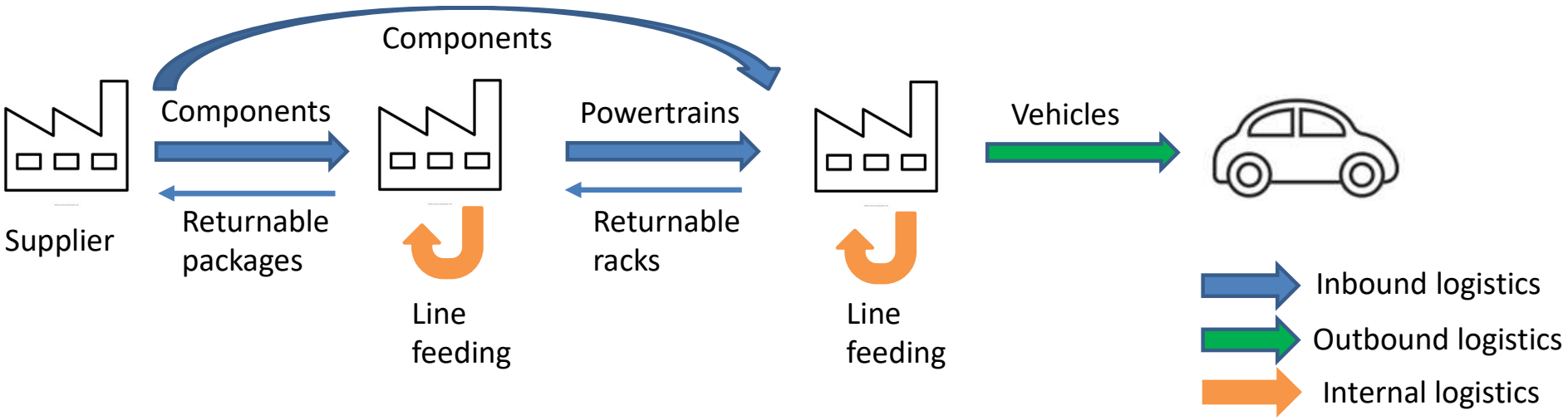
Logistics in a flexible environment

Logistics and flexibility

- The immediate success of the new flexible offer in the growing market in the 80's (in western countries) caused huge logistic issues in the manufacturing organization mainly in internal logistics.
- The simple logic that governed the material distribution in the era of Fordism was not applicable any longer. For a whole line there was 1 single volume, for each product a single list of components, for each component a single destination.
- With the flexibility there were:
  - Specific volumes for each product version
  - For each version, different lists of components or as usually is said a Bill of Materials (BOM)
  - For each component, possible different destinations
  - For each machine or robot or man, a lot of different work programs/operations
- Work organization made to solve social issues in a recession period demonstrated to be optimal also for the new challenges: machining centers or robot or asynchronous group but the logistics was to be reinvented

The logistic industrial problem

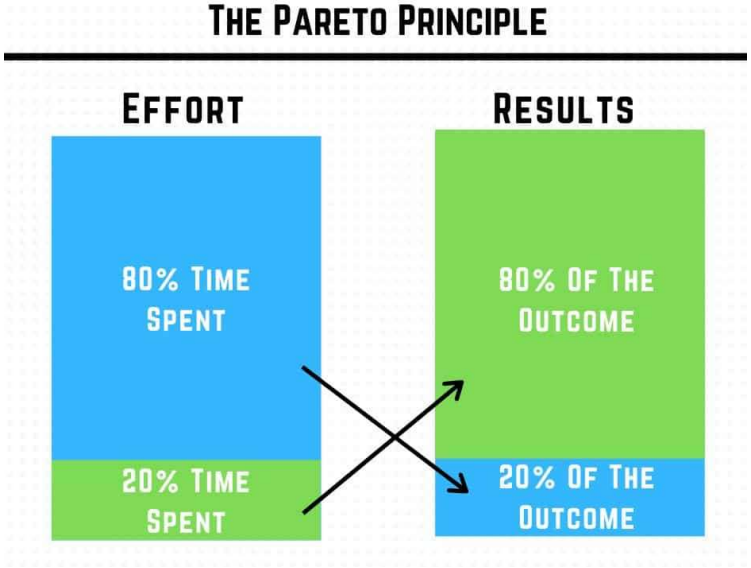


The logistics problem can be split in the following subproblems:

1. Physical transport of good or finished product with related strategy from plant to plant
2. Study of the optimal packaging strategy
3. Internal logistics: internal handling, warehouse and distribution logic to the line sides

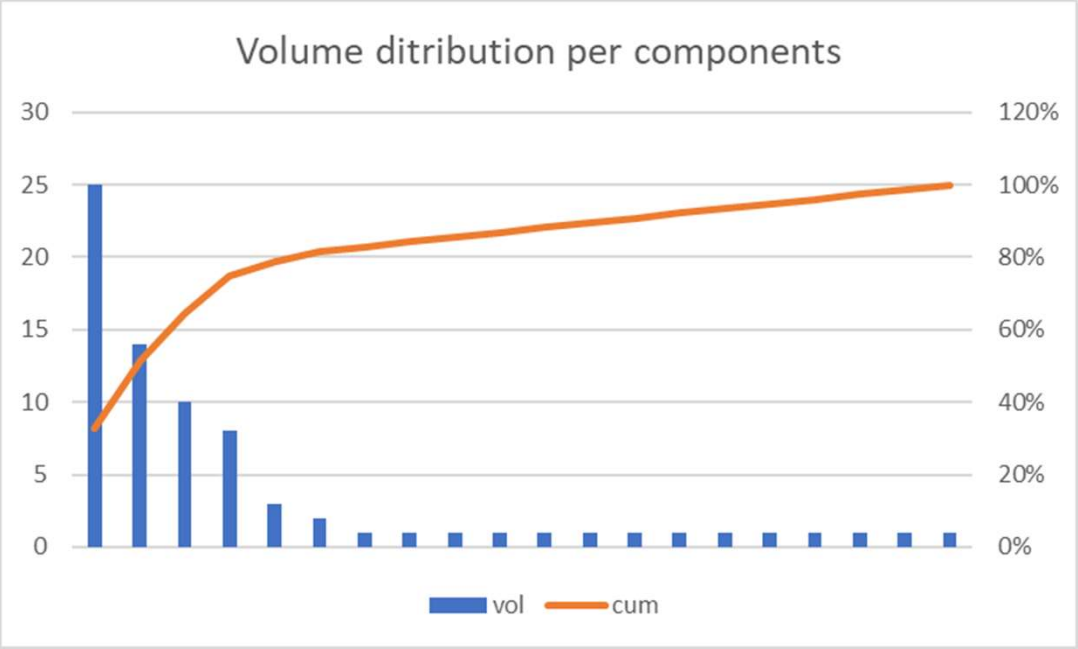
Pareto

- **Vilfredo Pareto** was an Italian engineer, lived between the second half of 1800 and the beginning of 1900, more or less as Taylor and Gantt, that had a wide field of interest touching mathematics, economy and philosophy.
- He is mainly known for **an important empiric principle,** applicable and applied in the last century on a wide range of fields, that states**: 80% of an achievement is generated by the 20% of the causes and vice versa.**
- **Examples:**
  - In 20% of the time is reached the 80% of the result. The completion of remaining 20% requires the 80% of the time.
  - The 80% of the richness is held by 20% of the men. The remaining 20% by the 80%.
  - The 20% of bugs provokes the 80% of downtime of a computer...
  - The 20% of part number represents the 80% of production volumes
- **This principle was applied with profit to the logistics and become the light to organize the complex world of flexibility.**



The diagram of Pareto

- To support the principle and take consistent decisions, normally an ordered diagram of the values of each element of a class is drawn.
- Starting from the most important to the less, and expressing the cumulate percentage of the population, as shown in the diagram aside, it is possible in general define some strategy to manage the complexity.
- E.g. In the diagram is easy to see #4 important components that must be managed with specific strategy while the remaining #16 can be treated in the same way.



Internal logistics application of Pareto law

- **ABC analysis** is a type of statistical analysis, which is based on the Pareto principle. It presupposes a division of the objects under consideration (eg: products) into **three categories**, in order to assess their impact on the business. In practice, identifying and classifying the different items of a complex set is useful for setting priorities.
- This type of analysis is mainly used in the management of materials business, for example, in the Plant logistics.
- Applying the same principle to logistics, it is noted that 80% of volumes/costs/products are produced by about 20% of part numbers. Obviously, Pareto's analysis does not suggest neglecting the slice of components that generates less revenue.
- The 80/20 division is only a reference value. In practice, the proportion is not always so clear and the ratio can vary considerably. **What remains valid is the basic concept of this analysis that allows to classify and put order in flexibility complexity.**

Material classification in ABC

- A practical example of ABC analysis for Logistics is the classification of items into groups A, B and C, following some rules:
  - **Group A** items are those with the highest annual consumption value. Since they generate the majority of turnover, these items deserve to be tracked regularly and stored in safer areas. It is necessary to provide a good supply, better if guaranteed by frequent reorders. Sometimes they are significant because of the physical dimensions rather than the cost instead of the volumes. They require often not only a specific warehouse management but also a focused handling system , Finally they require a careful management of the line side.
  - **Group B** articles occupy an intermediate position, with a consumption value of between 15 and 25% on average. The logistics is simplified but the line side require space, rules so as the handling.
  - **Group C** items are those with the lowest consumption value. To reduce their running costs, they should rarely be reordered/moved to the line.
- In general, this analysis can be used to reorder, to manage the working capital but today I want to focus on the internal Plant logistic

Internal logistics approach to ABC

- Criteria for ABC classification: volume in terms of dimension, number of variants, cost, distance of the supplier.
- Let consider that the starting point of internal logistics was “a place” for all the components along the line.
- So, a logical criteria could be:
    1. Big dimensions combined to high number of variants mean big line side occupation and cannot be considered all present in a specific place and they must arrive to the right place according to a precise plan (class A)
    2. Component in class require all types present(Class B)
    3. Medium part can be considered all present but in limited quantity and creating a complex handling management (class B)
    4. The smallest parts can be all present but in quantity to minimize handling (class C)
- High cost and distance of suppliers are in conflict in the warehouse minimization.

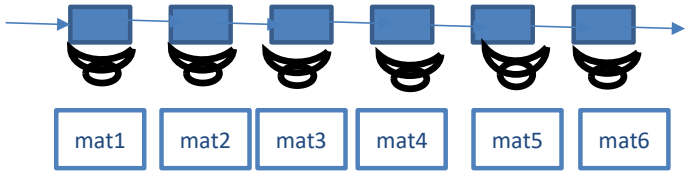
Engine: practical example

Family B/C engine in Pratola Serra (AV-Italy) was the first high flexibility engine plant, The strategy of internal handling and logic was based on an ABC law.

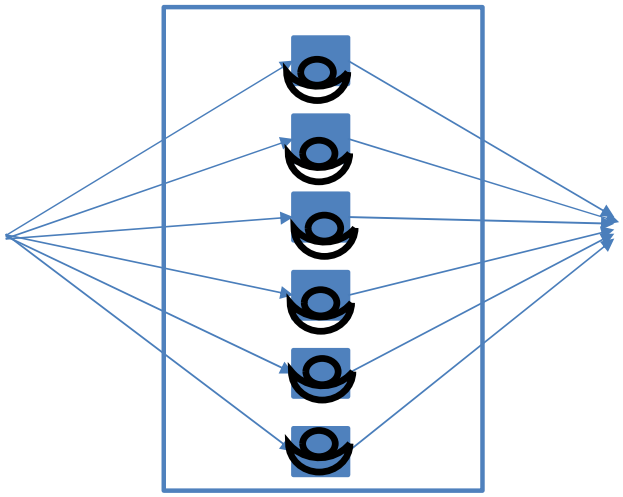
- Big volume : block head and crank but raw have different consumption points and batch production. Nonissue for handling apart from weight.
- Manifolds intake and exhaust, flywheels, clutches, turbos, injection pumps, oil pumps and other similar go in Class A and will be taken to the line according tom the plan and the line side will be anyway problematic but manageable
- Valves, tappets, water pump, tubes, gaskets and all other small go in Class B as pistons and bearings because of classes. They will be present all types in a quantity “enough” to the reorder from central warehouse when the level is minimum.
- Screws, plugs and other minor parts go in Class C with refill of the quantity periodically (end of the shift, end of the week)

Feeding of an asynchronous line

- The feeding of a synchronous line has been for years a simple operation.
- For each position there was a single operation with a specific material to me dispatched to that point.

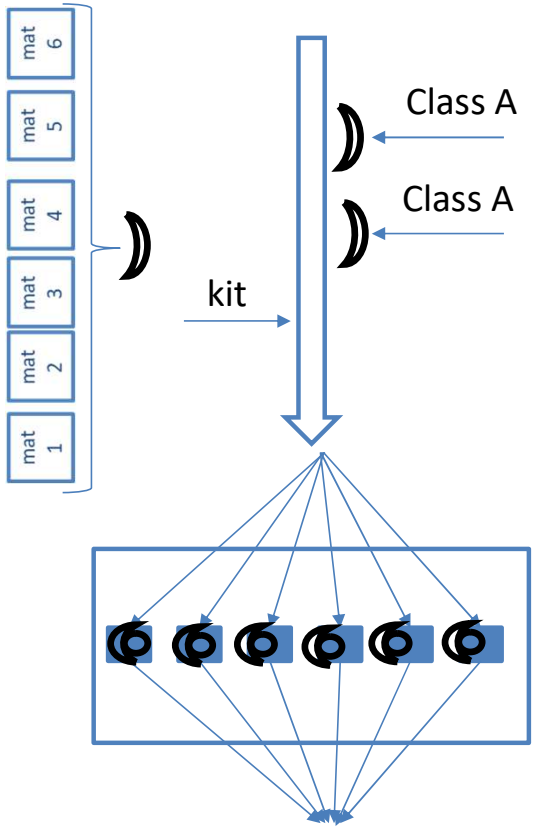


- It become very difficult for the Asynchronous lines. Expecially when the materials like in automotive had significant dimension, for sure major than an electronic industry like Olivetti.



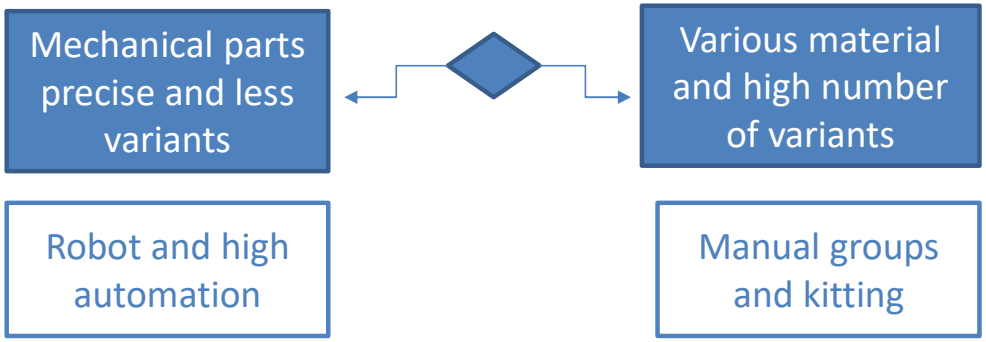
The kitting

- The solution was found creating a kit of component to be delivered to the manual station together with the product.
- Of course the big component (A classes) were excluded but for the B classes (The most crowded) was an optimal solution.
- So before the Asynchronous group there was a station of kitting loading whie the kit were build offline.
- Sometimes (e.g. Pratola Serra) the kitting was done online but it was not the optimal solution. Much better results were obtained with a Supermarket area in which some operators were preparing the kits in small batches to minimize mistake an simplify the internal reorder.
- The A classes material were assembled in specific station as the kit but completely assembled inside the Asynchronous groups.



Summary of flexible approach

- The solution found after the social issues risen in the 70s offered a perfect tool for the flexibility.
- In machining, the MC and the FMS was considered the right answer and a part of some teething problem are currently the base solution for any machining line. The transfer can be considered definitively dead.
- In assembly, the robots and group worked well in facing flexibility. In general there was a standard more or less defined everywhere used before the Japanese revolution and the globalization.



On this base, the ABC approach was the best to solve the internal logistics problem

General Supply chain problem

- While the internal logistics faced a complete revolution being connected to the new systems of production, the general supply chain did not change .
- It was based on big mainframe that managed all the BOMs and the production plan.
- The supply were based on the production plan and the gaps between the forecasted and the actual production were solved in the following loop.
- Immediately there were not alarms from this approach that become clearly obsolete when the knowledge of Japanese technologies, Just in time or Kanban, was diffused.
- It will be the object of a further focus but before reaching it let's go through the last subject introduced with the flexibility: planning and scheduling of a production line.