Supply Chain Academy 2017
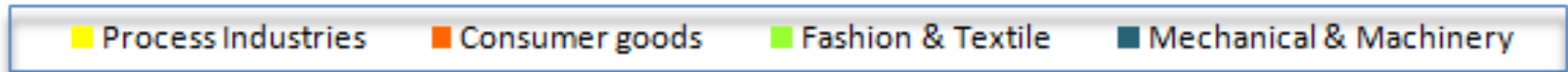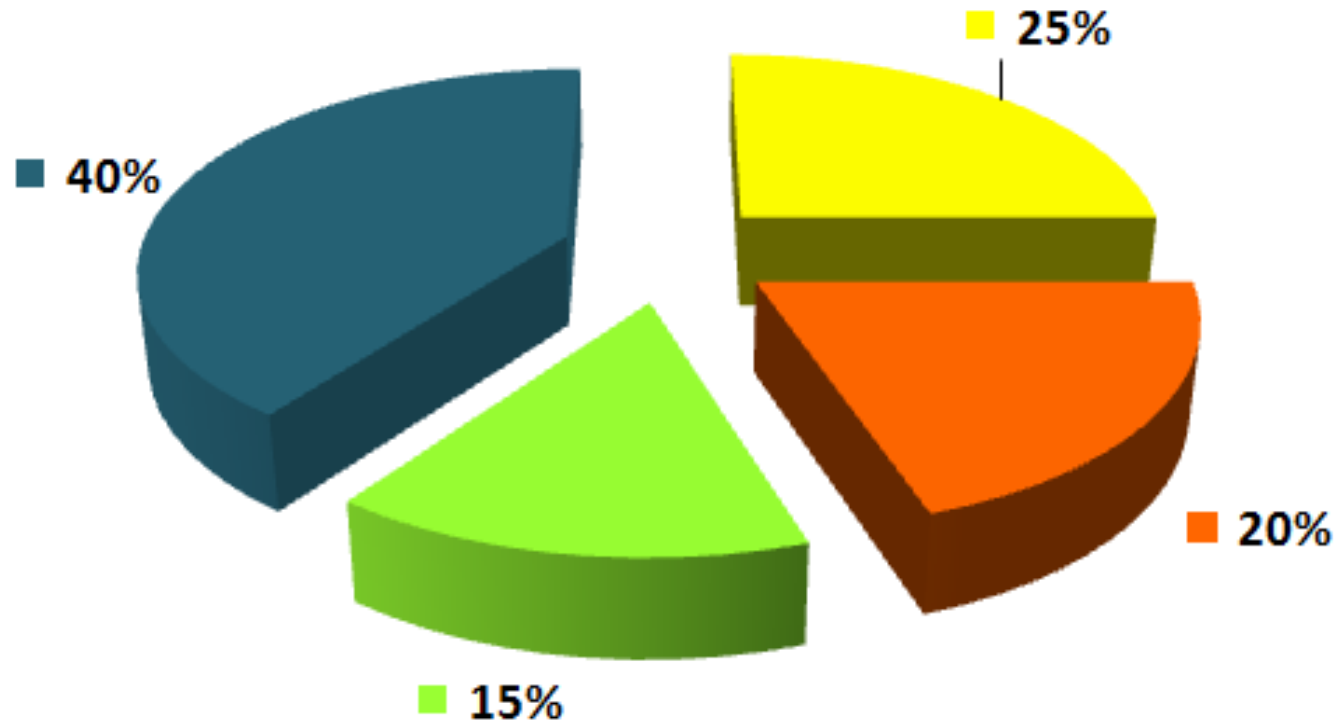
The rhythm wheel production approach combined to a stock mix optimization algorithm

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plannet.it

Some references

- **+ 150 companies**
- **industries:**

■ Process Industries	■ Consumer goods	■ Fashion & Textile	■ Mechanical & Machinery

Process Industries: 25%
Consumer goods: 20%
Fashion & Textile: 15%
Mechanical & Machinery: 40%

Main topics

Compass supply chain planning software combines a **tactical approach** with a detail planning scheduling always considering typical **manufacturing constraints**

The main parameters which determine world-class manufacturers are quality, cost effective, flexibility and innovation

- Rhythm wheel- reduction of set up time

- Multi-skilled employees

- Warehouse constraint – reduction of WIP material

WORLD CLASS MANUFACTURING

SAFETY
COST DEPLOYMENT
FOCUSED IMPROVEMENT
AUTONOMOUS ACTIVITIES
PROFESSIONAL MAINTENANCE
QUALITY CONTROL
LOGISTIC AND CUSTOMER SERVICE
PLANT DEVELOPMENT SPEED/ PRODUCT DEVELOPMENT SPEED
PEOPLE DEVELOPMENT
ENVIRONMENT

The rhythm wheel concept

- The rhythm wheel is a lean planning and scheduling concept and can be used with different manufacturing processes

- It can be combined with make-to-order (MTO) process or with a make-to-stock (MTS) process forecast driven

- The basic principle is to maintain a strict production sequence

- This repetitive production cycle eases production, increases the efficiency and reduces changeover time and cost

- The add-on provided by Plannet has been to build an algorithm that works with these concepts but that also looks to the incoming demand in order to mix the production and to optimize the stock

Sequence definition

- The definition of the wheel can combine **different sequence criteria** on the same machine

- Example: one machine can be scheduled combining 3 different layers or parameter type:
  - Type 1: Parameter type 1 PT1 (i.e. size)
  - Type 2: Parameter type 2 PT2 (i.e. format)
  - Type 3: Parameter type 3 PT3 (i.e. color)

- These parameters are characteristics of the item and they contain specific values

- Consequently each production order that can be scheduled on the machine owns specific values for each parameter type

Wheel definition

- Type 1: PT1 (first circle, possible values 200,100,300)
- Type 2: PT2 (second circle, possible values 20x50,20x60,30x60)
- Type 3: PT3 (third circle, possible values Y,R)
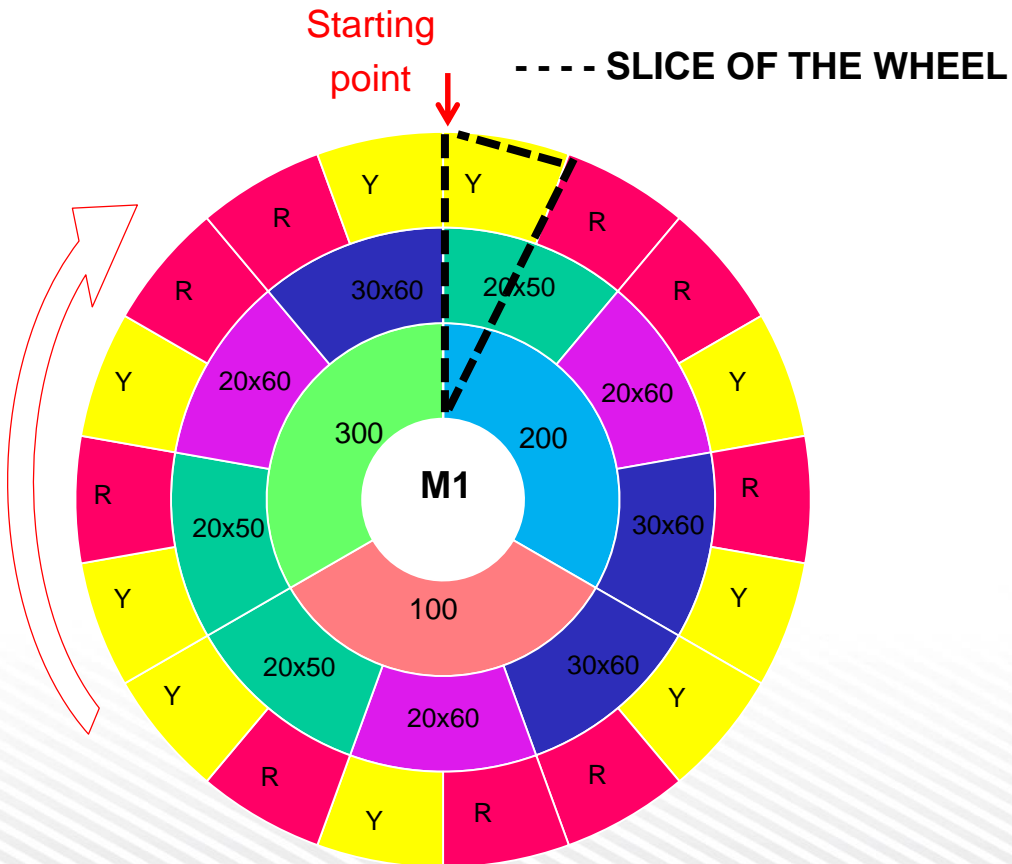
- Every slice of the wheel is composed by 3 different values
- Compass follows the sequence of the slices and try to fit this wheel in the defined period (week, month…)
- More wheels can be defined for the same machine -> **alternative wheels**
- More orders can belong to the same slice: Compass will schedule initially these orders following the priority assigned by their due date

Period of the wheel

- The main goal of the scheduling is to fit the wheel in a specific period

- This period can be defined choosing from different aggregation (month, week, day): i.e. a weekly period

04/09/17	11/09/17	18/09/17	25/09/17	02/10/17	09/10/17
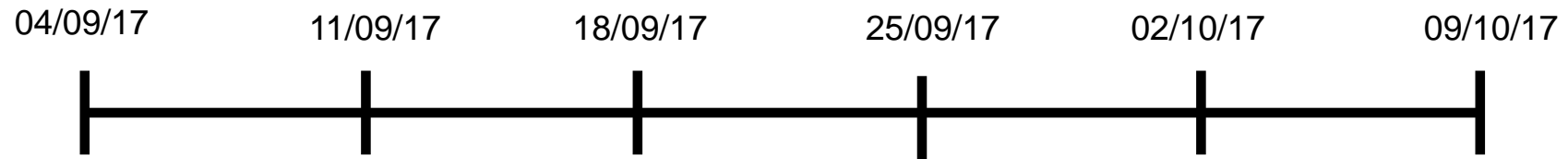
- The scheduling algorithm groups together all the production orders that have the due date falling into the period (i.e. week)

- The approach of the algorithm is to fit the wheel in the period to have a **maximum load** of the machine in order to use all the capacity available while **optimizing the stock mix**

Stock optimization algorithm

- 3 steps for each period and for each machine:

  - Create the balanced wheel

  - Choose the best wheel

  - Modify the wheel to respect minimum and multiple lot

Balanced wheel

- The stock optimization algorithm considers all the items that belong to the wheel and find the best solution to balance them **minimizing the coverage days** while respecting the wheel

- A specific mathematic formula considers for each item a factor expressed in production hour to generate/reduce 1 coverage day

- This factor value combined with all the items permits to find the best quantity to be produced for each item
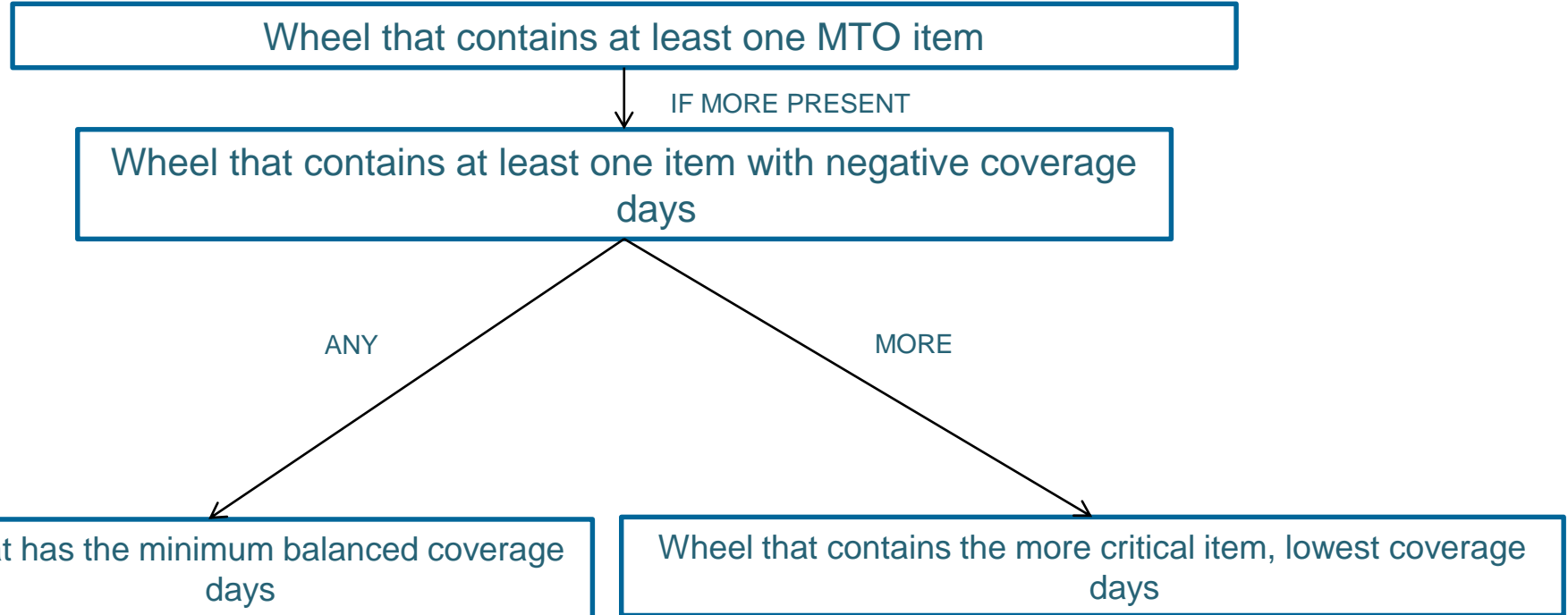
Stock and coverage days (>0)   Production mix

- The algorithm always considers shelf life and MTO item:
    - Shelf life: avoiding to schedule in advance orders that have a shelf life
    - MTO: the wheel that has MTO items always allocate capacity available to produce them

Choose the best wheel

- For each period and for each machine the best alternative balanced wheel is defined in the following way:

```
┌─────────────────────────────────────────────────────────────┐
│          Wheel that contains at least one MTO item           │
└─────────────────────────────────────────────────────────────┘
                              │  IF MORE PRESENT
                              ▼
┌─────────────────────────────────────────────────────────────┐
│  Wheel that contains at least one item with negative coverage │
│                            days                               │
└─────────────────────────────────────────────────────────────┘
            ANY                              MORE
┌──────────────────────────────┐   ┌──────────────────────────────┐
│ Wheel that has the minimum    │   │ Wheel that contains the more  │
│ balanced coverage days        │   │ critical item, lowest coverage│
│                               │   │ days                          │
└──────────────────────────────┘   └──────────────────────────────┘
```

Minimum and multiple lot

- The minimum and multiple lot is always considered in order to respect the planning policy:
  - - of the item
  - - of the sequence parameter defined for a particular slice of the wheel
1. Check items that are respecting the minimum lot
   1. Reduce the quantity to the first lower multiple lot
   2. Add production in order to reach the first higher multiple lot
2. Check items that are <u>not</u> respecting the minimum lot
   1. While choosing the starting item to apply the lot the algorithm creates a priority list in order to start from the item more critical and schedules in advance future requirements in order to reach the minimum lot while respecting the multiple lot
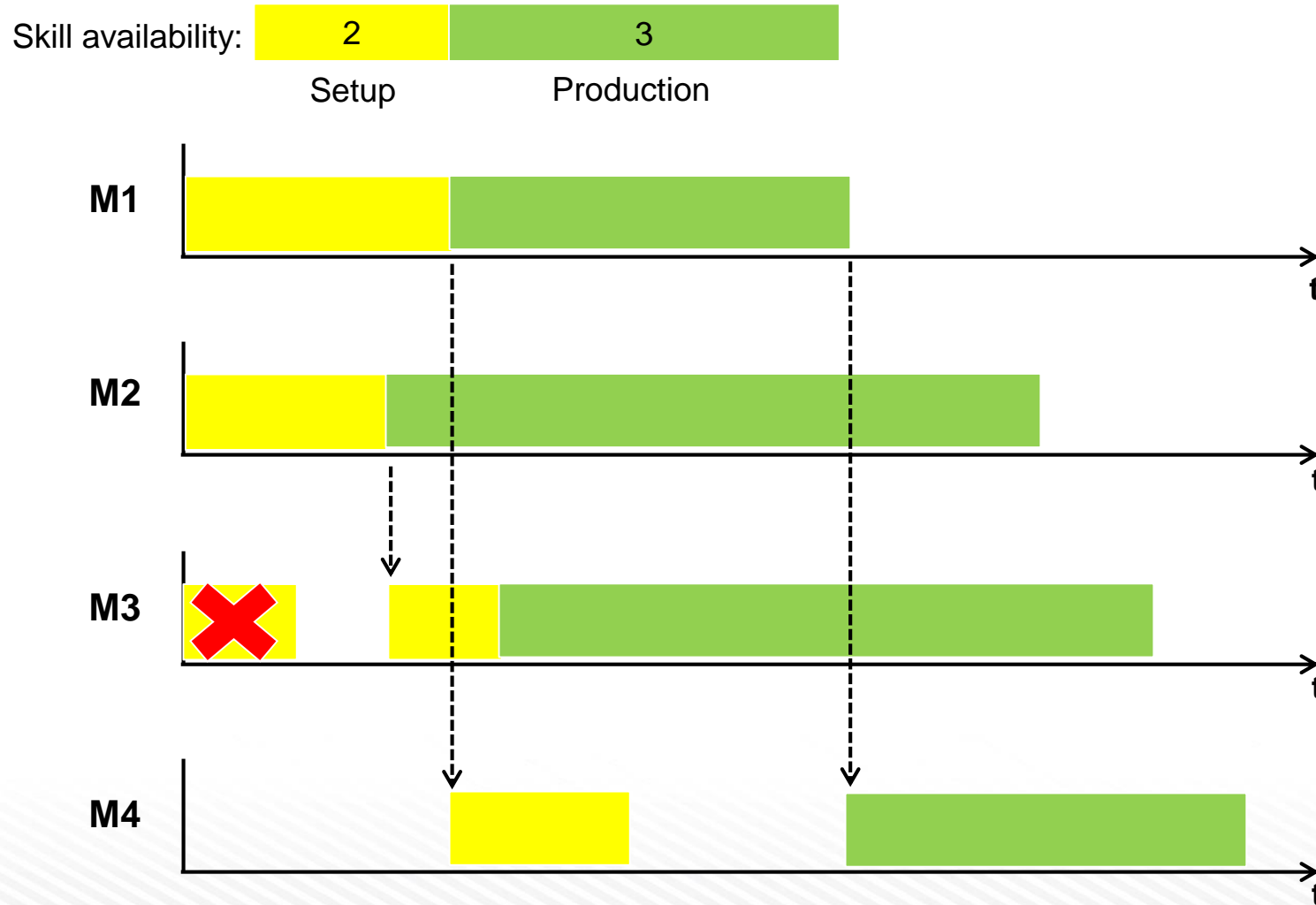
Scheduling constraints

- Finite capacity scheduling

- Multi-skilled operators constraint

- Warehouse constraint

Multi-skilled operators constraint

- Type of manufacturing process where the number of the machines is bigger than the number of operators that can activate them
- Different skill definitions
  - Operators employed in setup time and/or production time
- Definition of the availability of the skill by shift and by resource (plant, dept., machine)
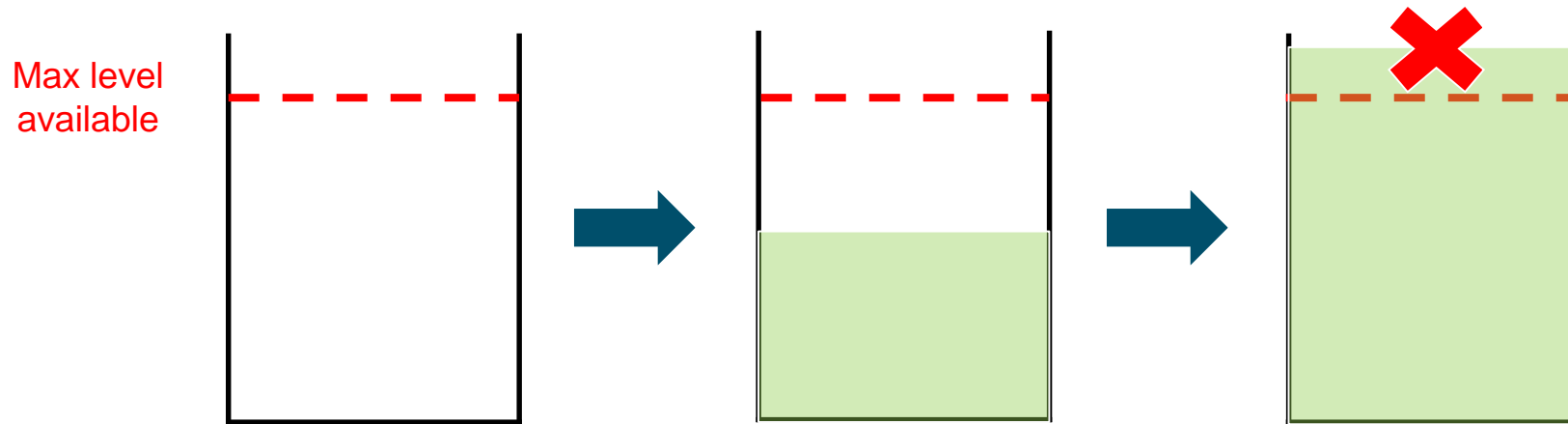- Skill utilization in the route

Setup time   Production time
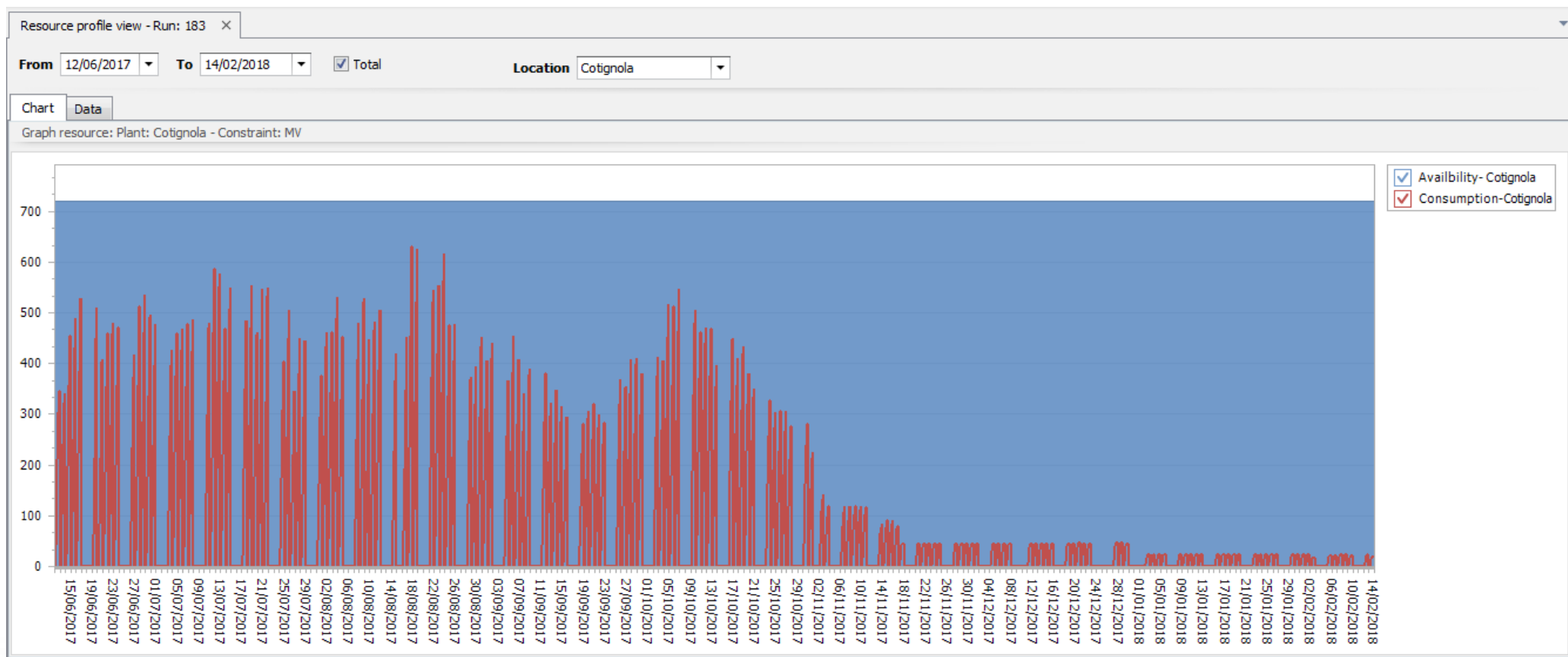
Multi-skilled operators constraint

Warehouse constraint

- Definition of the warehouse capacity

- Definition of the resource (plant, dept. ,machines) that produce and store goods in the warehouse

Max level available

- The scheduling will always considers also the warehouse consumption

Warehouse constraint

Business application

- The rhythm wheel approach can be used in those companies where it is important to try to reduce the stock and to reduce the setup time while maintaining a good service level

- The multi-skill operator constraint is a powerful tools for manufacturing activities that have high complexity in manpower utilization and management

- The warehouse constraint can be adopted by companies that works with silos to store their WIP goods (limited space) or where the warehouse cost is a key factor