**OPERATIONS MANAGEMENT EXAM**

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**January 12th, 2024**

**LEAN Exercise (10 points)**

Raffinatezza Srl is a boutique online company specializing in the manufacturing of shirts.

The company runs a business that it sells **400 units/week** on average. Such demand is composed by coloured shirts. The shirts can be made of 5 different fabrics and 40 colours. Notably, Raffinatezza has gained global recognition for its range of wooden button shapes, with 12 unique designs corresponding to each zodiac sign. Each shirt is composed of a total of 13 buttons.

Everyday all the variants are requested by the customers, who are not willing to wait for the products. The products are standardized and do not occupy a lot of storage space.

The production process is composed as follows:

* **Washing**: The fabric undergoes a pre-colouring wash with manual activities, performed by one operator. A setup is required every time a fabric is changed.
* **Button Cutting**: Simultaneous to Washing phase, wood is cutting into various shapes, with 1 setup per shape. A 20% scrap rate is associated with this process due to the unique button shapes.
* **Colouring**: Fabric colouring is executed with two operators working in parallel with manual activities. A setup is required every time a fabric is changed.
* **Stitching**: Fabrics and buttons are meticulously stitched together, requiring a setups for fabric and colour changes. At this stage, an operator manages activities with a dedicated machine.
* **Ironing**: Before shipping, shirts undergo ironing, with setup required for fabric and colour changes. At this stage, an operator manages activities with a dedicated machine.

Washing phase and Button Cutting phase work in parallel. All phases are dedicated to this product family.

Each stages are managed by 1 operator, except for the colouring phase.

The company works on shifts (8 hours per shift with 2 breaks per shift, each breaks of 15 minutes) 5 days per week.

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| **Phases** | **Cycle Time** | **Changeover** | **Availability (%)** | **Inventory**  **downstream** | **The Setup is done when changes** | **Shifts** |
| *Washing* | 5 min | 10 min | 100 | 500 (shirts) | Fabric | 1 |
| *Button cutting* | 3 sec/button | 20 min | 75 | 12000 (buttons) | Shape | 3 |
| *Colouring* | 3 min | 15 min | 95 | 1200 (shirts) | Fabric | 2 |
| *Stitching* | 3 min | 10 min | 90 | 350 (shirts) | Fabric +Colour | 2 |
| *Ironing* | 5 min | 15 min | 100 | 3000 (shirts) | Fabric + Colour | 2 |

Customers place orders daily. Raffinatezza's delivery system involves two daily shipments while production is scheduled every week for each stage. The raw material stocks upstream washing stage and button cutting cover respectfully 100 and 200 days of customer demand. Production and control send a daily delivery schedule to the shipping stage. The production and control places a raw materials order to the supplier every month and a monthly forecasts. The supplier delivers weekly. Every day, button cutting and washing stages inform production and control about the current level of Raw Materials available.

**Q1) (2 points) Draw the current state map for the production of shirts.**

**Q2) (8 points) Create a future state of the system, with timeline included (answering the first six questions of the future state). The target for the improvements is to ensure that the company is able to fulfill the demand of shirts (in volume and mix) in maximum to 1 days in each stage**.