# Analysis of a Sewing Line of a RMG Factory using Arena

This project presents a detailed simulation model of an assembly line in a Ready-Made Garment (RMG) factory, built using Rockwell Arena. The primary focus is to analyze the performance of operators and helpers, understand the associated costs, and propose alternative arrangements to improve the line's efficiency.

## 📝 Problem Statement

We are examining an assembly line that consists of **15 distinct processes**, operated by a team of **6 operators** and **6 helpers**. The management wants to determine the performance of the operators and analyze the costs involved in the current setup. The simulation team is tasked with modeling this system to identify areas for improvement and suggest better alternatives.

The hourly costs for labor are as follows:

- **Operator:** 100 Taka/hour
- **Helper:** 70 Taka/hour

## 🎯 Project Objectives

1. **Develop a Model:** Construct a comprehensive simulation model for the assembly line system using Arena.
2. **Simulate and Analyze:** Run the simulation to visualize the workflow and analyze the system's operational dynamics.
3. **Measure Performance:** Evaluate the performance of operators and helpers using data gathered over a certain number of replications.
4. **Propose Improvements:** Suggest better, cost-effective alternative arrangements based on the simulation results.

## 📊 System Parameters & Distributions

The operational parameters, including inter-arrival times and process durations, are defined by the statistical distributions below.

### Table 1: Inter-arrival Time (seconds) and Labor Cost (Tk/hour)

| Category | Distribution | Resource | Cost (Tk/hour) |
|---|---|---|---|
| Inter-arrival time | 9 + 9 * BETA(0.989, | Operator | 50 |

| | | 1.34) | | |
|---|---|---|---|---|
| | | Helper | 30 | |

## Table 2: Distribution of Process Time (seconds)

| Process | Name | Helpers/Operators | Expression of Process Time |
|---|---|---|---|
| Process 1 | Matching | Helper | 9 + 9 * BETA(0.989, 1.34) |
| Process 2 | Join Shoulder | Operator | TRIA(13, 16.3, 24) |
| Process 3 | Rib Tack | Operator | 5 + LOGN(1.53, 1.09) |
| Process 4 | Neck join | Operator | 10.1 + LOGN(1.94, 1.36) |
| Process 5 | BK tape attach | Helper | 9.26 + ERLA(0.962, 3) |
| Process 6 | BK TS | Operator (2) | 24 + 9 * BETA(1.09, 1.22) |
| Process 7 | Front neck TS | Operator | 9.26 + LOGN(3.13, 2.16) |
| Process 8 | Sleeve shearing | Helper | 3 + ERLA(1.64, 3) |
| Process 9 | Sleeve cut | Helper | 14 + GAMM(2.56, 1.49) |
| Process 10 | Sleeve join | Operator (3) | 34 + ERLA(2.71, 2) |
| Process 11 | Side close | Operator (2) | 25 + LOGN(3.1, 2.21) |
| Process 12 | Sticker remove | Helper | 8 + ERLA(2.01, 2) |
| Process 13 | Body hem | Operator | UNIF(11.3, 16) |
| Process 14 | Sleeve hem | Operator (2) | NORM(29.1, 1.66) |

| Process 15 | Thread cut | Helper | NORM(35.8, 1.32) |
|---|---|---|---|

## 🛠️ Model Details & System Logic

- **System Requirements:** Windows OS and Rockwell Arena simulation software.
- **Entities:** Fabric
- **Resource:** Operator and Helper
- **Processes:** 15 processes as listed in the table above.
- **Process Action:** The core logic for all operations is **Seize Delay Release**.
- **Queue Discipline:** All queues operate on a **First-Come, First-Served (FCFS)** basis.
- **Routing:** The model uses 15 distinct routes to move entities between the 15 stations.

## 🚀 How to Run the Simulation

1. Ensure you have **Rockwell Arena** installed on a **Windows** operating system.
2. Clone this repository or download the .doe model file.
3. Open the model file in Arena.
4. Set the desired number of replications for the simulation run.
5. Execute the simulation to generate performance reports.

## 📈 Results & Analysis

The simulation output will provide detailed statistics on resource utilization (operators and helpers), process cycle times, throughput, and work-in-progress levels. This data will be instrumental in identifying bottlenecks, evaluating labor costs, and forming the basis for proposing more efficient and cost-effective operational strategies.