# Optimizing Supply Chain Strategy and Tactics. A Pharmaceutical Industry application

Course: Production Management and Logistic Systems [10592713]

Economia e management (Latina Campus)

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# Objective of this lesson

- Optimizing the supply chain is becoming increasingly important. New challenges require supply chains to become more reliable and more flexible, e.g.,
  - Global launches with steep ramp-ups
  - Increasing complexity of products and production networks

- Before launching improvement programs, an analysis of the existing supply chain has to be performed in order to
  - Thoroughly understand the real issues the client faces
  - Define a clear baseline against which improvements are measured
  - Adjust the design of a new supply chain to possible constraints

# CONTENT

- Pharma supply chain types
- Frequently identified issues
- Key performance indicators
- Data generation and performance assessment
- Target definition
- Project setup for supply chain redesign

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- **Pharma supply chain types**
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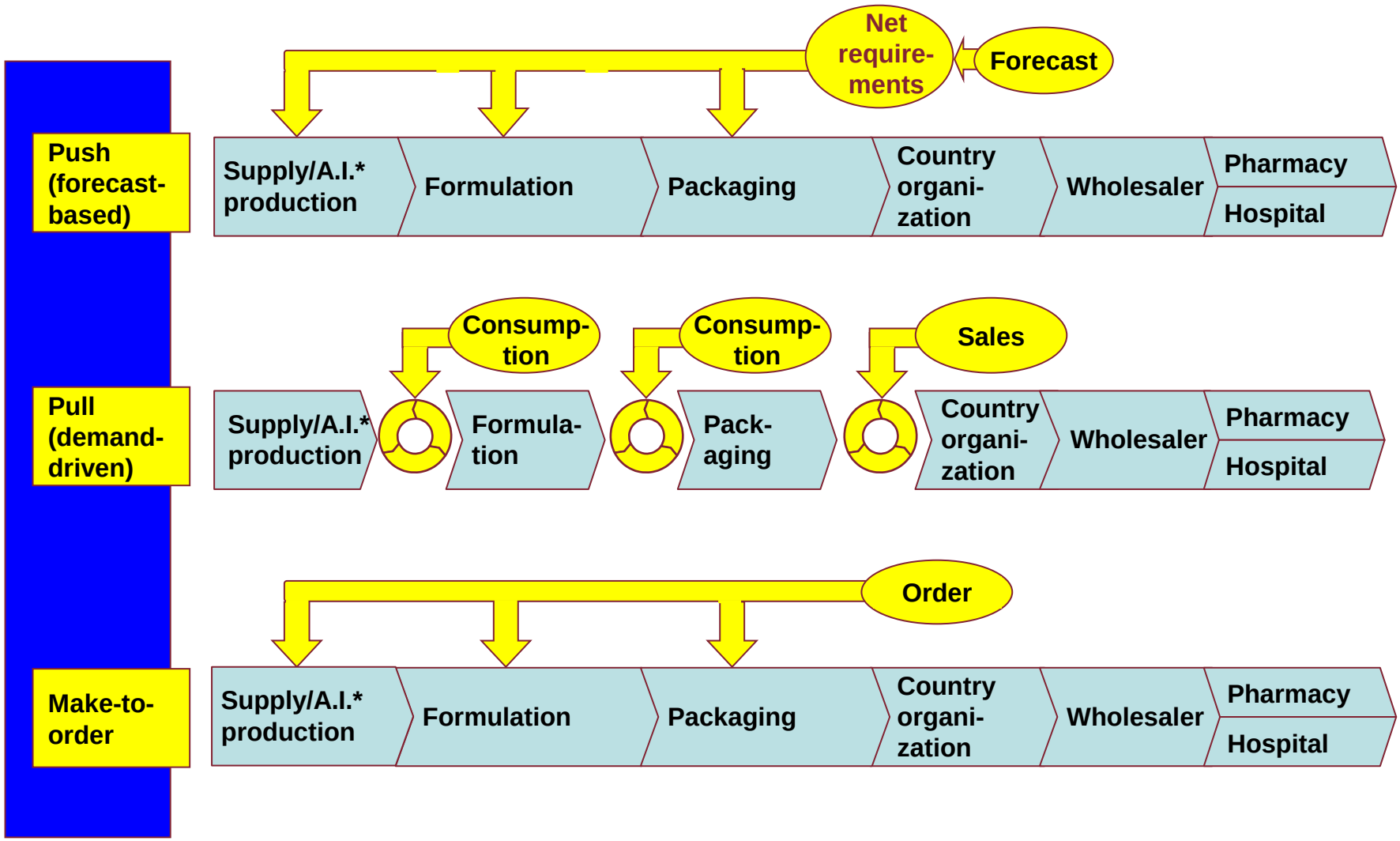
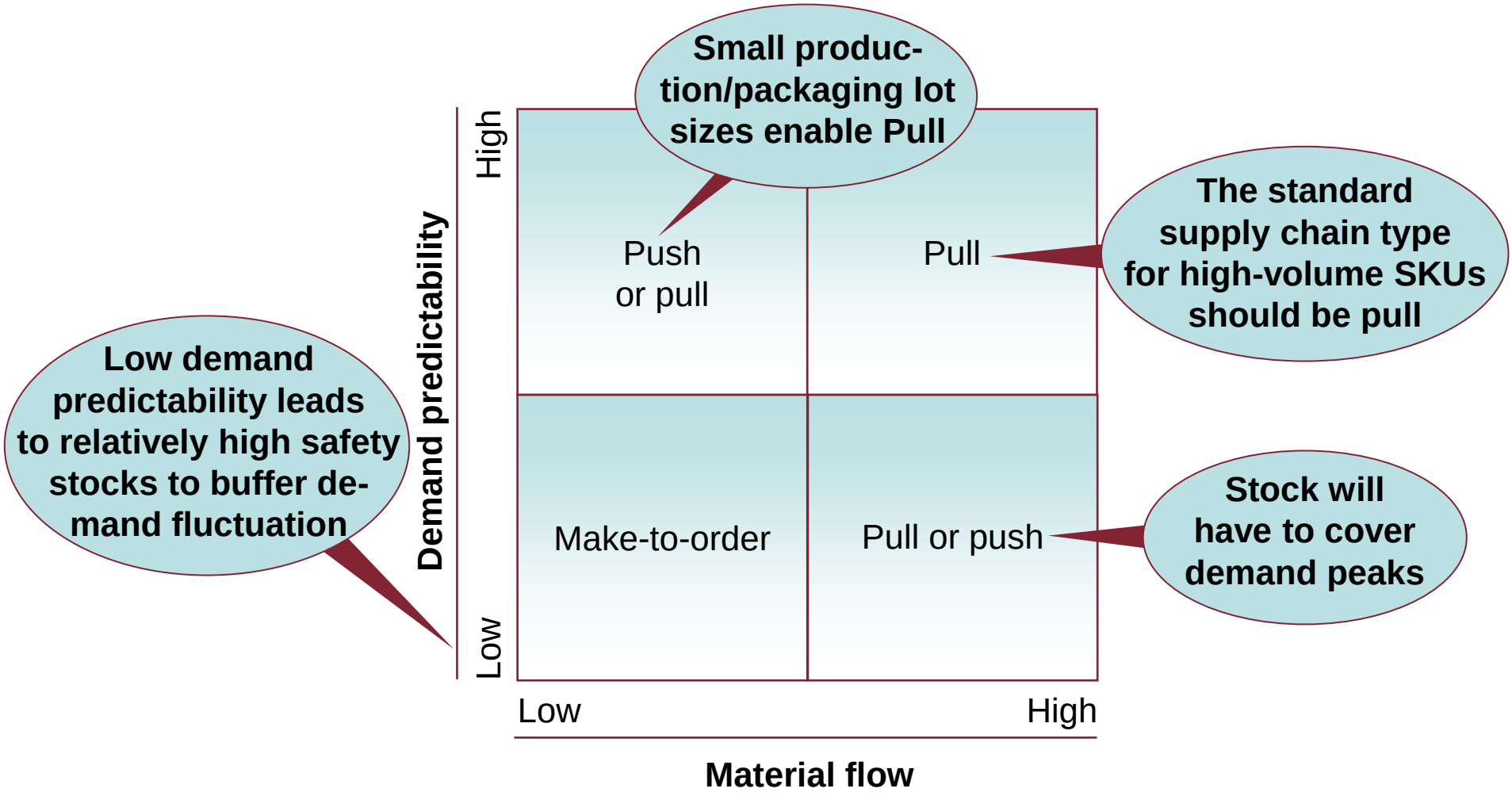
# PHARMA SUPPLY CHAIN TYPES



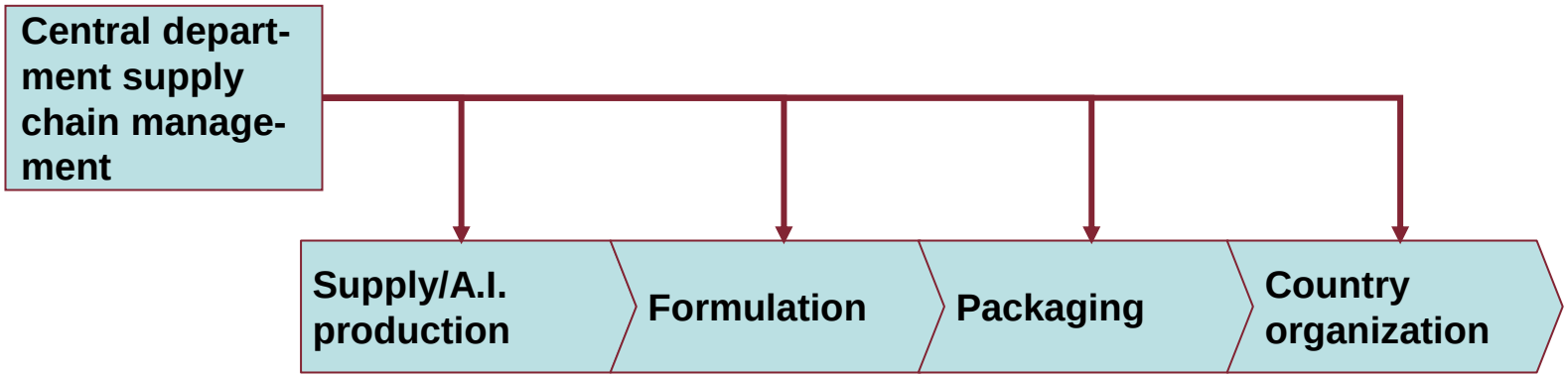
# SUPPLY CHAIN TYPES IN PHARMA INDUSTRY

| | Description | Application in Pharma industry |
|---|---|---|
| **Push** | • Production controlled by fore-casted demand for product over defined period of time based on experience/estimates. High incidence of excess stock due to forecast inaccuracy | • Wide application in the industry for most products<br>• Especially important for product launch phase |
| **Pull** | • Production controlled by down-stream inventory levels. Orders triggered whenever defined threshold levels (reorder points) are crossed | • Only few companies apply pull systems |
| **Make-to-order** | • Production only in case of concrete order. No stock keeping of product. Long reorder time | • Wide application in the industry, e.g., low volume products for niche markets or samples |

# CHOICE OF SUPPLY CHAIN TYPE



# KEY FUNCTIONS IN SUPPLY CHAIN MANAGEMENT




**Supply chain management**

- Exception handling (e.g., express orders, product launches)

**Supply management**

- Ordering of starting materials from suppliers

**Formulation planning**

- Resource planning
- Ordering of starting materials

**Packaging planning**

- Resource planning
- Ordering of bulk and packaging materials

**Dispatching**

- Logistics management

**Demand management**

- Inventory management
- Order placement (net requirement plans)

**Product management**

- Sales forecast

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# FREQUENT ORGANIZATIONAL ISSUES

**Root causes**

- Supply chain management department lacks implementation power or no such department exists
- Management information systems does not include supply chain KPIs
- Incentives not based on supply chain perspective

**Issues**

- Limited coordination of activities and little interaction along the supply chain
- Limited information exchange between similar local functions
- Partial optimization in sub-functions instead of comprehensive optimization along entire supply chain
- Intransparent supply chain situation (inventory levels, throughput times)

**Results**

- Supply chain managed poorly
- High inventory cost

# FREQUENT ISSUES IN DEMAND MANAGEMENT

**Root causes**

- Poor demand management
  - High forecast deviation
  - Large order sizes
  - Disconnect between sales forecast and net requirements planning
  - Disconnect between sales and net requirements/ deliveries
  - Artificial demand peaks, e.g., due to an anticipated price increases
- Bulk formulation/packaging
  - Large production campaigns
  - Long throughput times

**Issues**

- High inventory levels of finished goods at
  - Manufacturing plant
  - Country organization
- Stock outages at country organization

**Results**

- Low **flexibility** to adapt to market changes
- High inventory and obsolencence **cost**
- Low **service** quality

# FREQUENT ISSUES IN FORMULATION AND PACKAGING

**Root causes**

- High throughput equipment
- Incentive system that promotes large campaigns, e.g., machine productivity as most important indicator
- High product complexity (SKU/SDU*)
- No harmonization of order size and packaging lots
- Frequent machine stoppages
- Long changeover times
- Poor transparency on available production capacity

**Issues**

- Long lead times in
  - Production
  - QC
- High inventory coverage of bulk and finished goods
- Low machine equipment utilization

**Results**

- Low **flexibility** to demand fluctuations
- High capital **cost** on inventories
- Low **service** level



* SKU: Stock keeping unit (pack); SDU: Single dosage unit (e.g., a tablet, an ampule)

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# KEY PERFORMANCE INDICATORS ALONG SUPPLY CHAIN

| | Supply/A.I. production | Formulation | Packaging | Distribution | Country organization |
|---|---|---|---|---|---|
| Quality | • Supplier service level | • Formulation service level | • Packaging service level | • Inter-company service level | • Forecast deviation<br>• Customer service level |
| Cost | • Raw materials inventory coverage | • Productivity<br>• Bulk inventory coverage | • Productivity<br>• Central finished goods coverage | • Shipping cost per unit | • Local finished goods coverage |
| Time | • A.I. production throughput time | • Formulation throughput time | • Packaging throughput time | • Transpor-tation time | • Delivery time to customer |

# PERFORMANCE DIMENSIONS AND KEY PERFORMANCE INDICATORS

| | Key performance indicators | Rationale |
|---|---|---|
| **Quality** | • Service levels<br>• Forecast accuracy | • Meet client demands regarding amount, delivery date, and quality<br>• Be able to estimate future demands accurately to determine sales fluctuations |
| **Cost** | • Productivity<br>– Machine<br>– People<br>• Inventory coverage | • Keep costs at minimum by having low stock levels and high productivity |
| **Time** | • Throughput time | • Have a short throughput time to be able to react quickly to demand fluctuations and to reduce inventories |

# GENERAL DEFINITIONS AND INPUTS OF KPIs

| | KPIs | Definitions | Required inputs |
|---|---|---|---|
| Quality | • Service level | Deliveries on time and of correct volume* / Total orders | • Delivery times and volumes<br>• Corresponding order times and volumes |
| | • Forecast accuracy | Forecast error** / Real sales | • Forecasts<br>• Real sales |
| Cost | • Inventory coverage | Inventory / Sales forecast | • Inventory volumes at all process steps |
| | • Productivity (machine) | Production time x 100 / Operation time | • Operation time<br>• Production time |
| Flexibility | • Throughput time | Time from order placement to delivery of released goods | • Order and corresponding delivery times |

* Tolerance should be -3/+0 working days and ± 10% of volume

** Forecast error = forecast – real sales; generally absolute error is used (deviation)

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# GENERAL DATA COLLECTION STEPS

**Map supply chain structure**

- Organizational setup
- Physical process flow mapping
- Information flow
- Product complexity

**Analyze volumes**

- Sales and deliveries
- Forecasts and net requirements
- Production volumes and campaign sizes
- Inventories over time at all supply chain steps and inventory coverage

**Analyze equipment capacity and utilization**

- Equipment capacity
- Shared equipment information
- Equipment utilization
- Changeover times
  - By type
  - Bottom-up estimate

**Analyze throughput times**

- Throughput times
  - Summary
  - Distribution
  - Variation
  - Theoretical minimum

# ORGANIZATION

BU = Business unit
SU = Service unit

**Level 1**

Plant manager

- Logistics
- Controlling

**Level 2**

Head of BU Oral

Head of BU Sterile

Head of SU QA (QC)

Head of SU Gen. services

**Level 3**

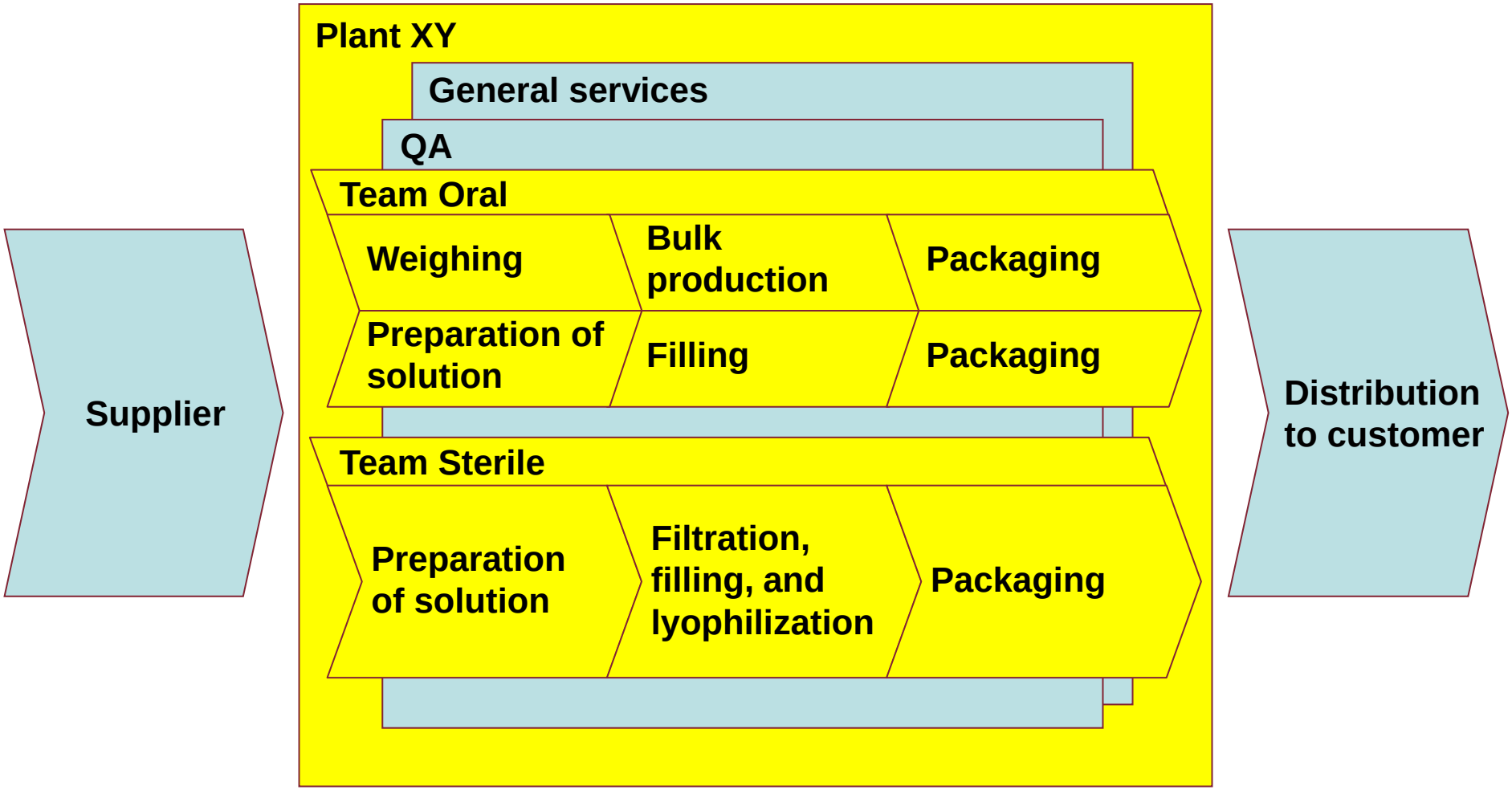
Group work

Group work

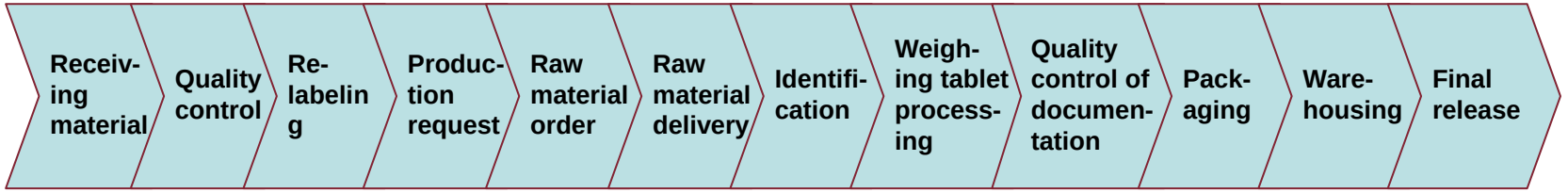
Group work

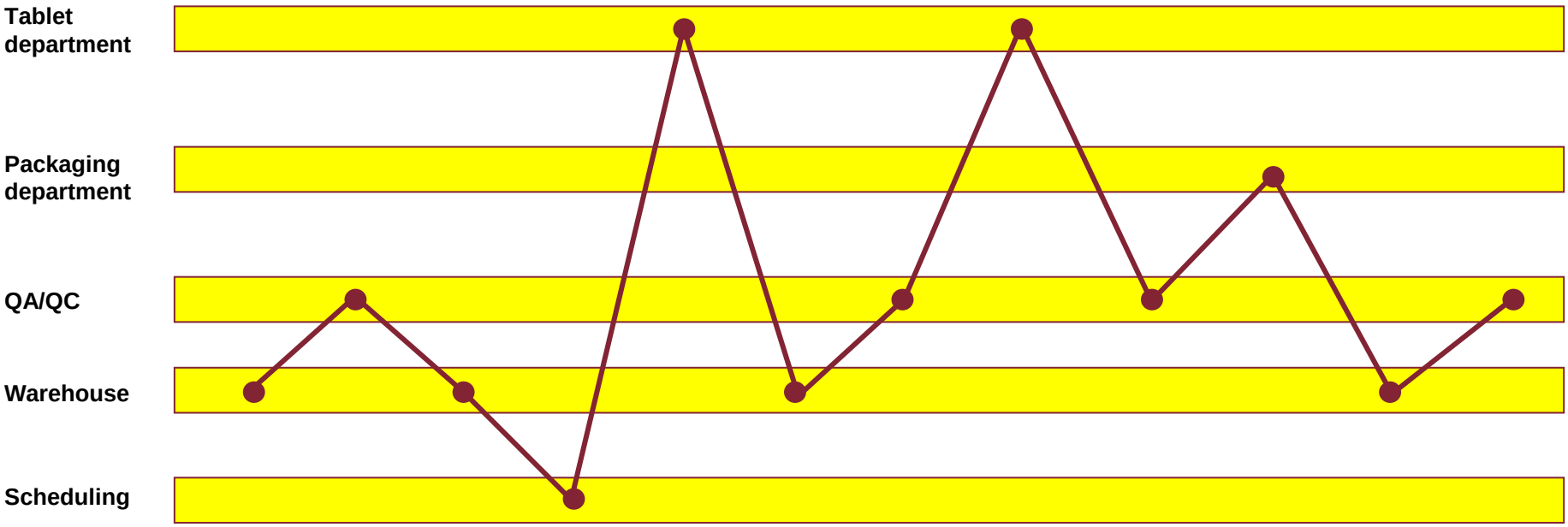
Group work

# ORGANIZATIONAL SETUP

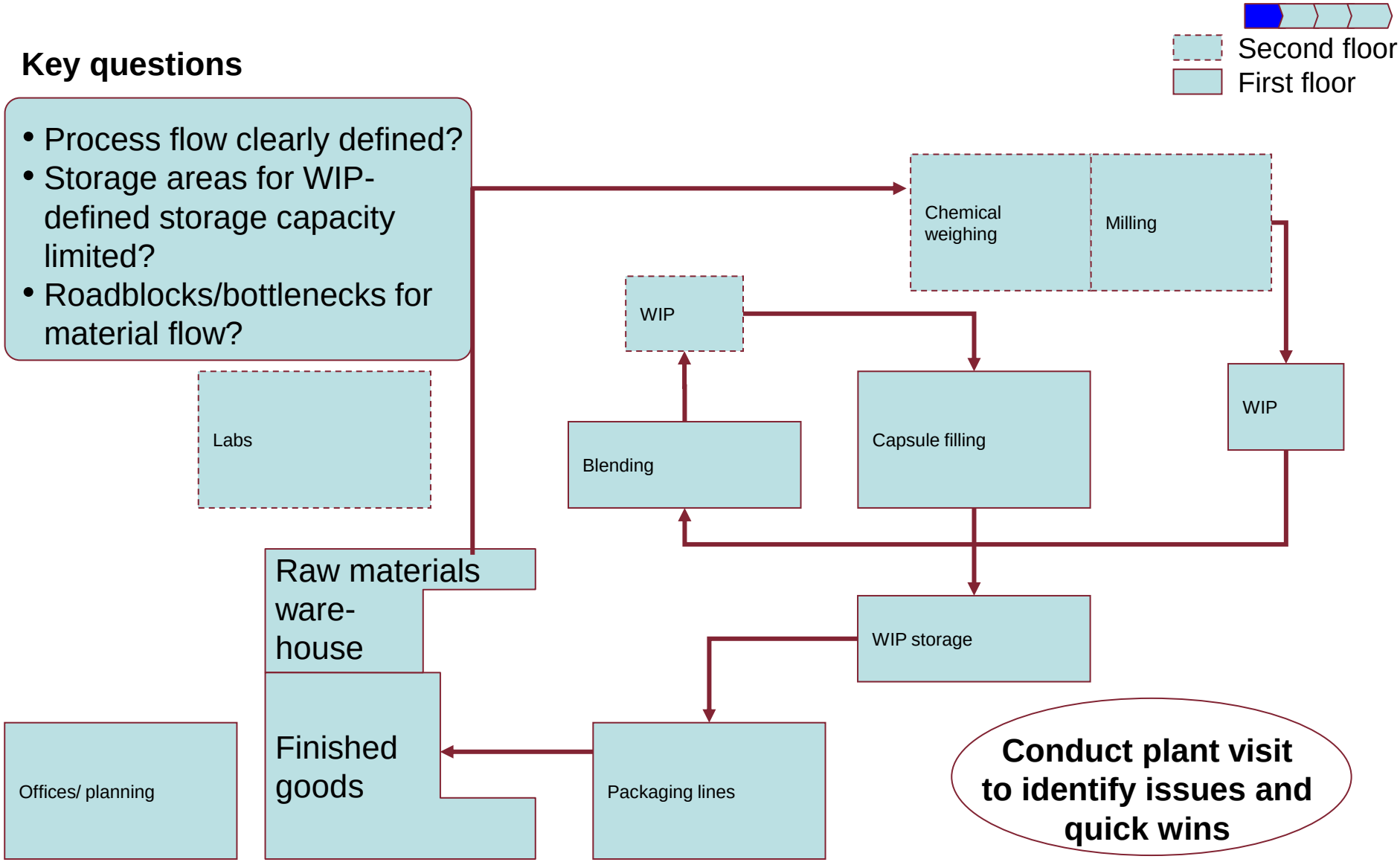


# ORGANIZATIONAL SETUP – PROCESS RESPONSIBILITIES

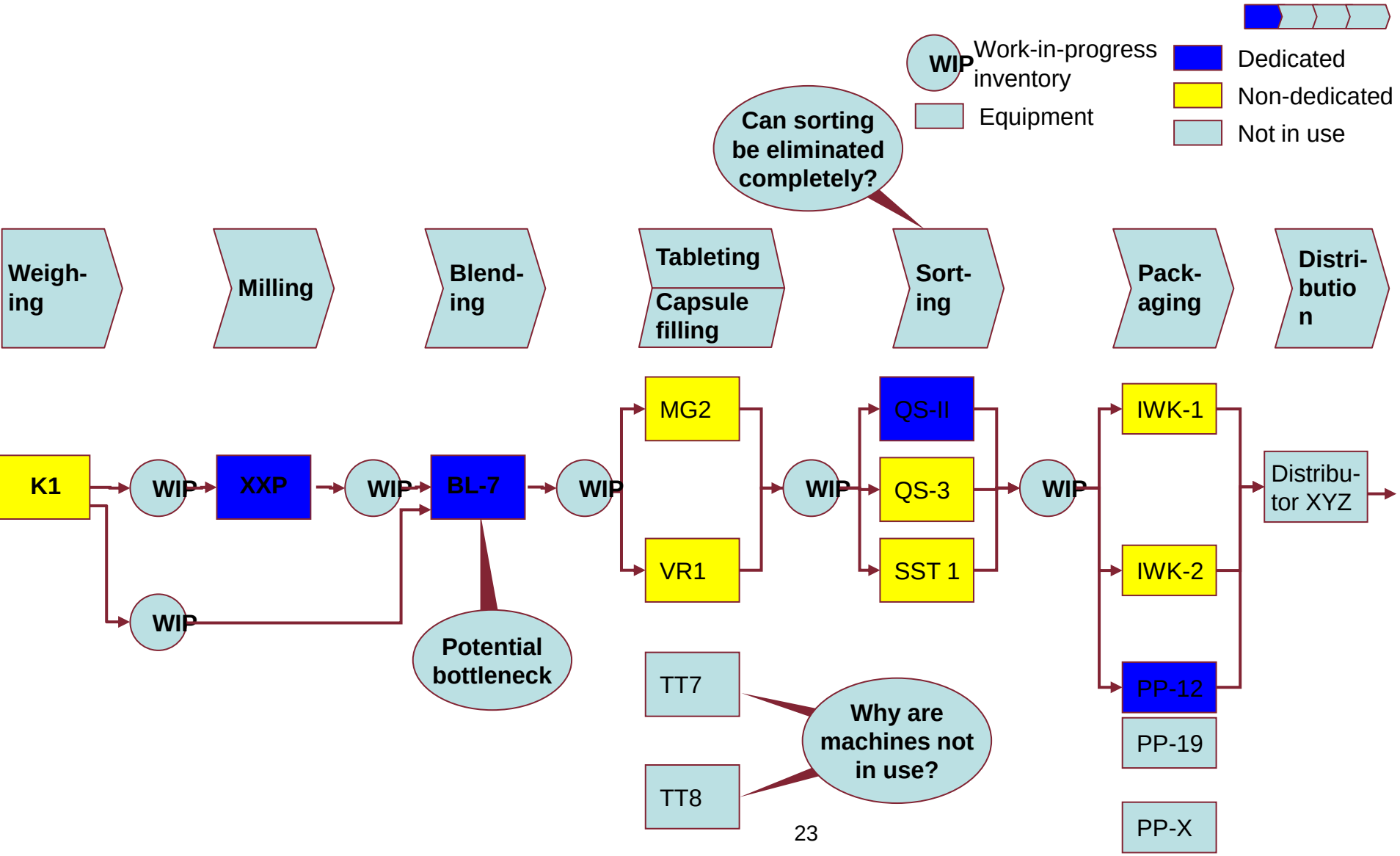


# PHYSICAL LAYOUT



# PROCESSES – PHYSICAL FLOW MAPPING

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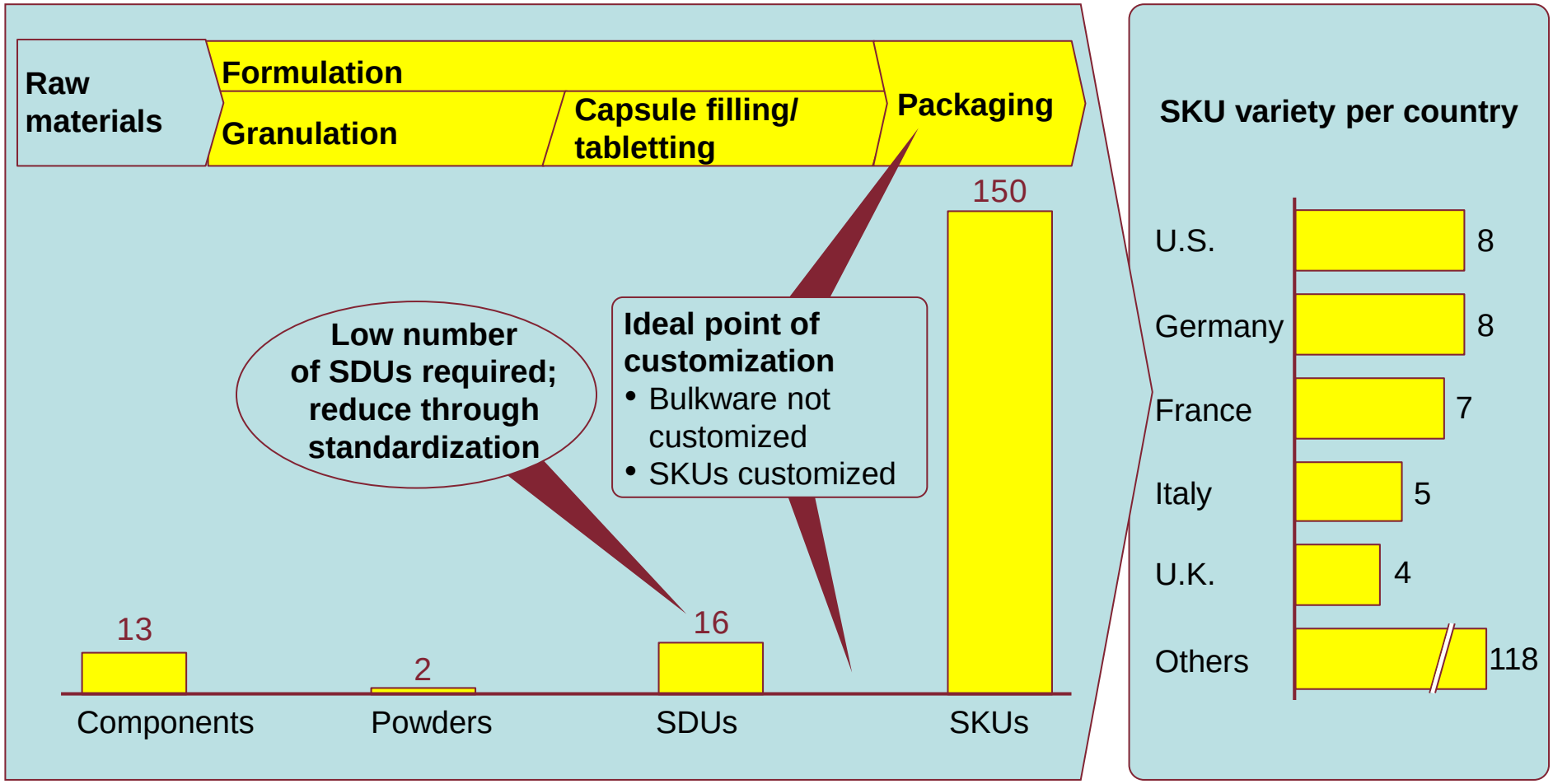
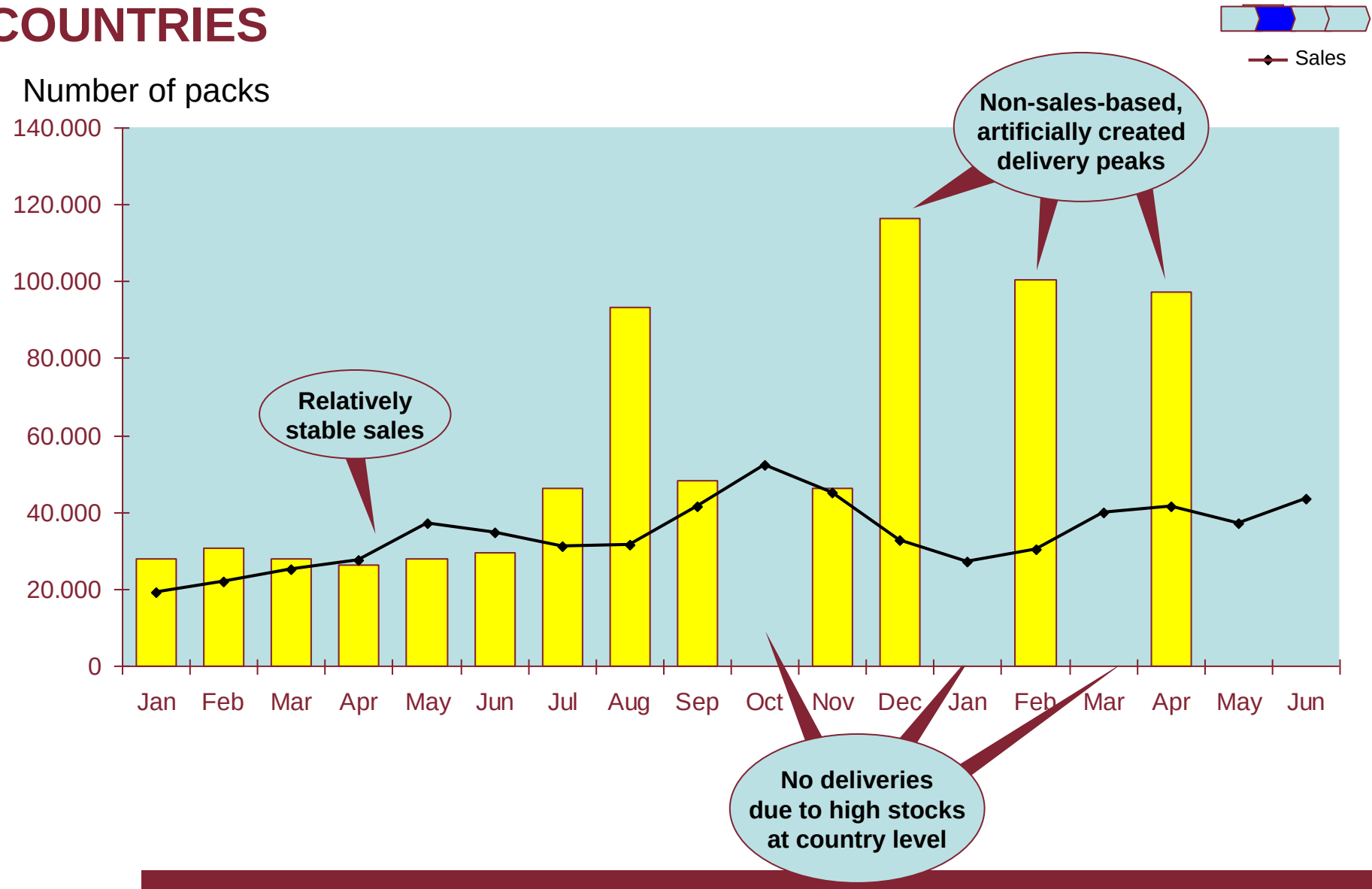
# INFORMATION FLOW

| | Sales forecast | Stock level cross-check | Net requirement (business unit) | Supply chain management logistics department | Net requirement (production) |
|---|---|---|---|---|---|
| **When?** | • 1st day of every month | • 5th day of every month | • Next day | • Next day | • 15th of every month |
| **What?** | • Forecast sales (units) | • Cross-check current stock and stock level policy | • Calculate net requirement based on forecast and current stock<br>• Create order | • Check requirement plausibility and customer-product relation<br>• Check conformity to ordering regulations | • Check changes of net requirements from BUs and consolidate them<br>• Check current stock<br>• Calculate net require-ment (production) for starting materials, WIP, and FG |
| **Who?** | • Local product manager | • Local demand manager | • Local demand manager | • Supply chain management | • Production planning |
| **Systems used** | • Forecast system | • Demand system | • Demand system | • Demand system | • SAP |

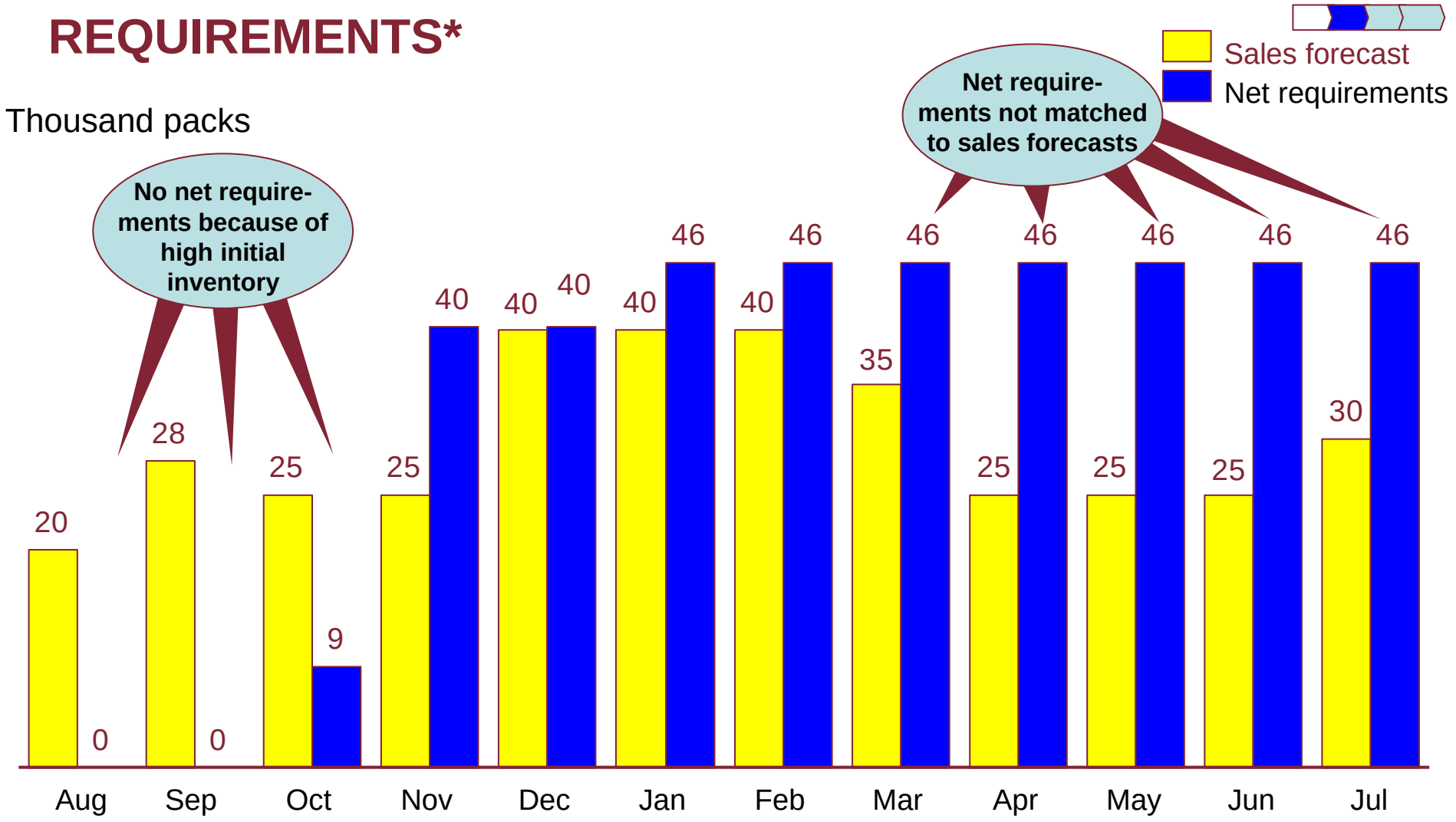
# PRODUCT COMPLEXITY FOR PRODUCT ABC



# VOLUMES – SALES AND DELIVERIES TO COUNTRIES

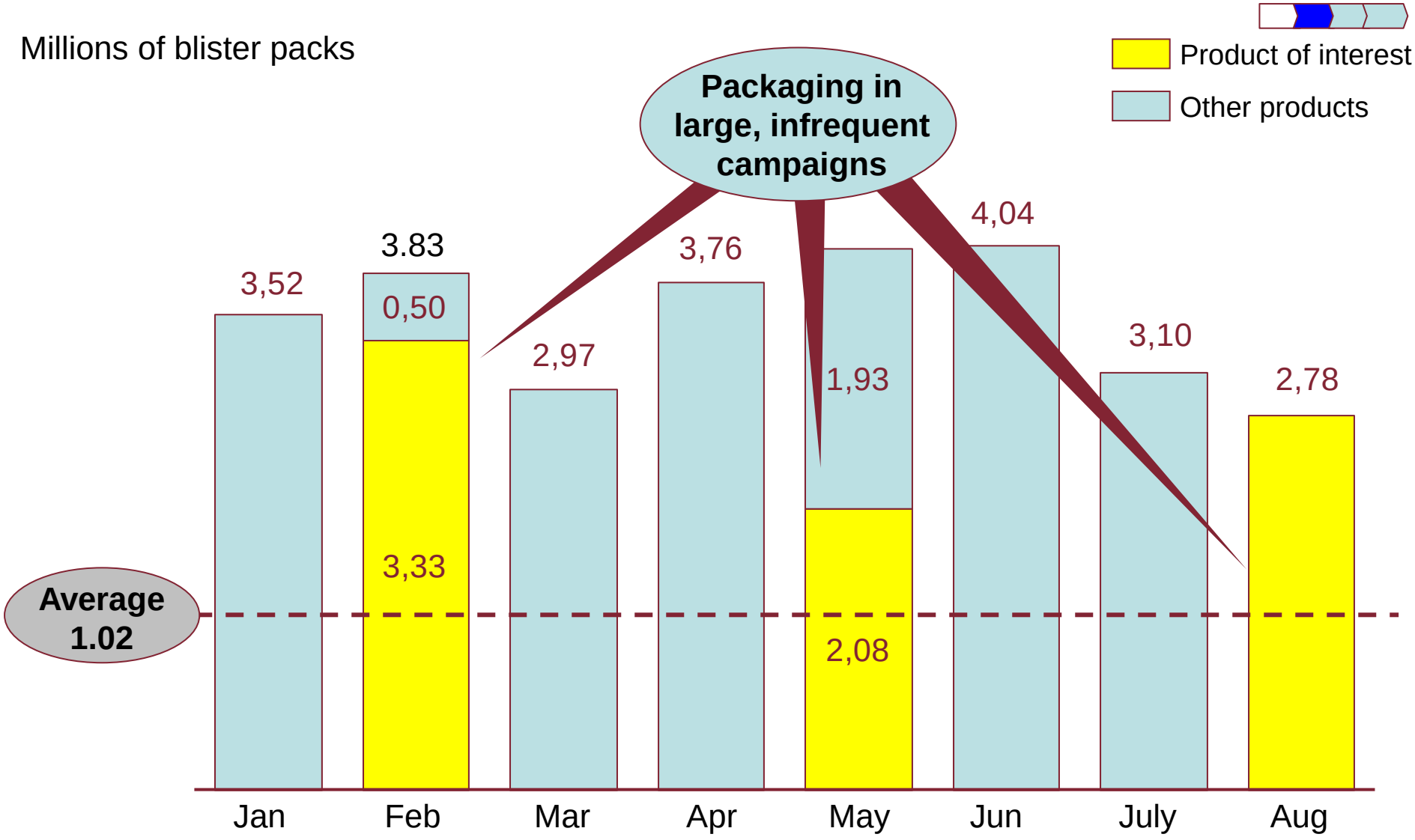


# VOLUMES – SALES FORECASTS AND NET REQUIREMENTS*



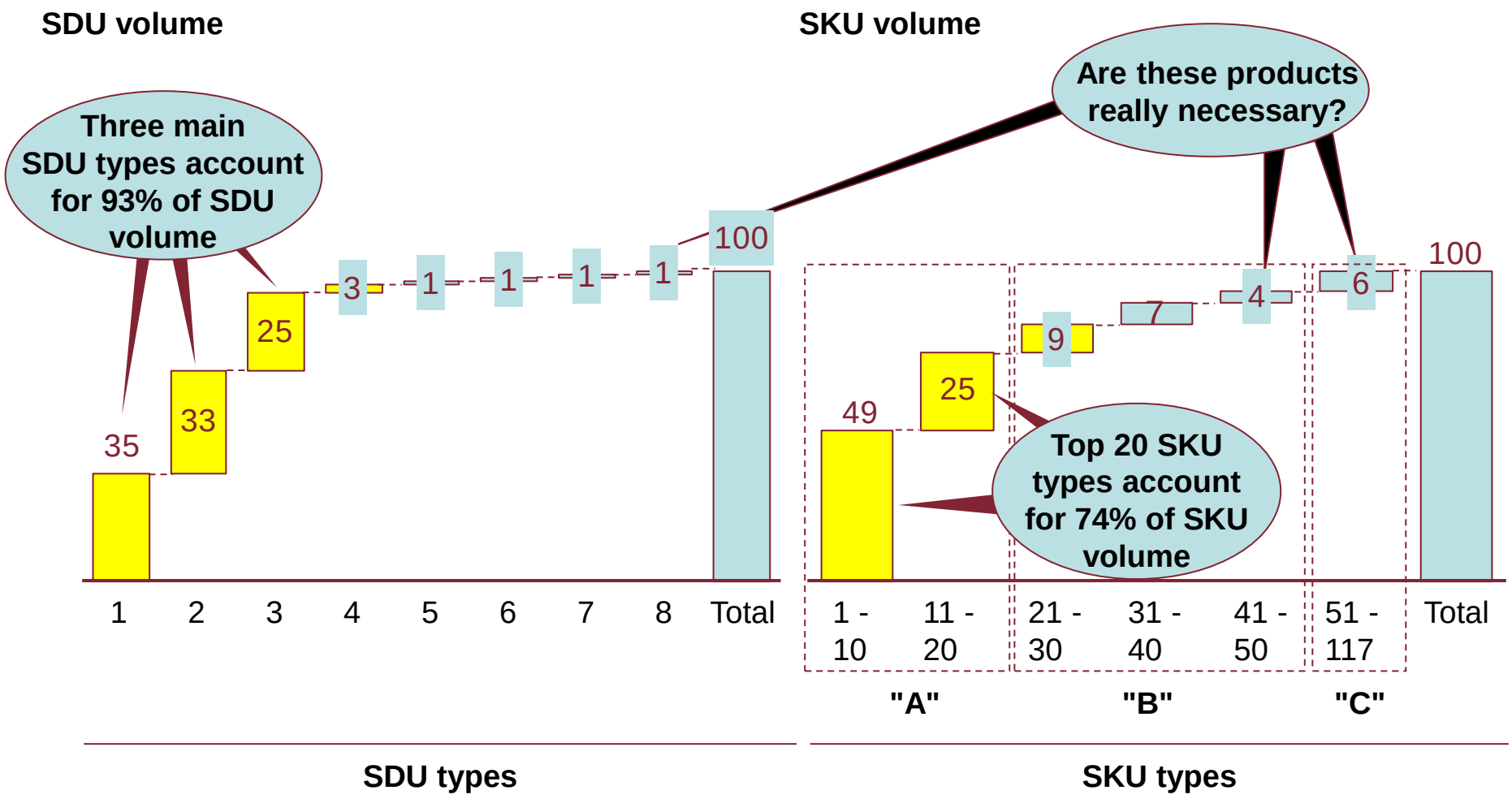

* Monthly sales forecasts as provided by marketing; monthly net requirements as provided by demand management

# VOLUMES – PACKAGING

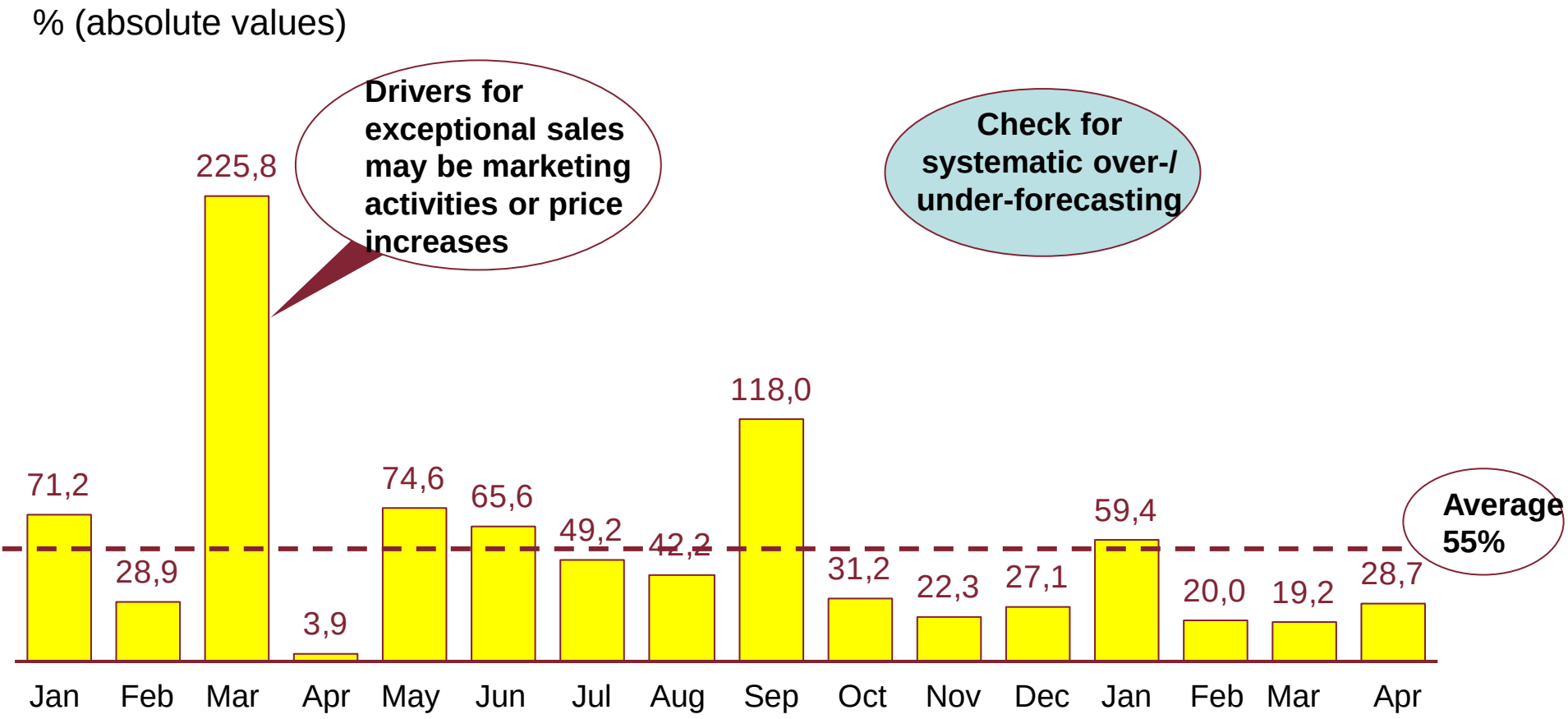


# VOLUMES – ABC ANALYSIS OF SDU AND SKU TYPES

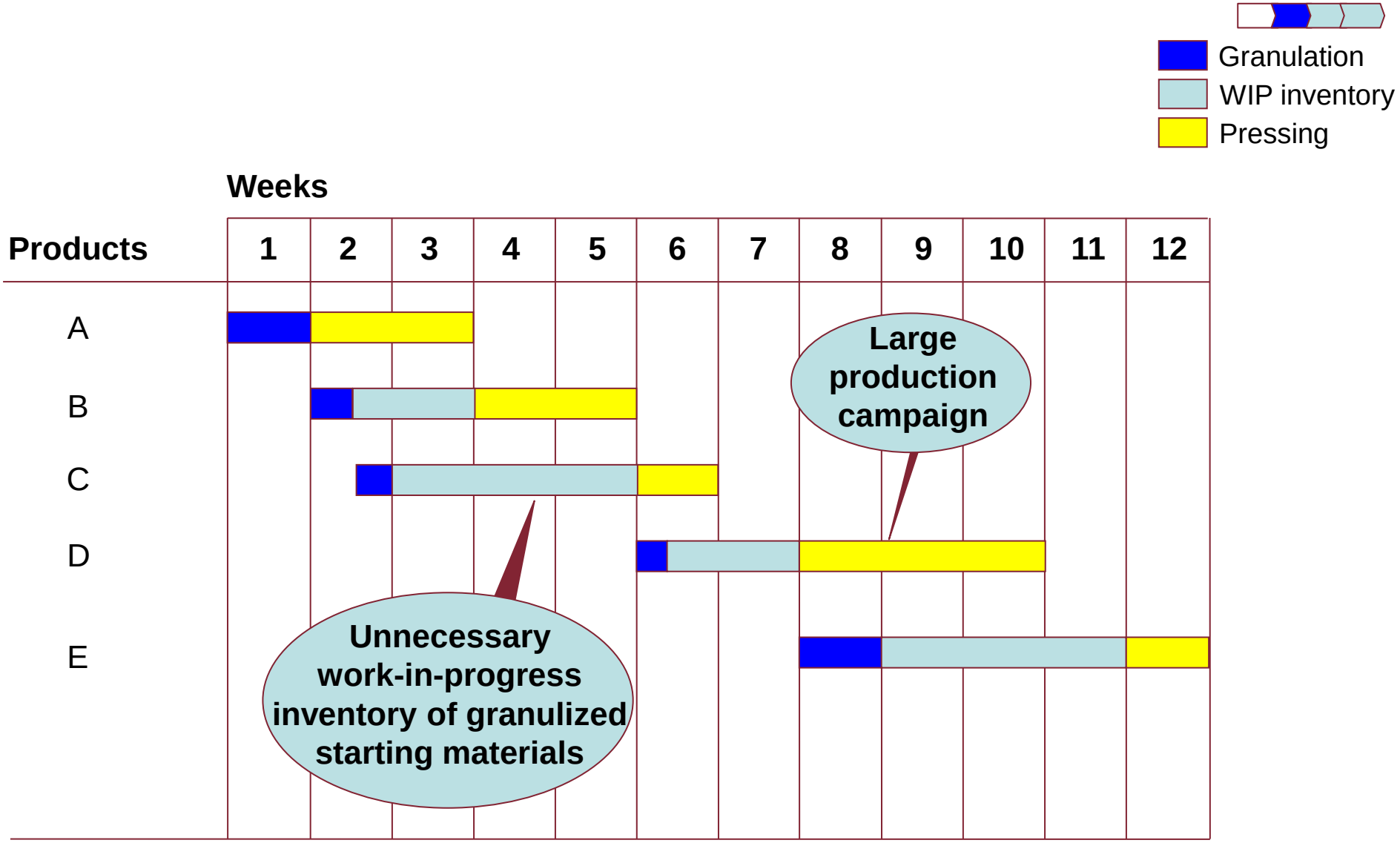
%



# VOLUMES – FORECAST DEVIATION FROM ACTUAL SALES

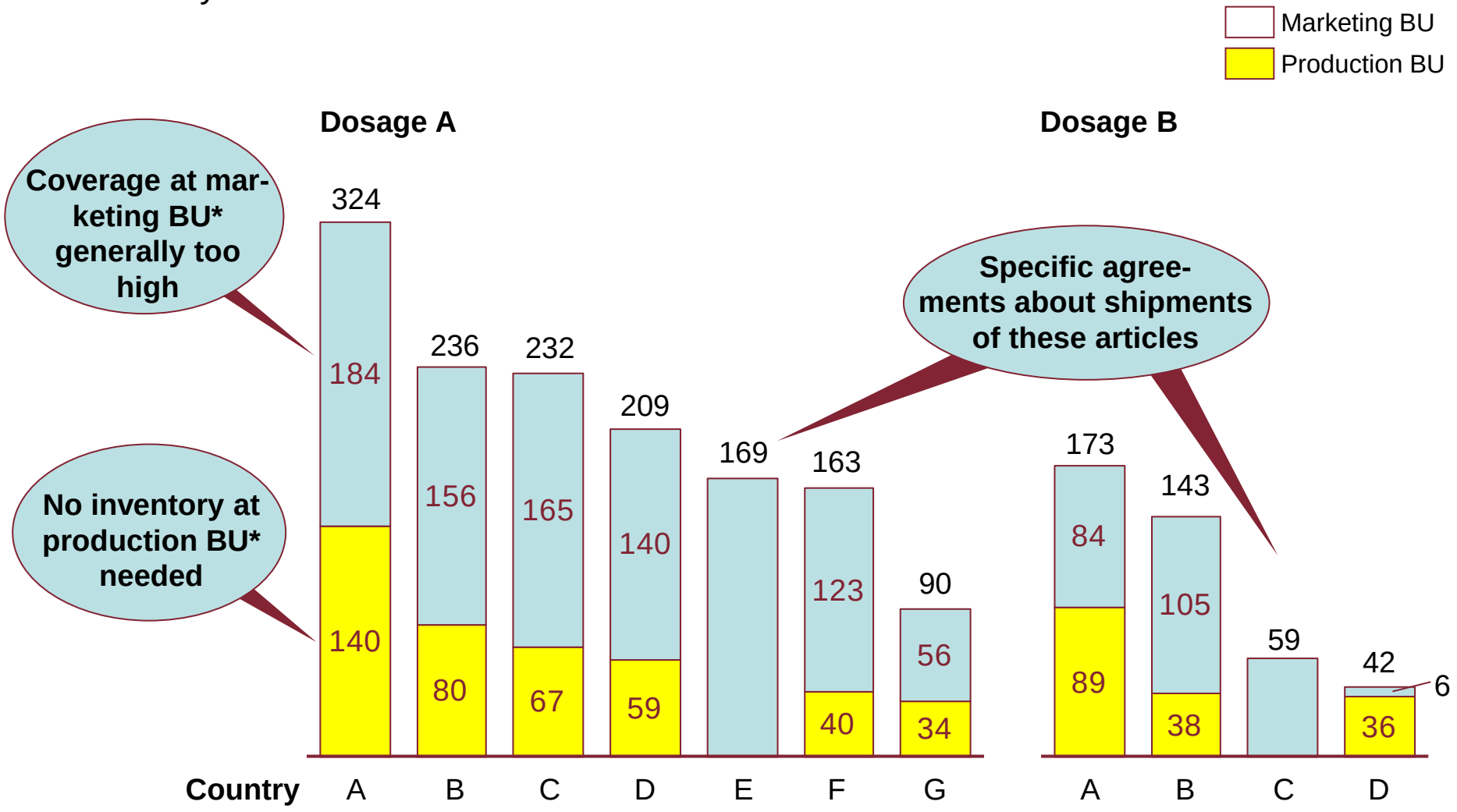


# VOLUMES – FORMULATION

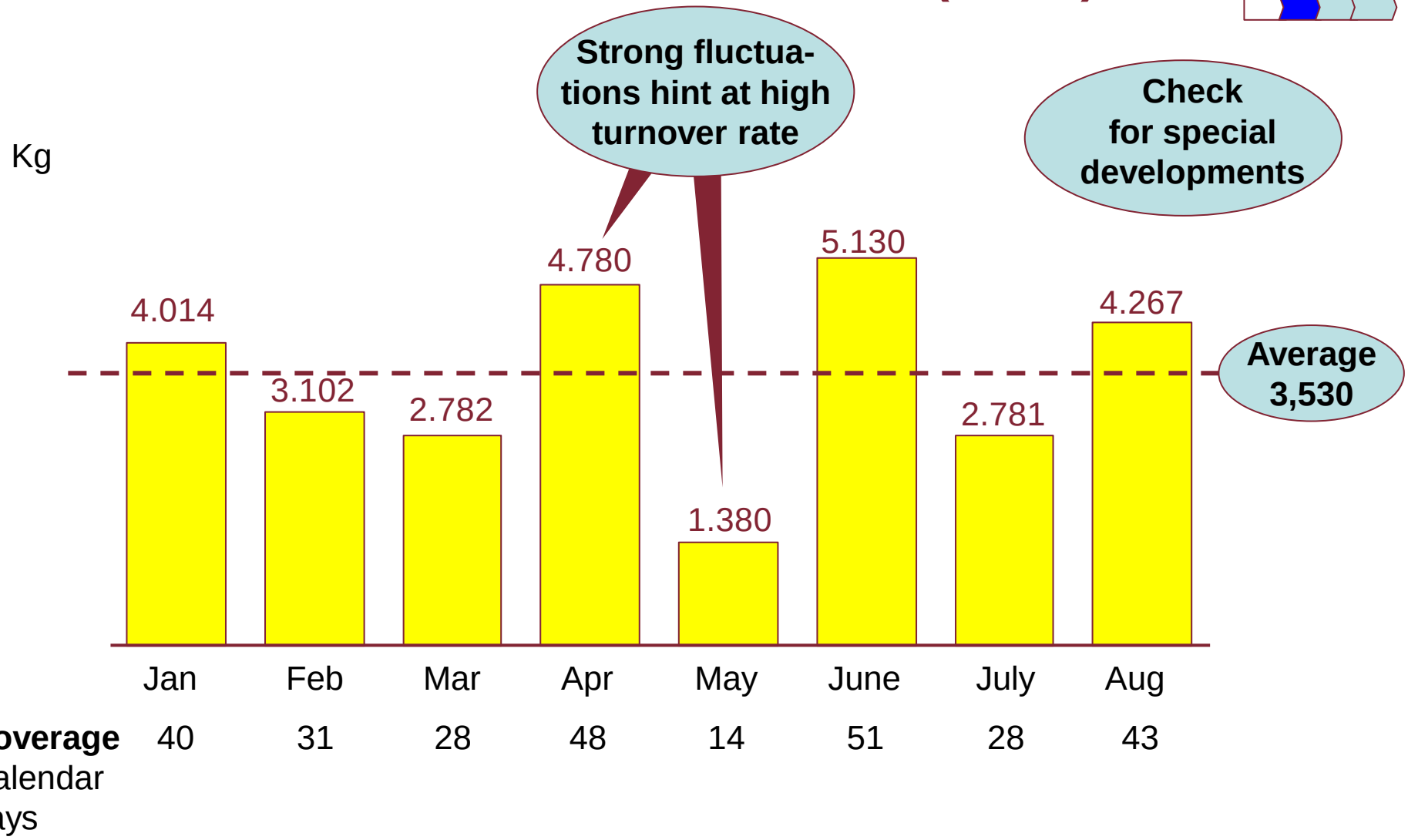


# VOLUMES – INVENTORY COVERAGE (SKUs)

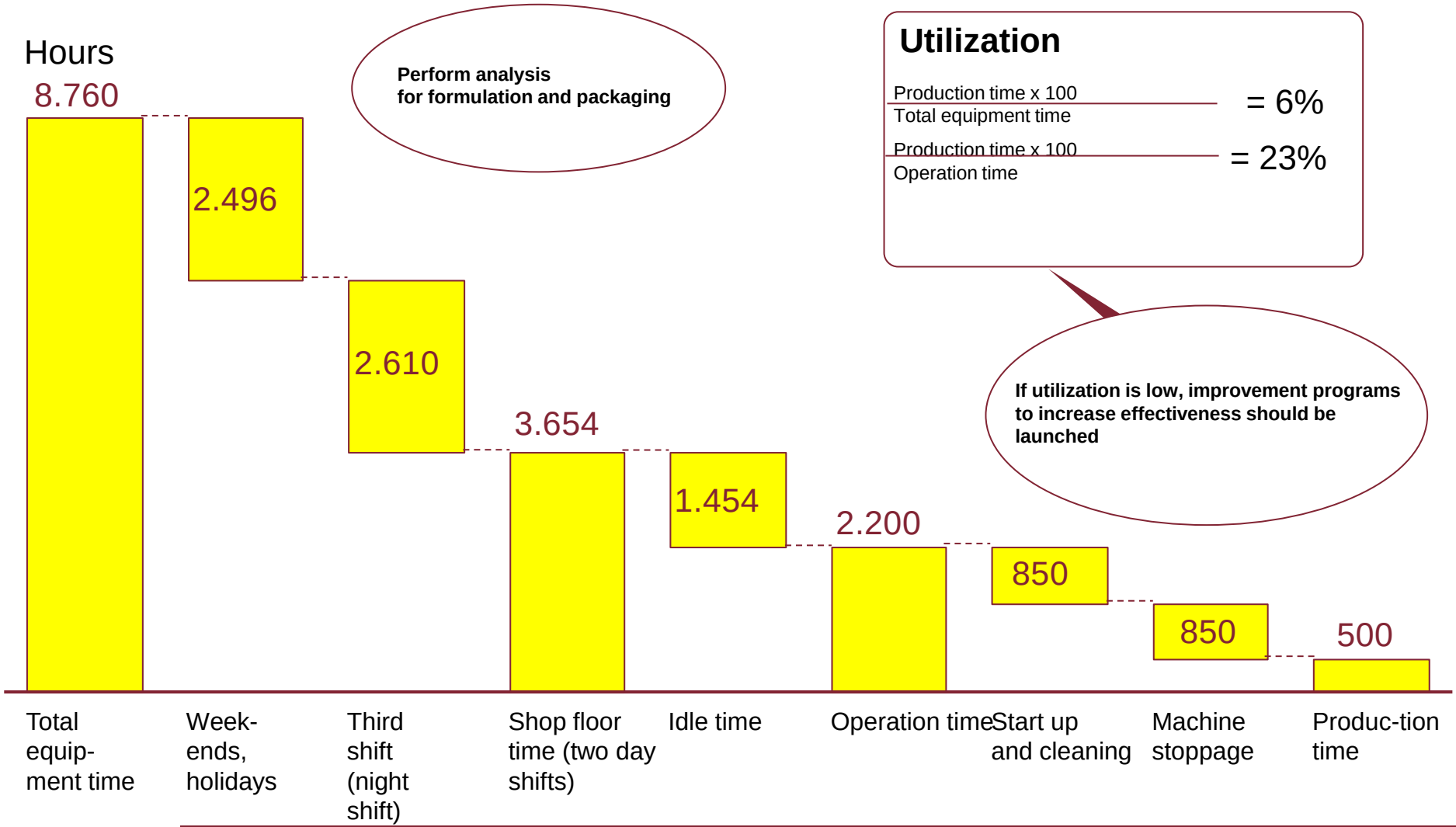
Calendar days



# VOLUMES – HISTORICAL INVENTORIES (SDUs)

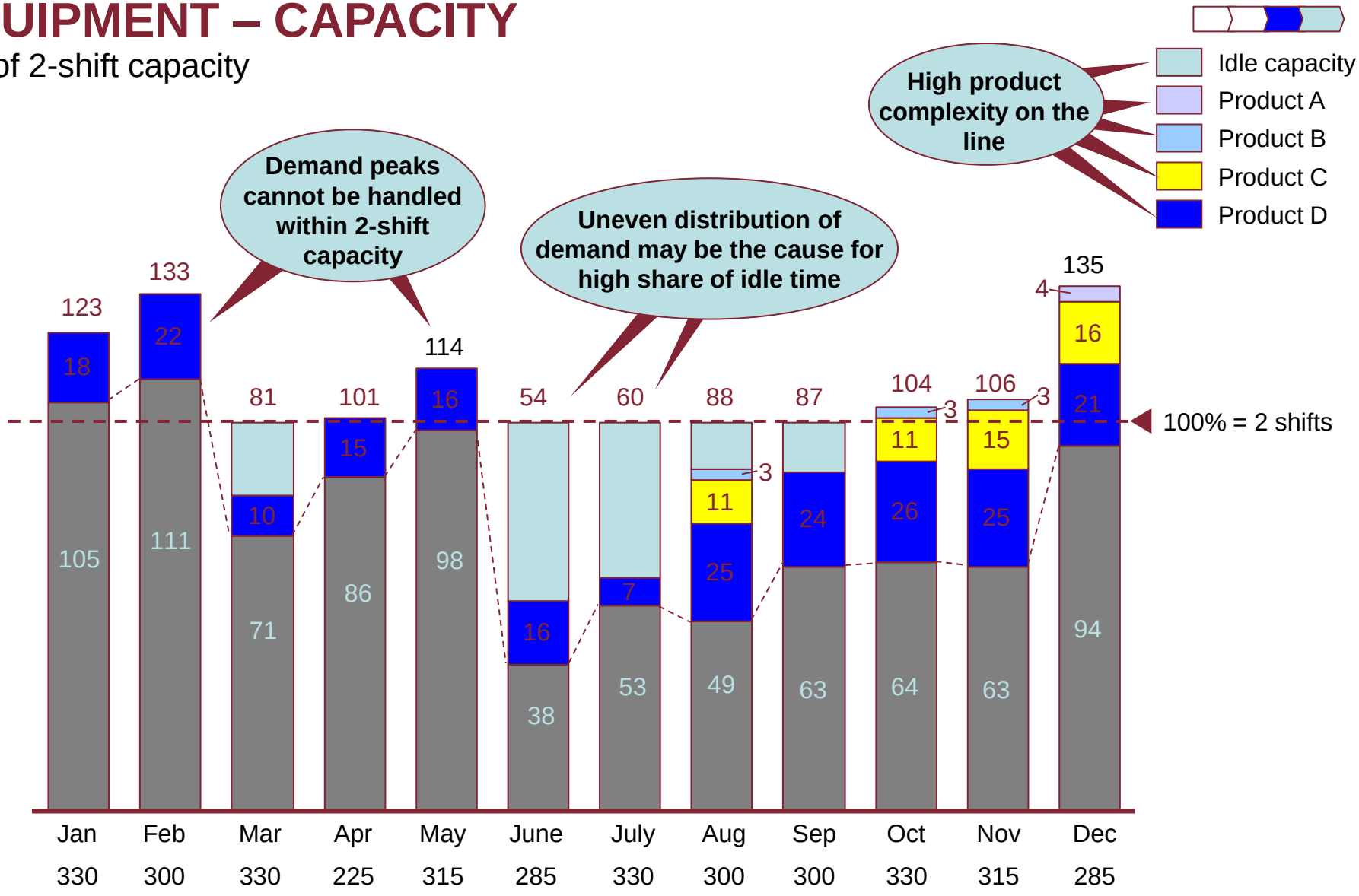


# EQUIPMENT – UTILIZATION (OVERALL EQUIPMENT EFFECTIVENESS)



# EQUIPMENT – CAPACITY

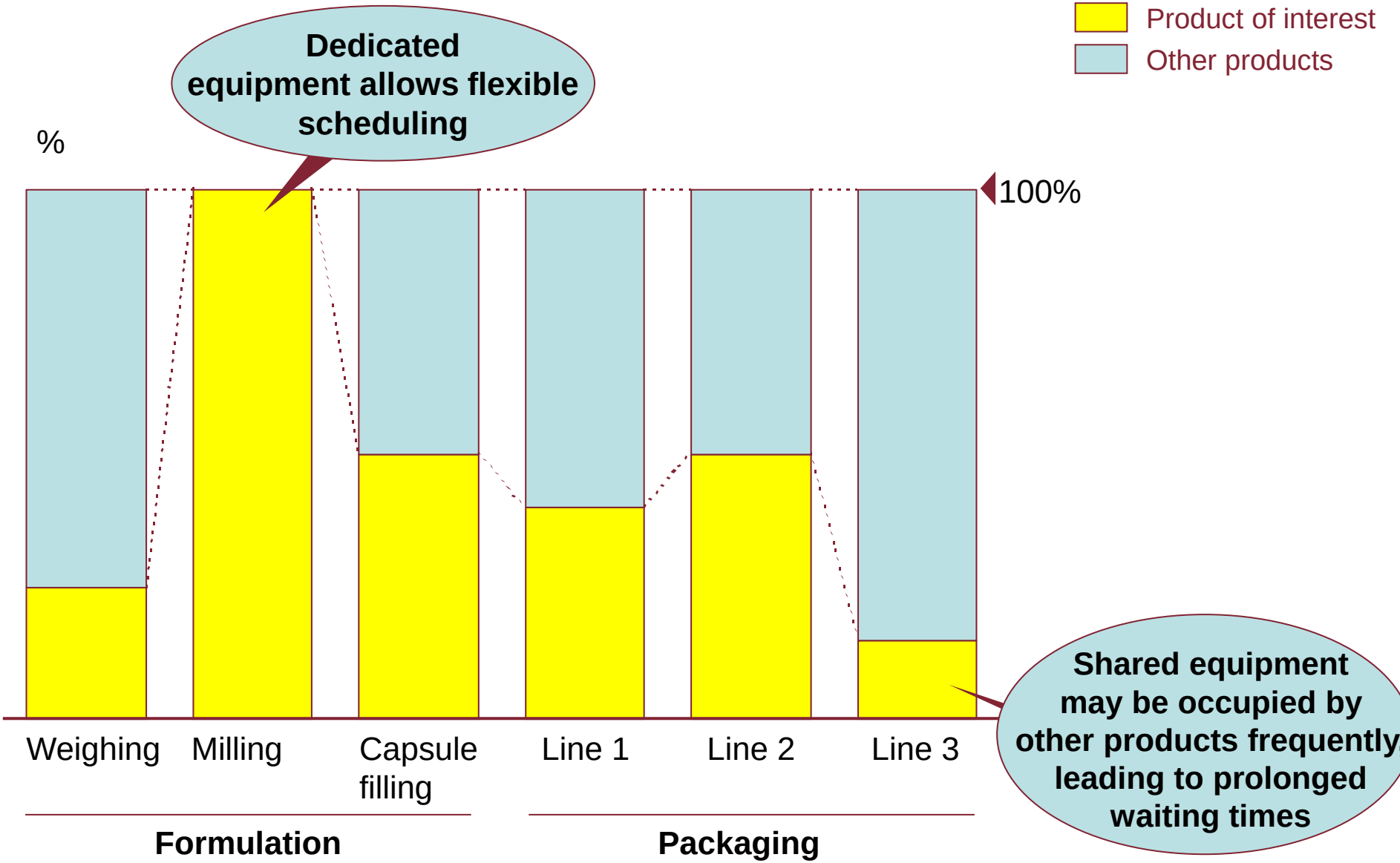
% of 2-shift capacity




**Capacity ***
Hours

* Based on 2 shifts, 8 hours each

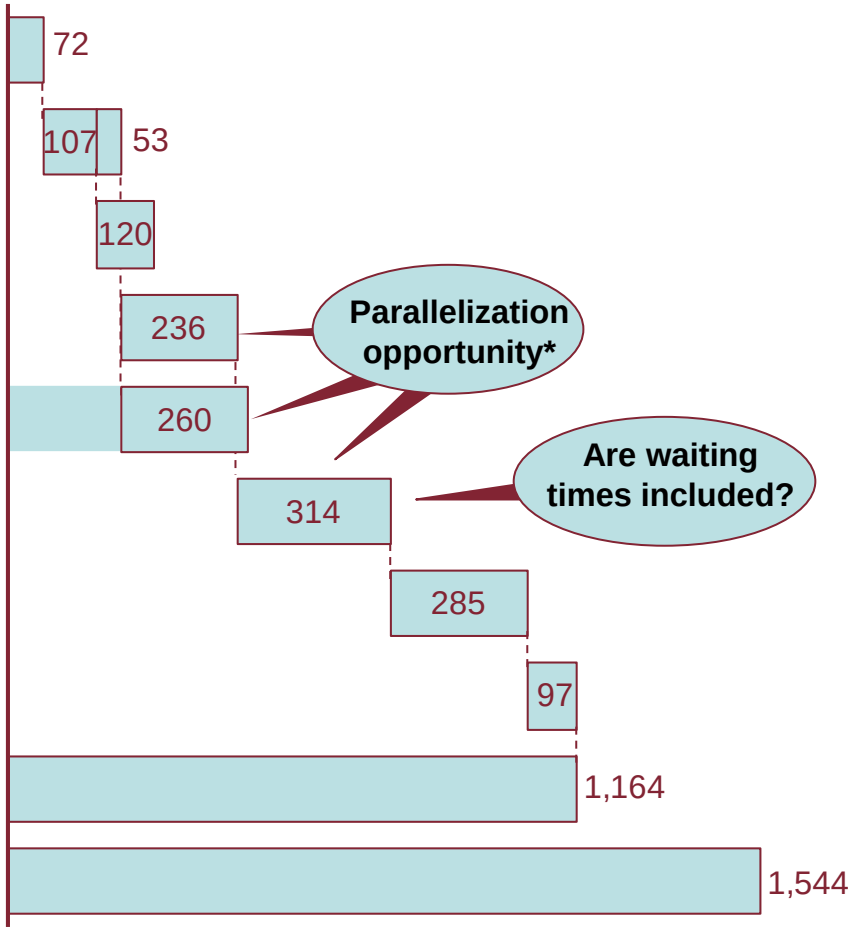
# EQUIPMENT – SHARING INFORMATION



# EQUIPMENT – CHANGEOVER TIME ON TABLET PRESS

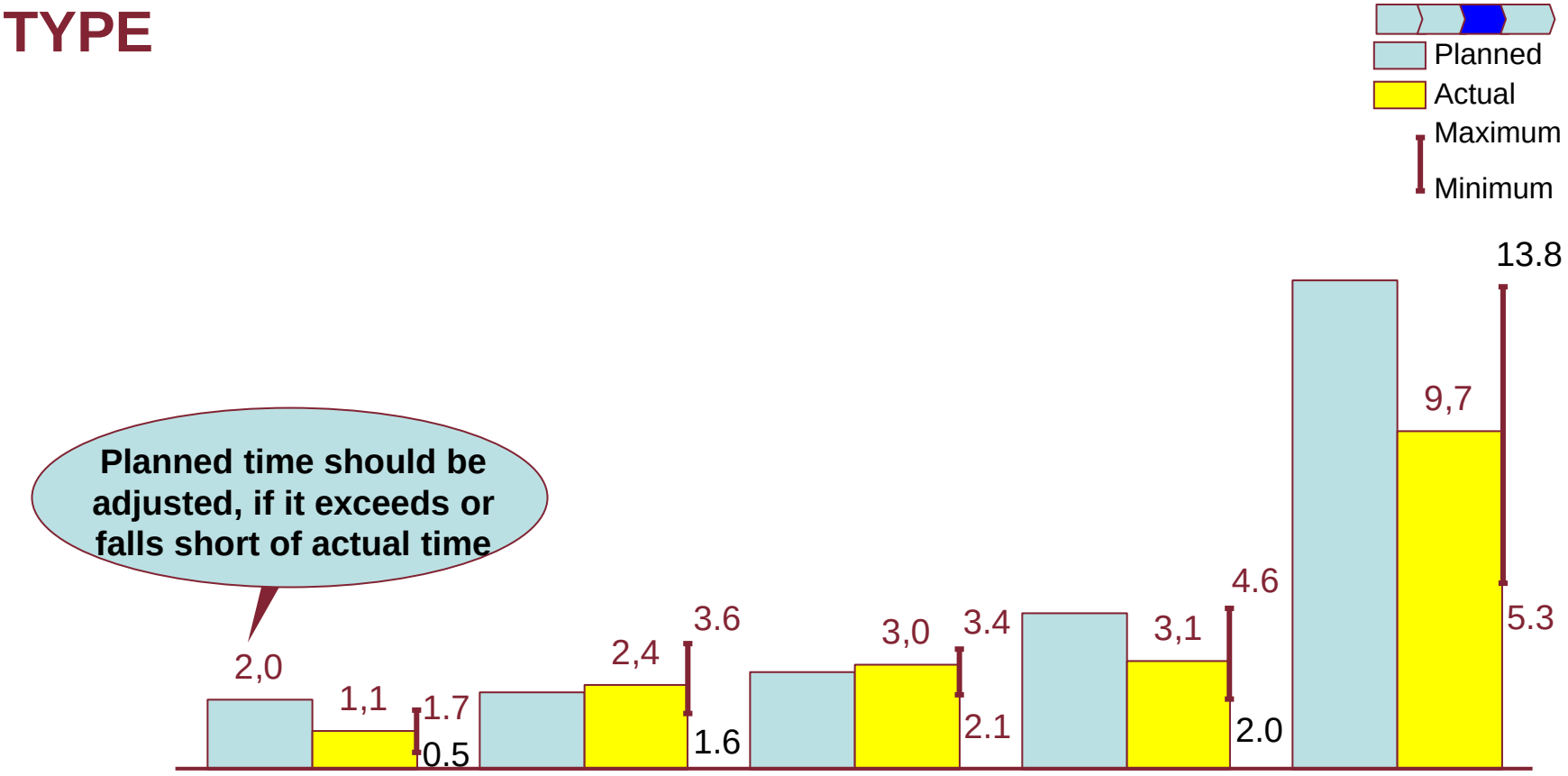
Hours:minutes

| Step | Process steps | Personnel required: Mechanic worker | Production worker | Cleaner |
|---|---|---|---|---|
| 1 | Preparation | 0:12 | 1:00 | |
| 2 | Demounting of machine | 2:40 | | |
| 3 | Washing of machine parts | | 2:00 | |
| 4 | Cleaning of machine parts | 3:56 | | |
| 5 | Cleaning of stamps | 4:20 | | |
| 6 | Room cleaning | | 0:14 | 5:00 |
| 7 | Mounting of machine | 4:45 | | |
| 8 | Mounting of peripherals | 0:18 | 1:19 | |
| **Current path duration** | | **16:11** | **4:33** | **5:00** |
| **Total duration** | | **Total: 25:44** | | |




Can activities be performed by less-qualified workers?

# EQUIPMENT – PACKAGING CHANGEOVER TIMES BY TYPE



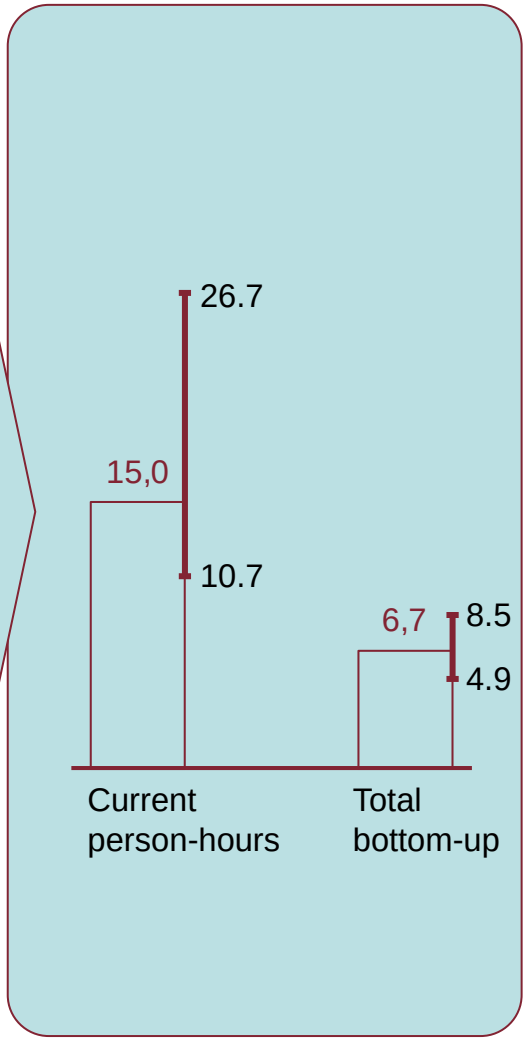

| | | | | | |
|---|---|---|---|---|---|
| **Type of setup procedures** | "End-of-day" procedure | "End-of-week" procedure | Setup between shop orders<br>• Same format<br>• Different bulk | Setup between shop orders<br>• Same format<br>• Same bulk | Setup between shop orders<br>• Different format<br>• Different bulk |
| **Number of setup procedures per week** | 5 | 3 | 4 | 3 | 1 |

# EQUIPMENT – BOTTOM-UP ESTIMATE OF CHANGEOVER TIMES

Hours

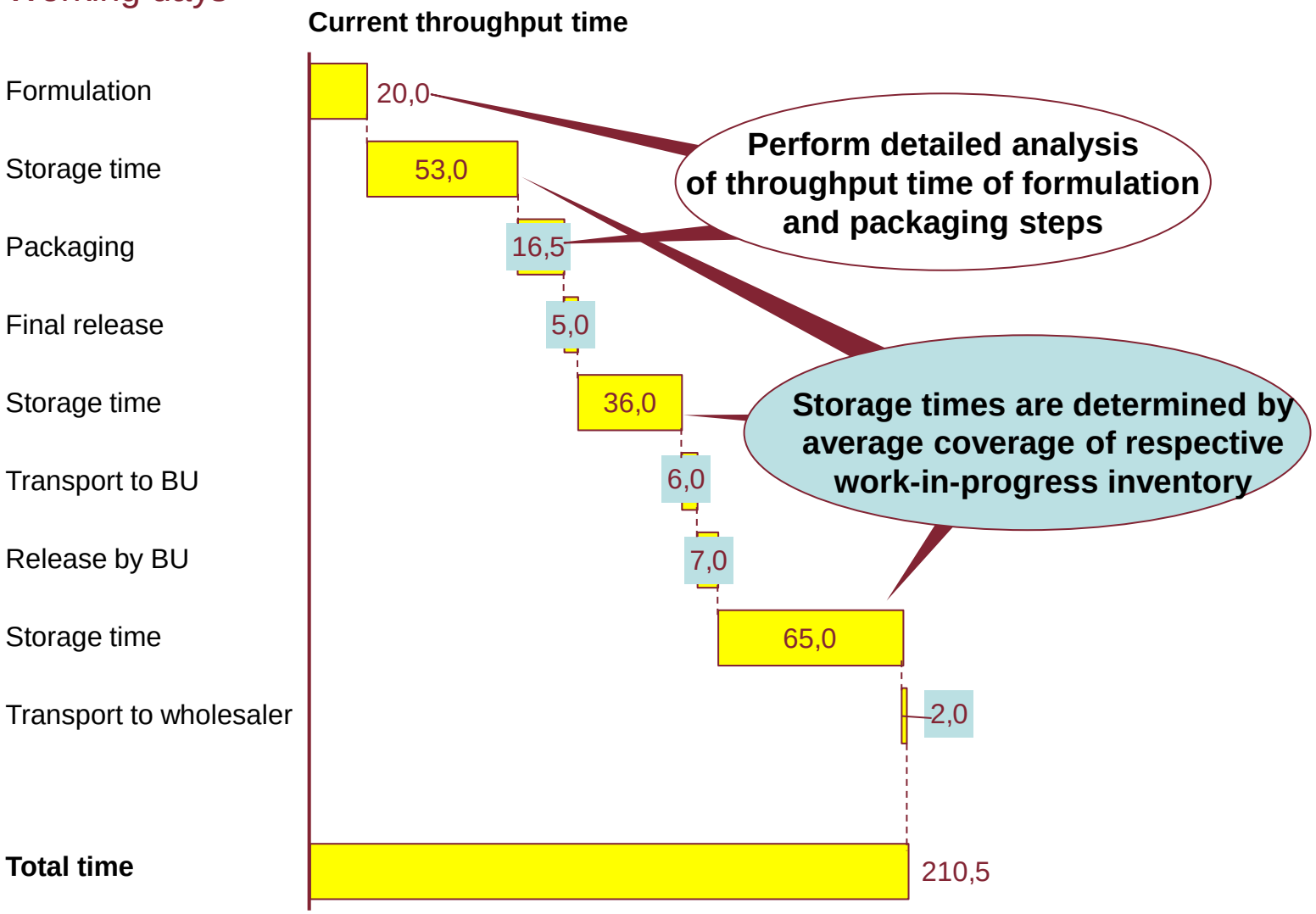
**Bottom-up time estimated by interviewing operators about time required to conduct individual activities**

| Activities | Time required Minutes |
|---|---|
| • Provide new shop order file | 01 - 02 |
| • Transport new flow box | 15 - 30 |
| • Check bulk of new shop order | 01 - 02 |
| • Prepare load | 05 - 10 |
| • Dismantle filling machine | 10 - 15 |
| • Rinse filling machine | 20 - 30 |
| • Clean filling machine | 20 - 50 |
| • Sterilize filling machine | 60 - 70 |
| • Adjust wrapping machine | 20 - 30 |
| • Identify packaging materials | 10 - 30 |
| • Fill machines with packaging materials | 10 - 20 |
| • Introduce new identification codes | 10 - 20 |
| • Clean "end of line" | 40 - 60 |
| • Install new flow box | 10 - 20 |
| • Finish previous shop order | 01 - 02 |
| • File protocol, QC samples and file | 01 - 02 |
| • Count produced quantities | 03 - 08 |
| • Install new loads | 10 - 20 |
| • Clear full pallets, install empty pallets | 05 - 10 |
| • Perform "process empty line" | 10 - 20 |
| • Clear waste | 05 - 10 |
| • Check "process empty line" | 10 - 20 |
| • Install new file | 03 - 05 |
| • Check starting | 10 - 20 |
| • Checking in Advanco | 01 - 05 |
| **Total hours** | **4.9 - 8.5** |



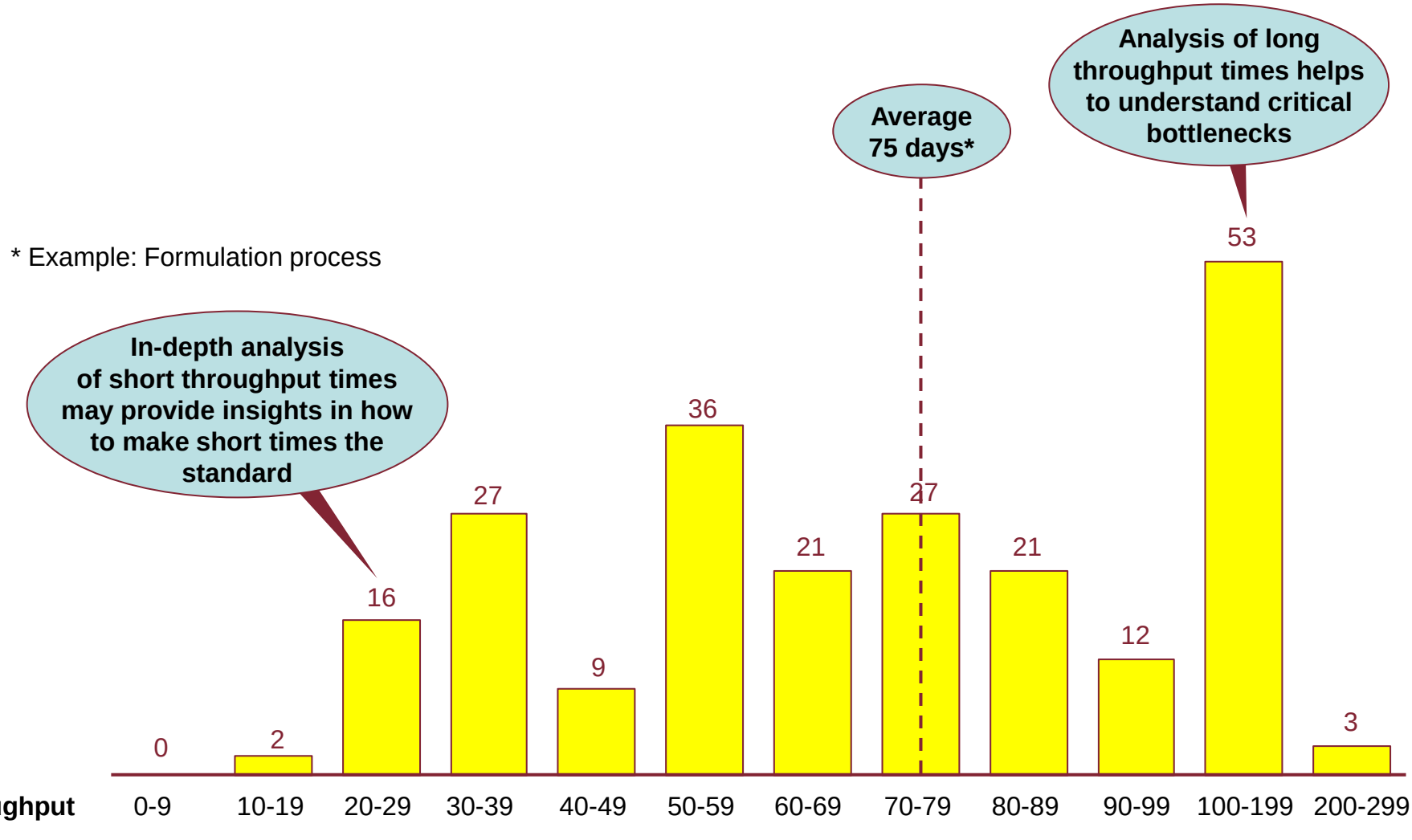
# THROUGHPUT TIME – SUMMARY OF AVERAGES

## Working days



# THROUGHPUT TIME – DISTRIBUTION

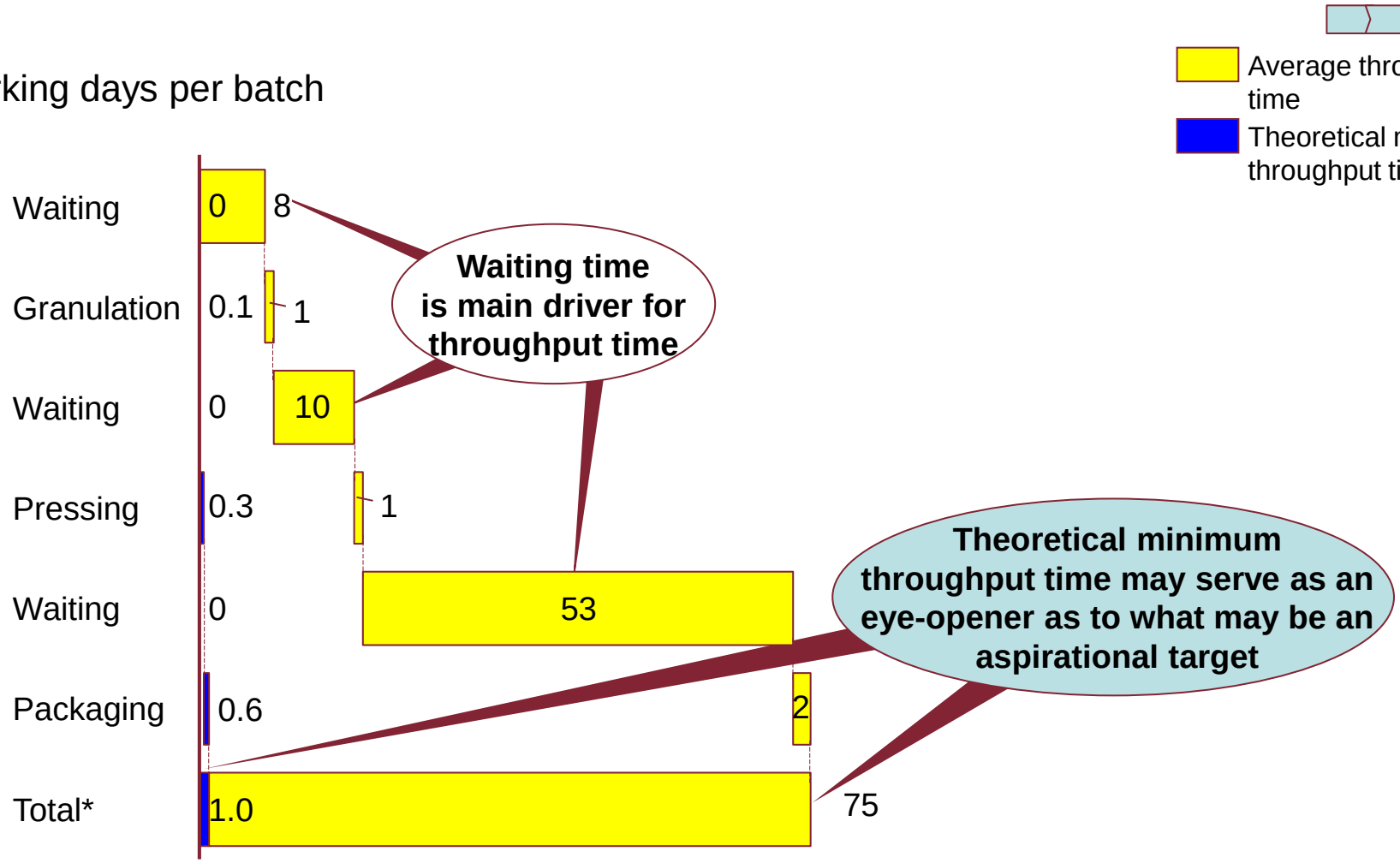
Number of batches




* Example: Formulation process

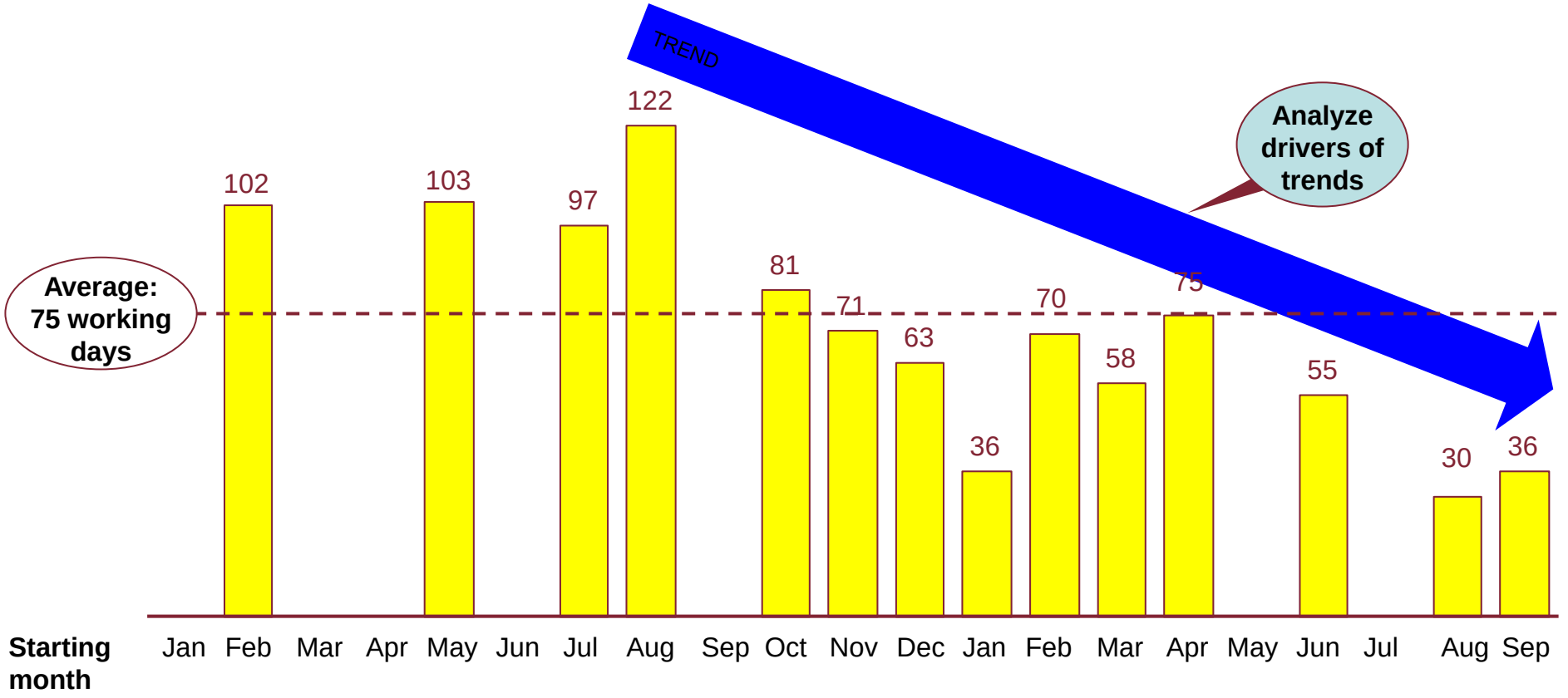
**Throughput time**
Working days

# THROUGHPUT TIME – THEORETICAL MINIMUM



# THROUGHPUT TIME – VARIATION BY STARTING MONTH

Average throughput time in working days



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# KPI TARGETS

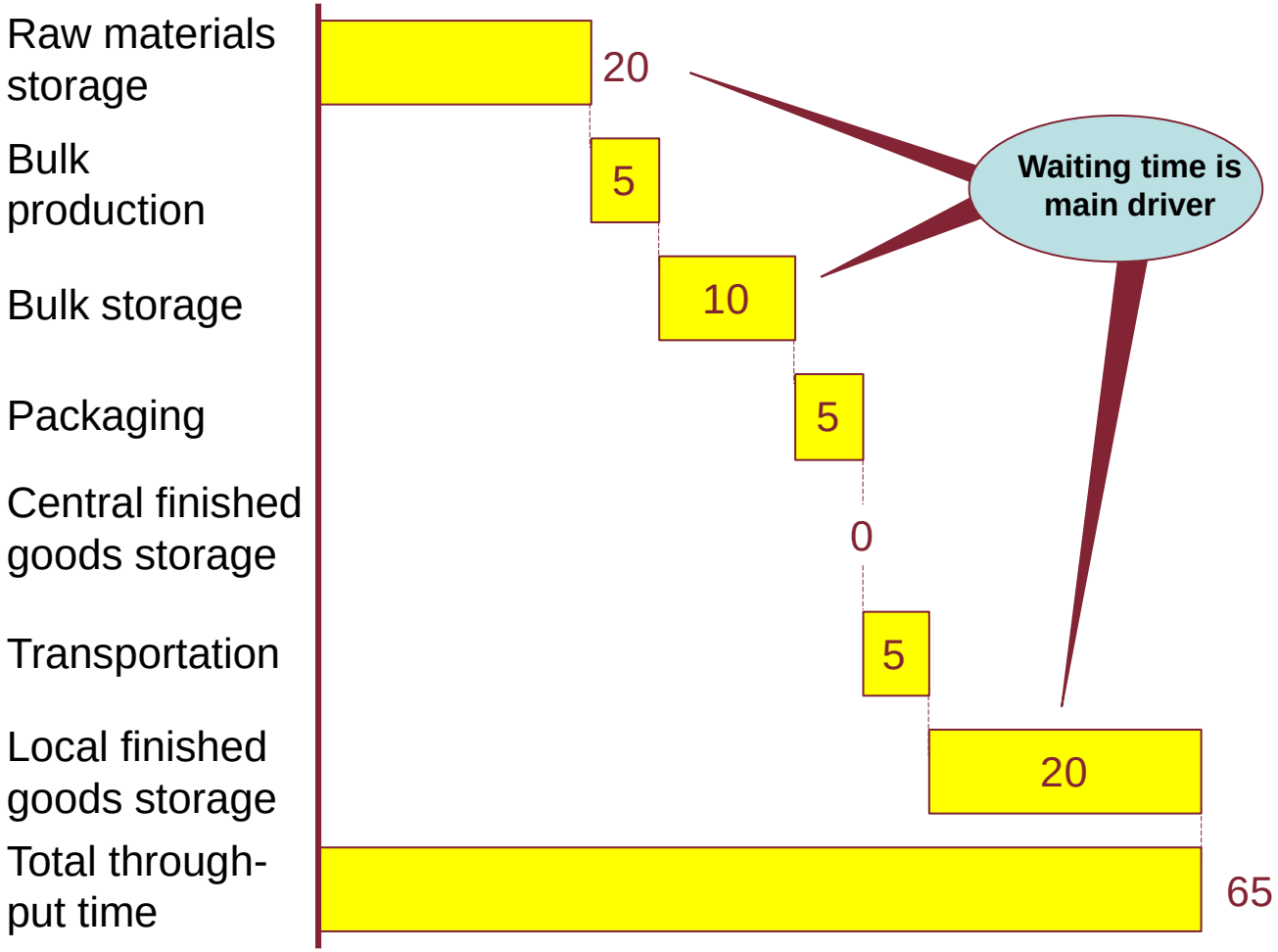
TEAM EXPERIENCE

Industry best practice

| | Supply | Formulation | Packaging | Marketing BU |
|---|---|---|---|---|
| **Quality** | • Supplier service level **100%** | • Bulk production service level **100%** | • Packaging service level **100%** | • Intercompany service level **100%**<br>• Forecast deviation **10%** |
| **Cost** | • Raw materials inventory coverage **4 weeks** | • Productivity **50%-70%***<br>• Bulk inventory coverage **2 weeks** | • Productivity **50%-70%***<br>• Central finished goods coverage **0 days** | • Local finished goods coverage **4 weeks** |
| **Time** | | • Bulk throughput time **5 days** | • Packaging throughput time **5 days** | • Transportation time **5 days** |

# INDUSTRY BEST PRACTICE – THROUGHPUT TIME

Working days




## Key levers

- Agree on committed replenishment times with suppliers
- Increase flexibility
- Increase production flexibility
- Increase flexibility
- Reduce planning times
- Ship immediately
- Harmonize production lot size with order size
- Reliable replenishment process renders high stocks obsolete

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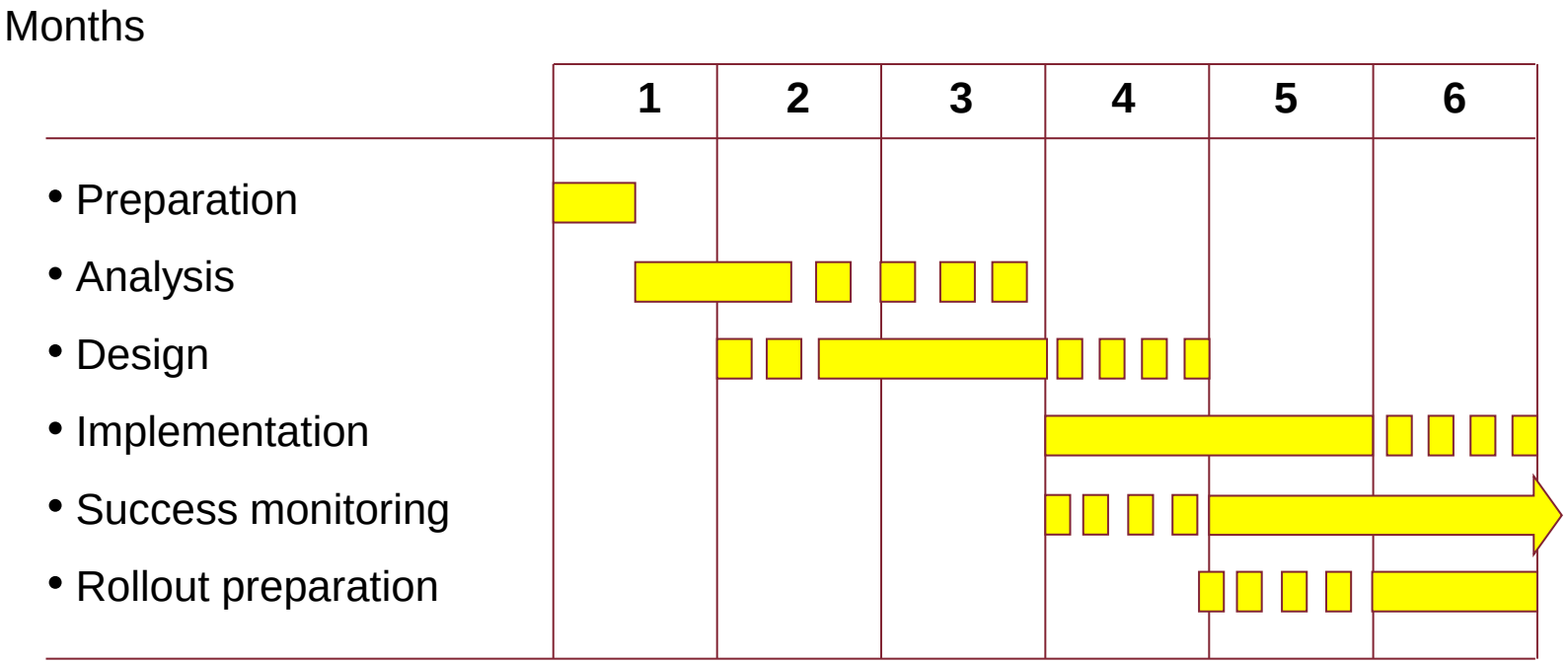
# APPROACH TO SUPPLY CHAIN REDESIGN

| | Preparation | Analysis | Design/ implementation | Success monitoring | Rollout |
|---|---|---|---|---|---|
| **Activities** | • Set up project core team and steering committee<br>• Decide on pilot plant and pilot product<br>• Communicate project goals and timelines to entire supply chain | • Perform supply chain analysis (as detailed) | • Decide on future supply chain type and KPI targets<br>• Switch to new supply chain by a stepwise approach with increasingly aspIrational targets<br>• Trigger supportive activities, e.g., efficiency improvement, software adapta-tion/development | • Setup project controlling<br>• Check consistency with existing control-ling system<br>• Measure performance at defined intervals<br>• Take necessary actions to reach agreed targets | • Define logical rollout sequence to next products, plants, countries<br>• Implement re-designed supply chain with support from experienced project team members |
| **End products** | • Project setup and timelines<br>• Pilot plant and pilot product<br>• Buy-in of all participants | • Comprehensive understanding of current situation<br>• Improvement levers<br>• KPI baseline | • Redesigned supply chain of pilot product<br>• Targets<br>• Detailed project plan | • Continuous monitoring of KPI development | • Companywide redesign of supply chain |

# TIMELINE FOR SUPPLY CHAIN REDESIGN PILOT



# CRITERIA TO SELECT A PILOT PRODUCT

| Criteria | Rationale |
| --- | --- |
| • High economic importance | • Get high commitment from all parties<br>• Have significant impact immediately |
| • No strong seasonal variance | • Avoid influence of strong demand fluctuations |
| • Common production technology | • Easy rollout to products with similar technology |
| • Stable production process | • No quality issues during pilot phase |
| • Production by client company, not subsidiary | • Have direct access to production |

**Possible pilot products**

# ORGANIZATION OF SUPPLY CHAIN REDESIGN PROJECT

**Include top managers to ensure sufficient weight of Steering Committee decisions**

**Steering Committee**

- Head of production BU
- Head of marketing BU
- Head of supply chain management department

**Project team**

- Supply chain manager
- Production manager
- Production planner
- Bulk production line manager
- Packaging line manager
- Quality manager
- Demand manager
- Supply chain expert

**Include managers of all functions where the project will lead to changes**

**Additional support from**

- Controlling
- IT
- Purchasing
- Marketing
- Warehousing