

# THE DESIGN OF PRODUCTION SYSTEMS FOR LOW-INCOME HOUSING PROJECTS

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Management of Social  
Interest Housing Project



# Objective

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- Investigate the **role and the content of the production system design** in low-income house building projects
  - Propose a **sequence of steps**
  - Devise or adapt a **set of tools**
  - Identify **interfaces** with product design and production planning & control

# Low-income housing in Brazil

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## → **Government (client) establishes**

- Duration of the project (10-12 months)
- Minimum gross floor area
- Minimum specification of key components
- Cost yardstick

## → **Projects**

- Large number of repetitive housing units (120-400 units per project)
- Use of some traditional labour-intensive technologies
- Low profit margin
- Need for time compression

## → **Companies in this sector often face serious managerial problems**



# What is production system design?

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- Discuss and **translate the intended production strategy into a set of decisions**, forming the structure that will be used to manage different activities (Slack et al., 1997):
  - involves not only production on-site but also suppliers and consumers
  - devise layout and flows
- a set of manufacturing policies and **how the basic elements of the production system will be linked and operated**
- ... should create **appropriate conditions for control and improvement** (Ballard et al., 2001)

# Production system design is not (exactly)

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- **Long term scheduling**
- **Preparation of production planning and control** (Laufer and Tucker, 1987)
- **Work structuring** (Tsao et al., 2000)
- **Site layout planning**
- **Design for production** (Melhado, 1994)
- **Preparation of the production stage** (in France)

# Research method: six case studies

<b>Project</b>	<b>Number of Units</b>	<b>Lead Time</b>	<b>Main components</b>
Cidade de Águeda	356 houses	10 months	Pre-cast concrete panels, fibre-cement tiles
Duque de Caxias	02 buildings (112 apartments)	12 months	Load-bearing brick walls, pre-cast concrete slab, ceramic tiles
Solar dos Carvalhal	136 houses	10 months	Load-bearing brick walls, pre-cast concrete slab, ceramic tiles
Cruzeiro	03 buildings (111 apartments)	10 months	Load-bearing brick walls, pre-cast concrete slab, fibre-cement tiles
Noel Gurarany	10 buildings (200 apartments)	12 months	Load-bearing brick walls, pre-cast concrete slab, fibre-cement tiles
Novo Tempo	10 buildings (200 apartments)	12 months	Load-bearing brick walls, pre-cast concrete slab, fibre-cement tiles

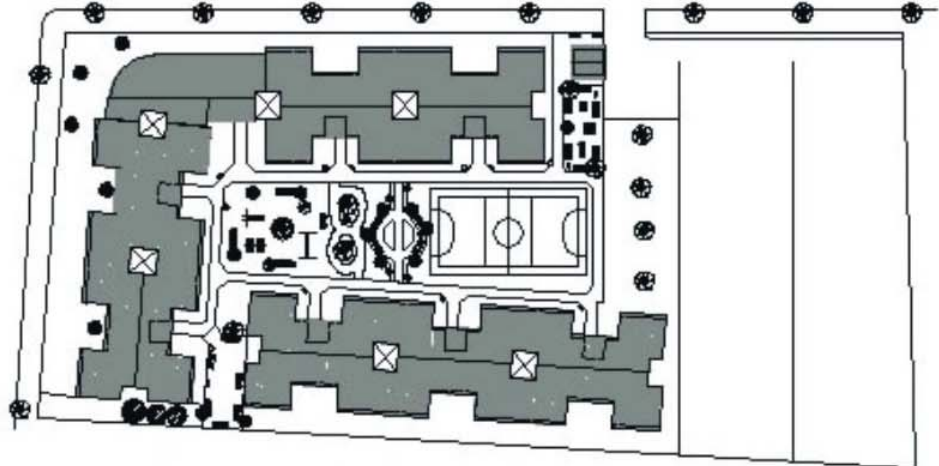
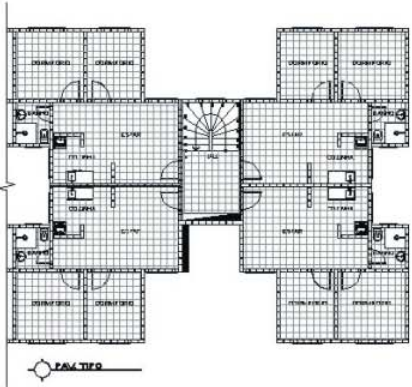
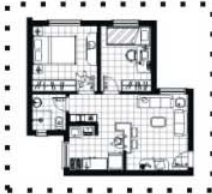
# Research method: main stages

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- Design of the production system
  - Weekly meetings involving the production management team
- Monitoring the implementation
  - Production control data: PPC, causes of non completion of plans, production delays, sequence deviation, analysis of site layout

# Generic product (base-unit) x Specific product

Base-unit



Generic product

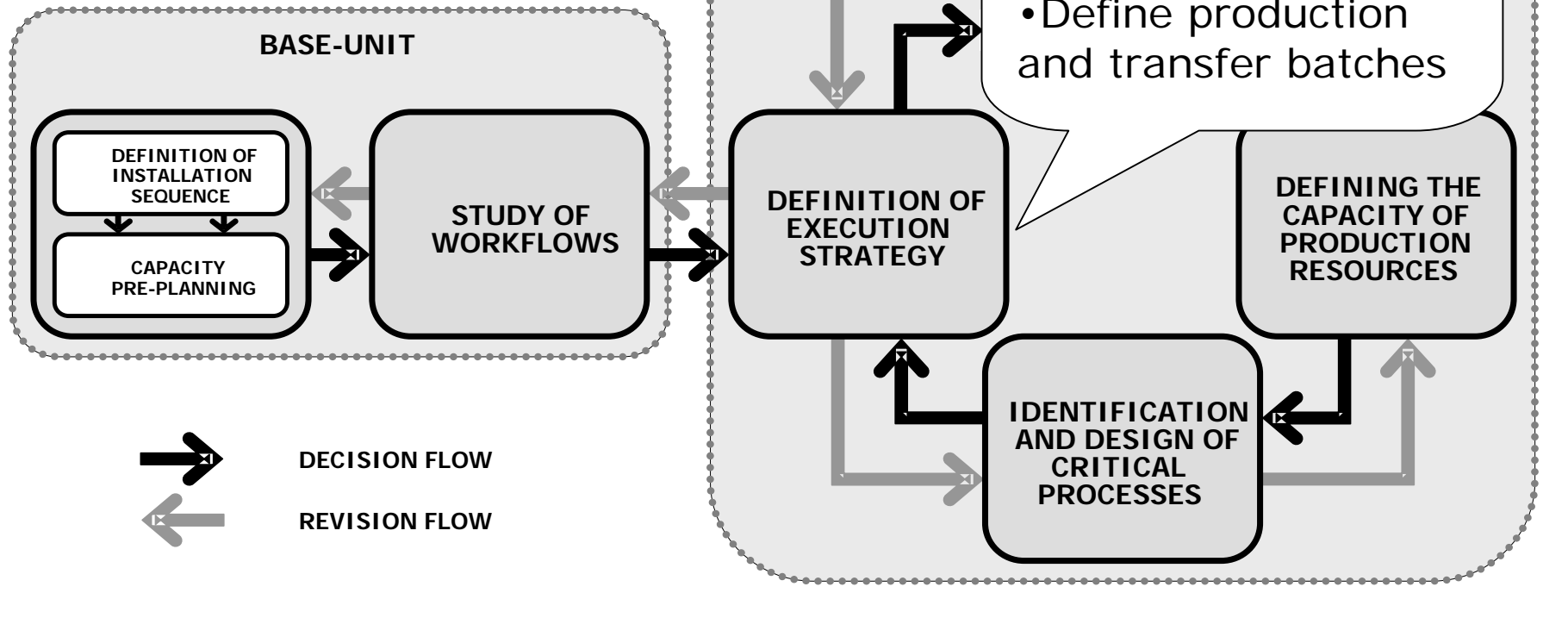


Specific product



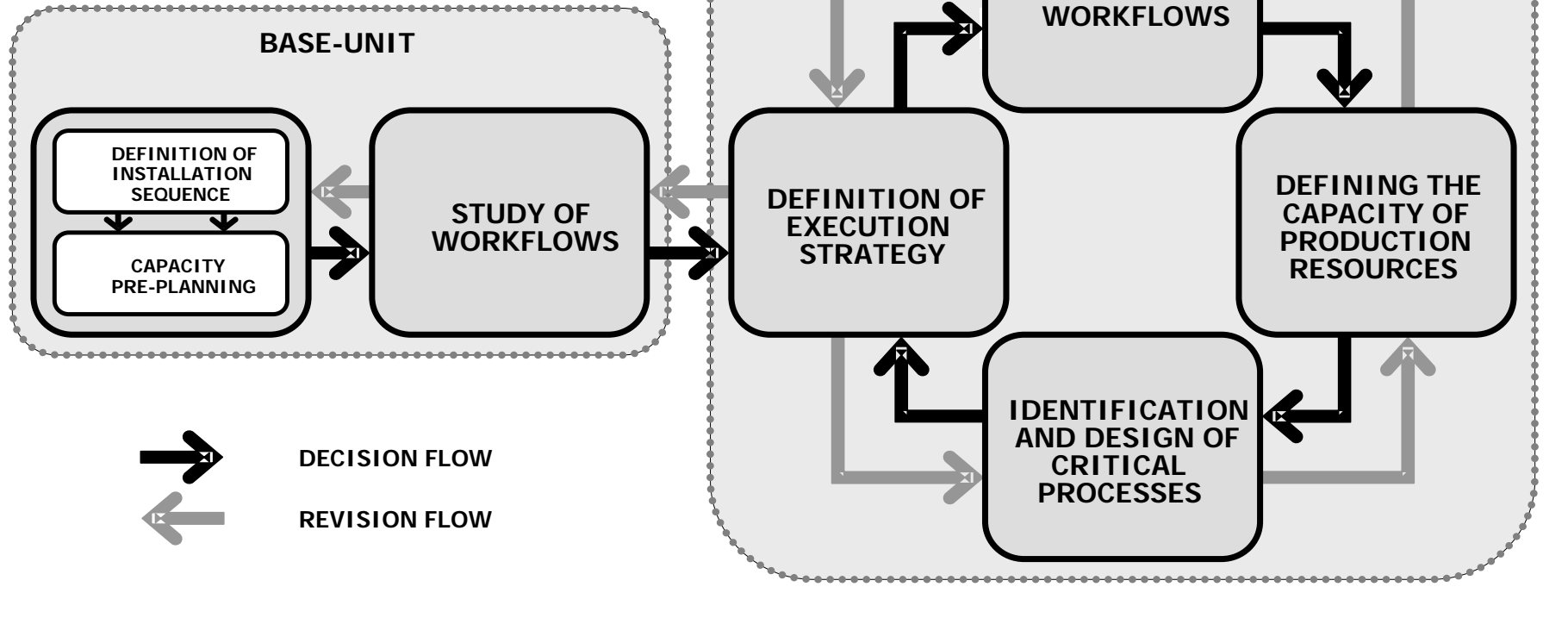
# Production system design: scope of decisions

## DESIGN OF PRODUCTION SYSTEM FOR LOW-INCOME HOUSING PROJECTS

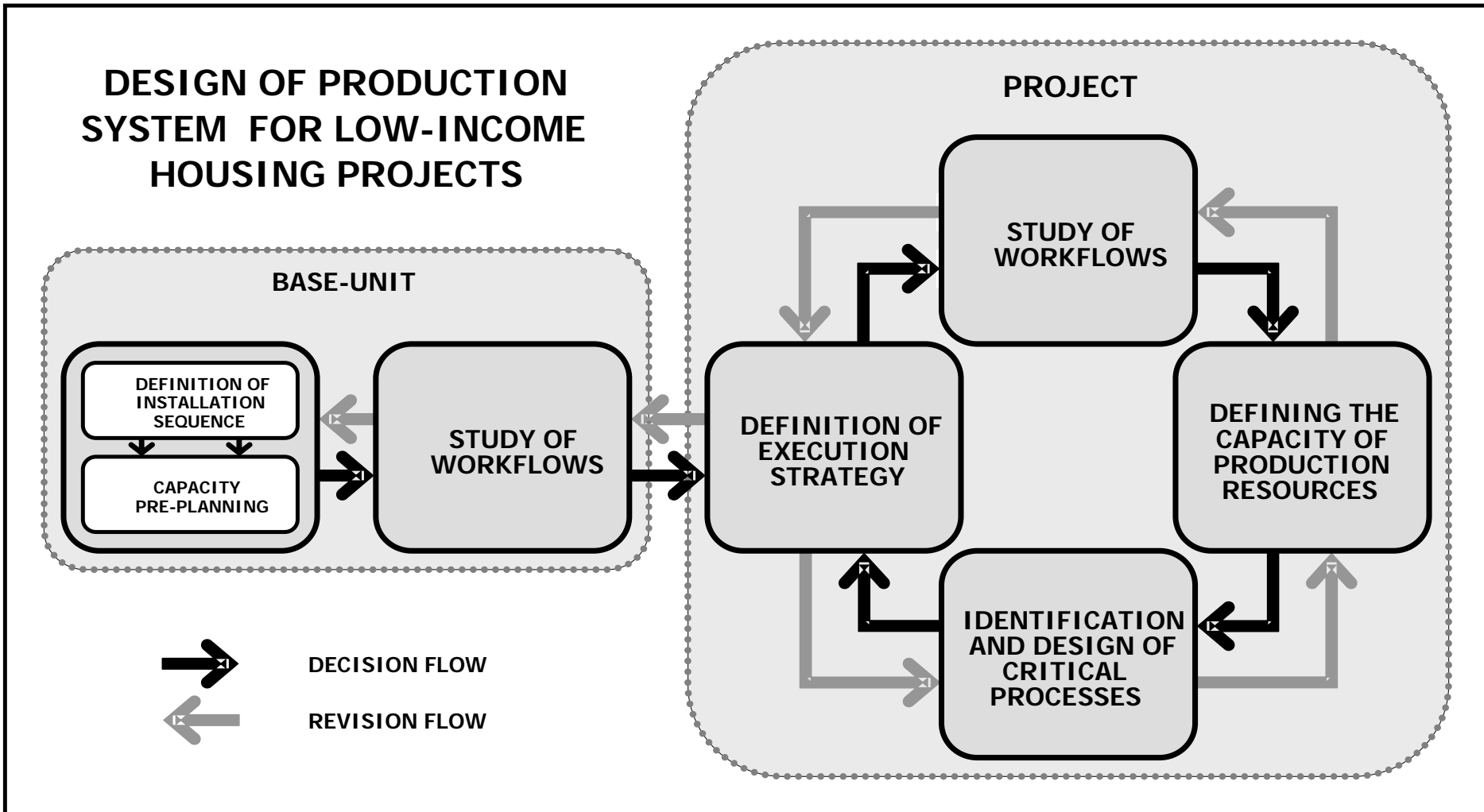


# Production system design: scope of decisions

## DESIGN OF PRODUCTION SYSTEM FOR LOW-INCOME HOUSING PROJECTS



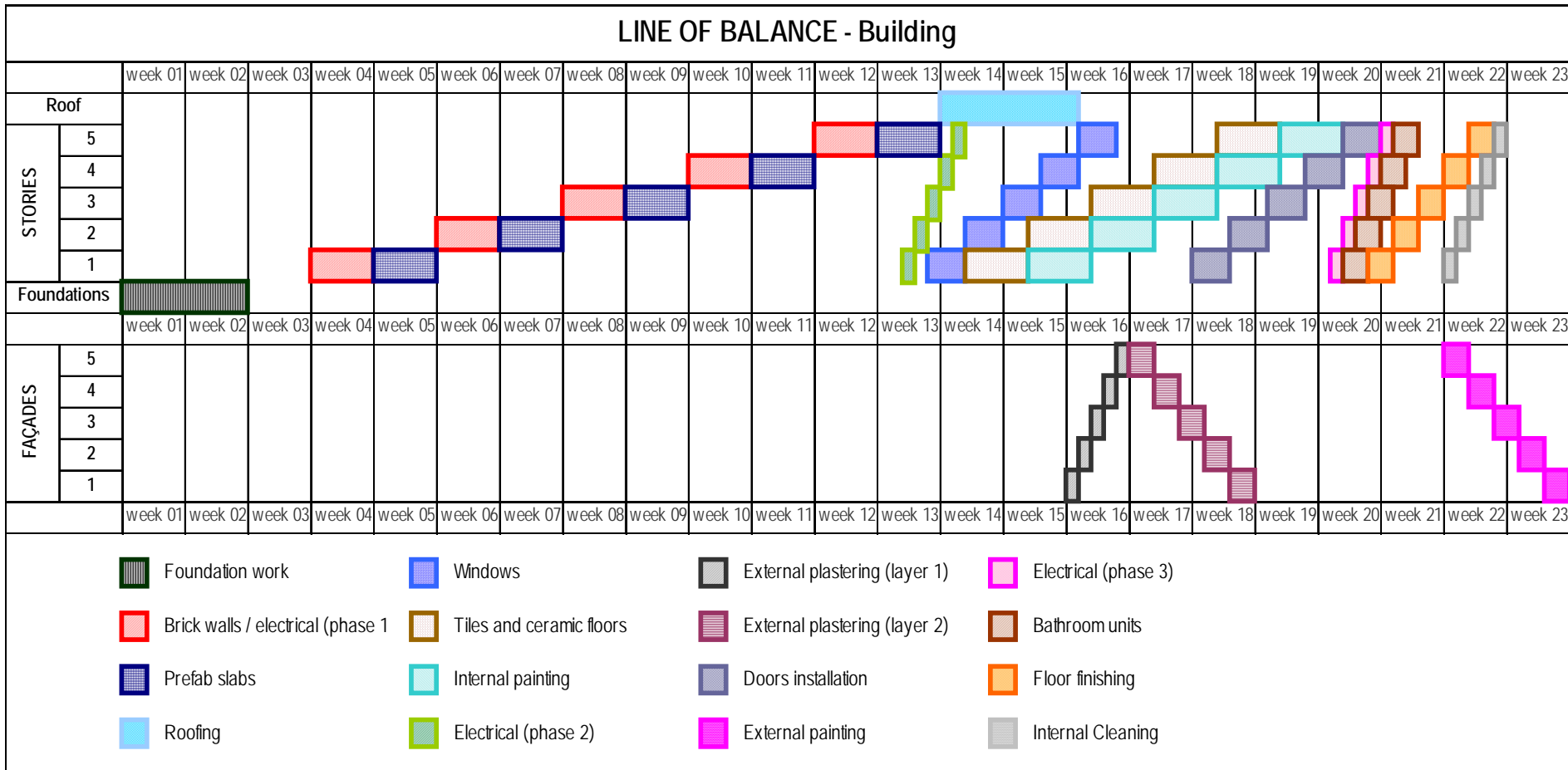
# Production system design: scope of decisions



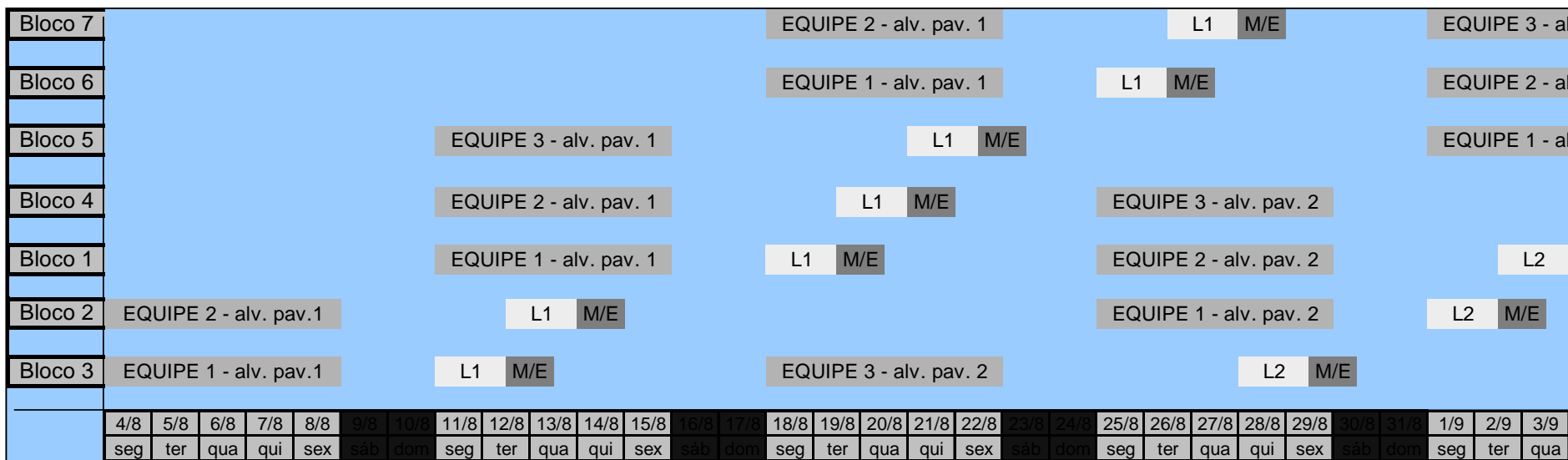
5-7 two-hour meetings

# Line of balance: base-unit workflows

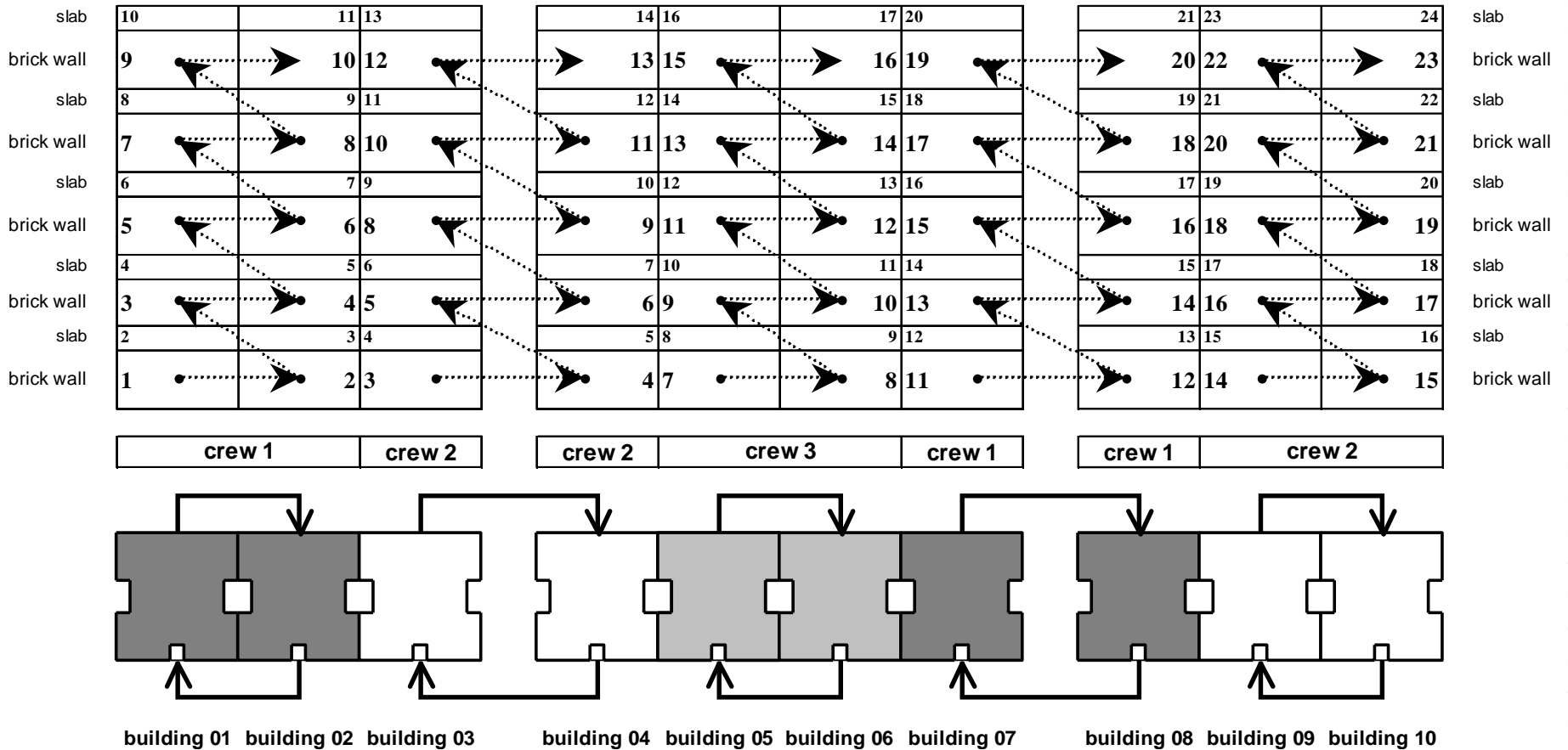
LINE OF BALANCE - Building



# Synchronization of critical processes

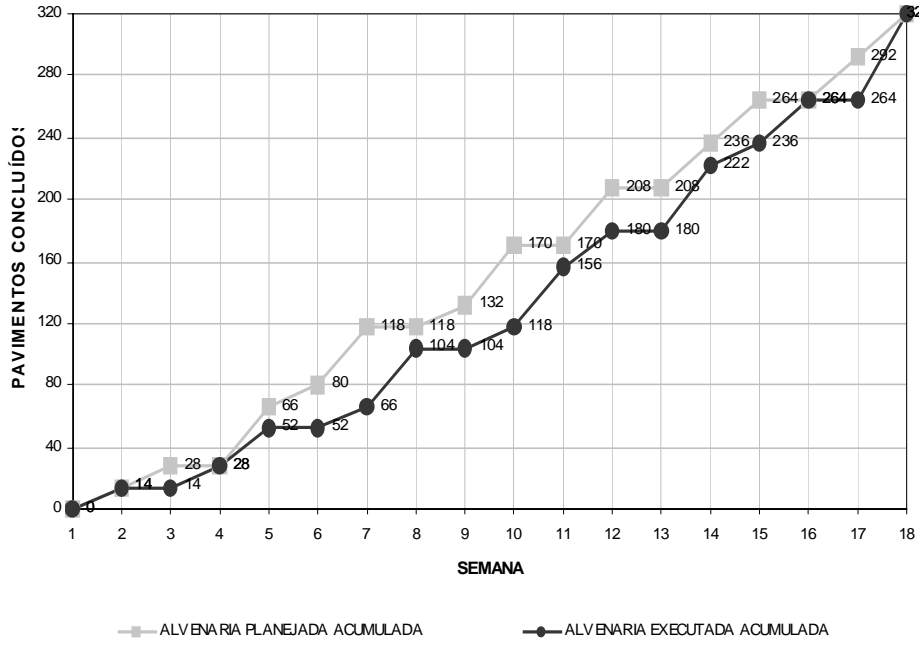


# Main process flows

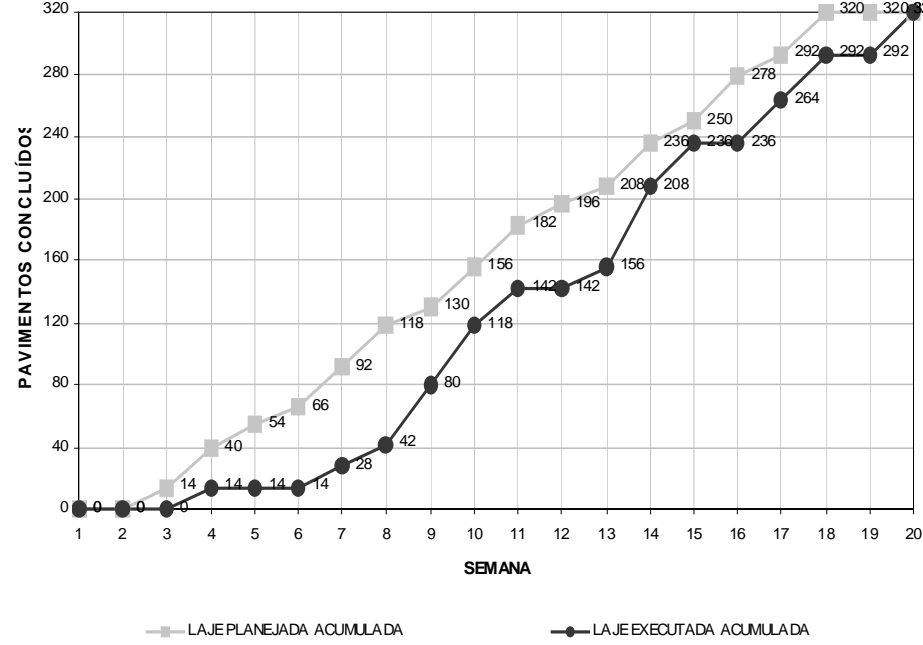


# Project control

PAVIMENTOS SEMANALMENTE CONCLUIDOS  
(ALVENARIA)



PAVIMENTOS SEMANALMENTE CONCLUIDOS  
(LAJES)



# Critical factors for the implementation of production system design

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- Production manager must regard the production system from a **strategic view point**
- **Several alternatives** should be generated and some **selection criteria** should be previously established
- Emphasis on **process transparency** to disseminate plans and goals:
  - Tools must be easy to learn
  - Plans must be simple and straight forward
- Focus on **critical processes** and potential **bottlenecks in the supply chain**



# Further Studies

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- Introduce **variability** in the model
- Use of **simulation** to analyse the implications of variations in sequencing, and batch and buffer sizes on the system throughput
- Include **quality and safety management** in the model
- Explore the **interfaces** between product and production system design
- Extend the application of the model to **other types of projects**