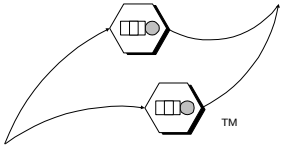

The Modeling Pyramid: From Design to Production

CMG2000 Session 4404, December 13, 2000

http://www.simalytic.com/CMG00/4404ppt.pdf

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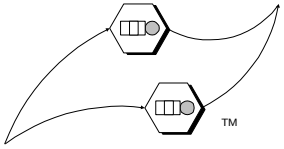
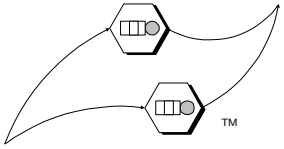


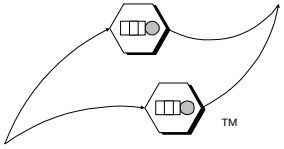
Agenda

- **Introduction**
  - Modeling through the Application Life Cycle
- **Role of Modeling Techniques**
  - General Modeling Tools
  - Specialized Tools for Modeling
- **The Modeling Pyramid**
  - Modeling Pyramid Levels
  - Modeling Pyramid Implementation
- **Conclusion**



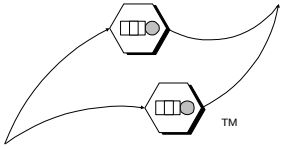
Introduction

- **Value of Modeling to Management**
  - Binary Condition (valuable or worthless)
  - Understanding Political Situation Key
    - Improve the business based on real measurement objectives
    - Frustration with modeling cost and effort when the answer is already known (hidden agendas)
  - Modeling Pyramid assumes existing value at one level
    - Objective: Increase value by relating models from adjacent Application Life Cycle stages



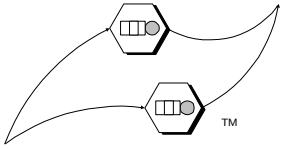
Life Cycle Stages

- **Application Design Models**
  - Understanding application characteristics
- **Implementation Models**
  - Understanding application behavior
- **Deployment Models**
  - Understanding the relationship between the application and the environment

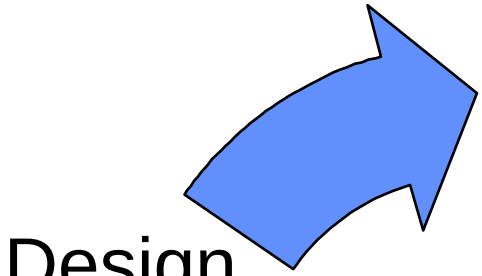


Life Cycle Stages

- **Production Models**
  - Understanding the relationship between application load and resource requirements
- **Planning Models**
  - Predicting future resource requirements
- **Enhancement Models**
  - Predicting the impact of application changes



Application Life Cycle

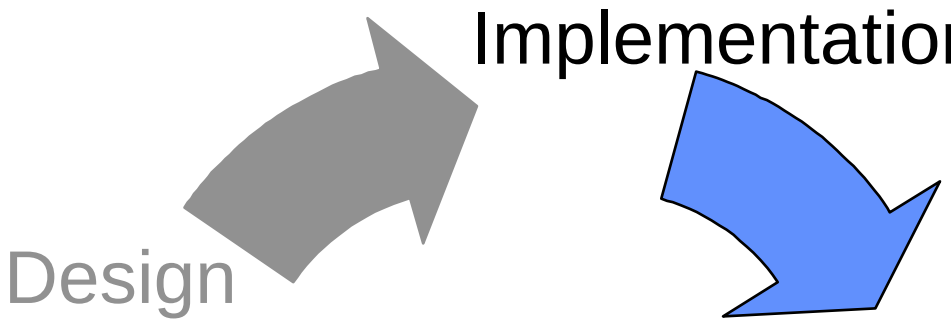


Application Life Cycle

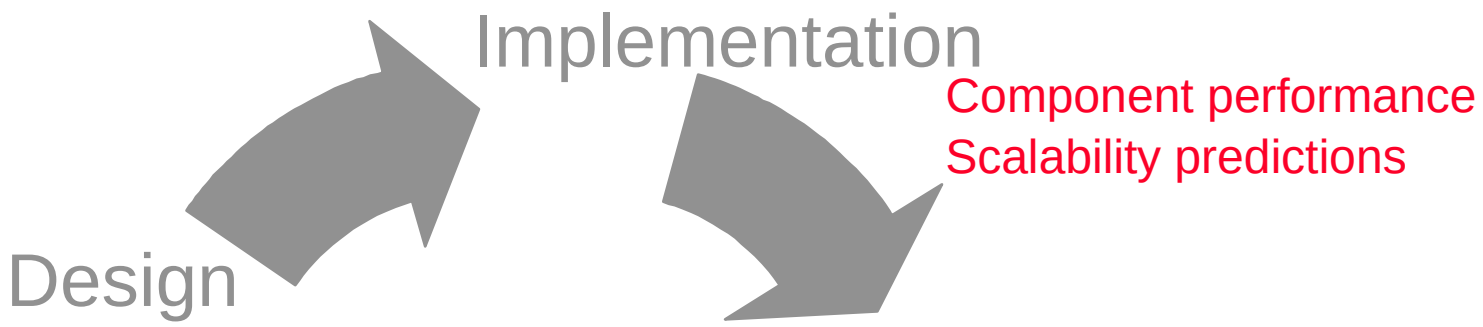
Function - UML
Performance - SPE

Design

Application Life Cycle



Application Life Cycle



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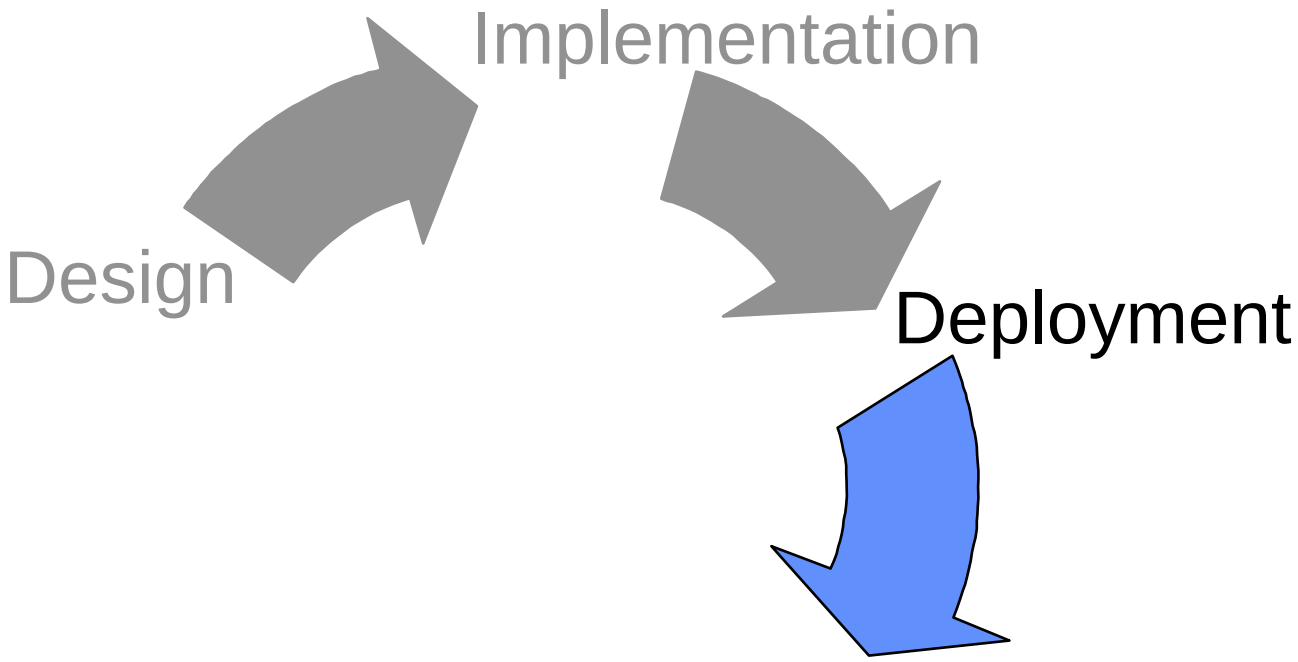

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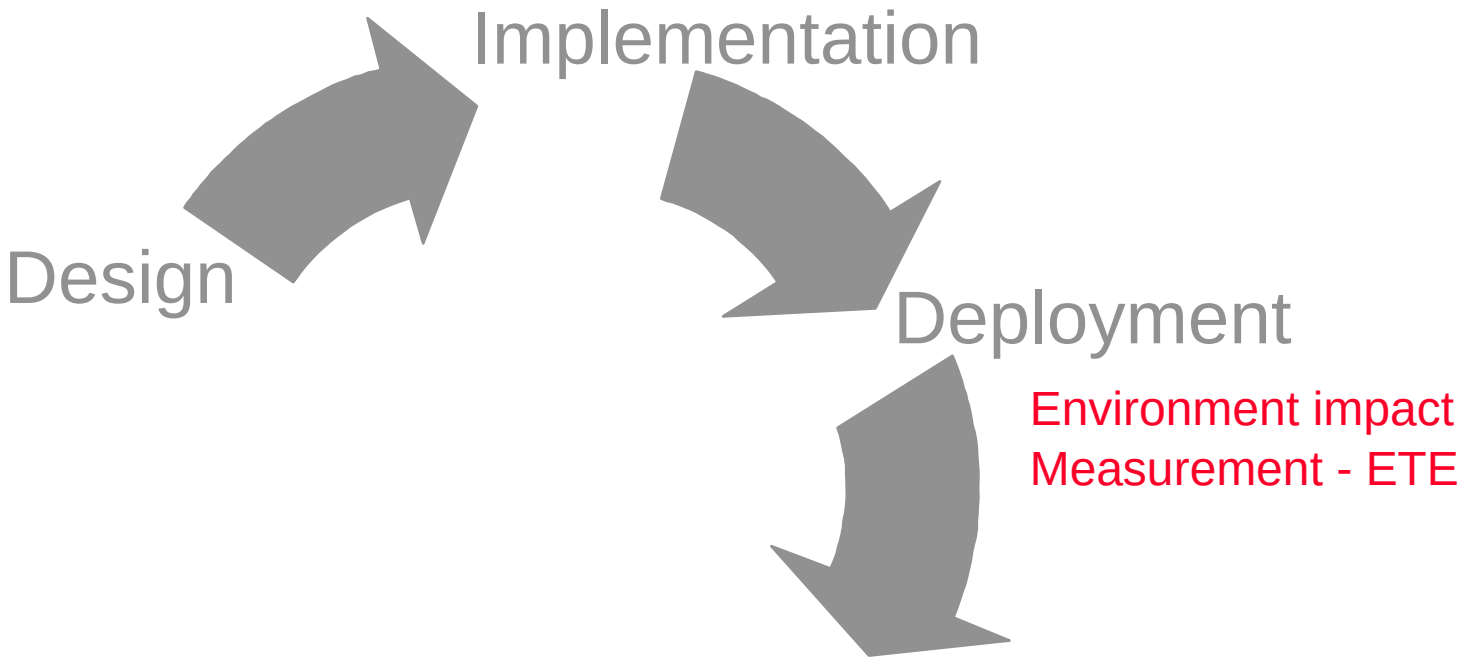

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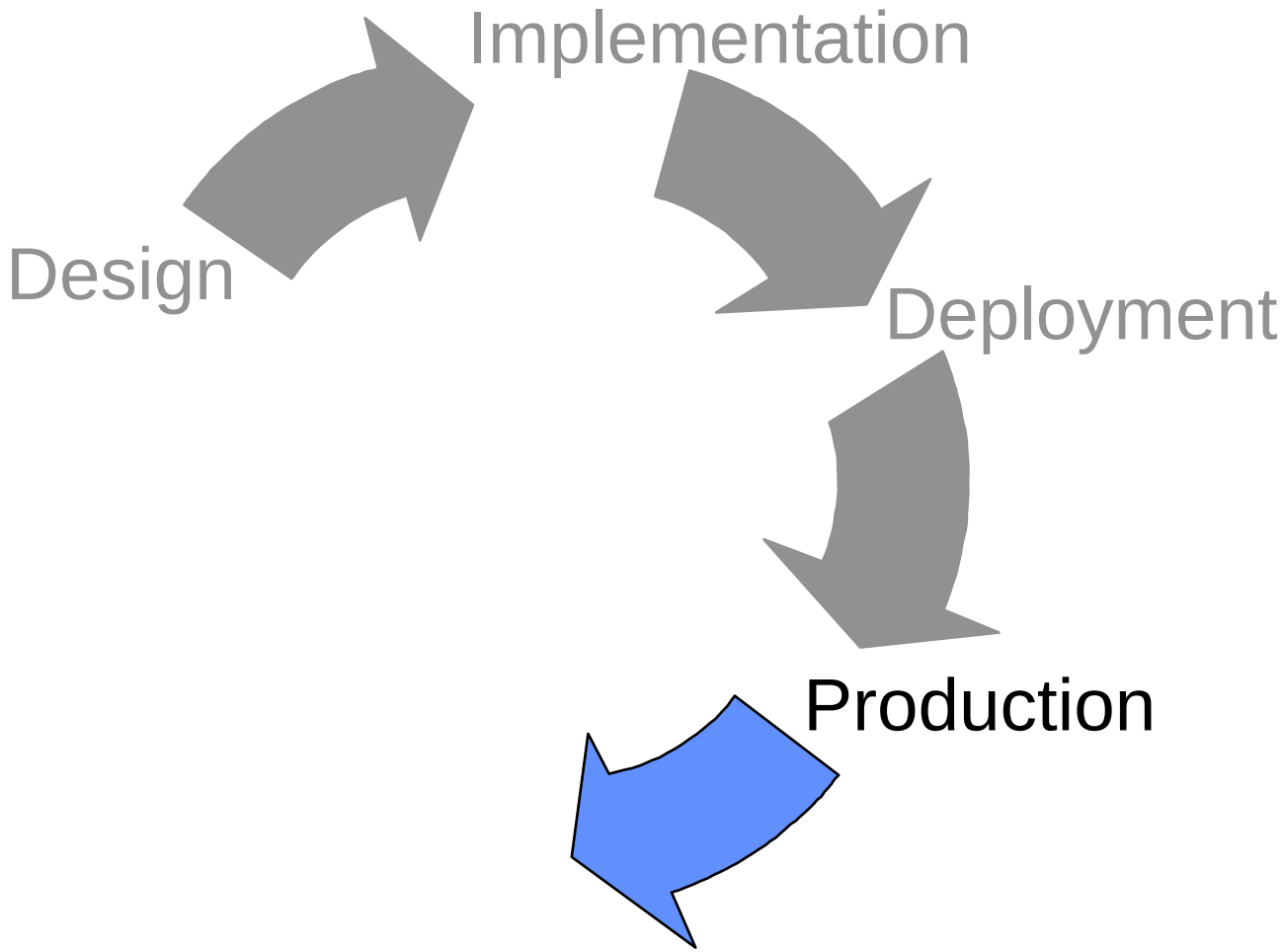

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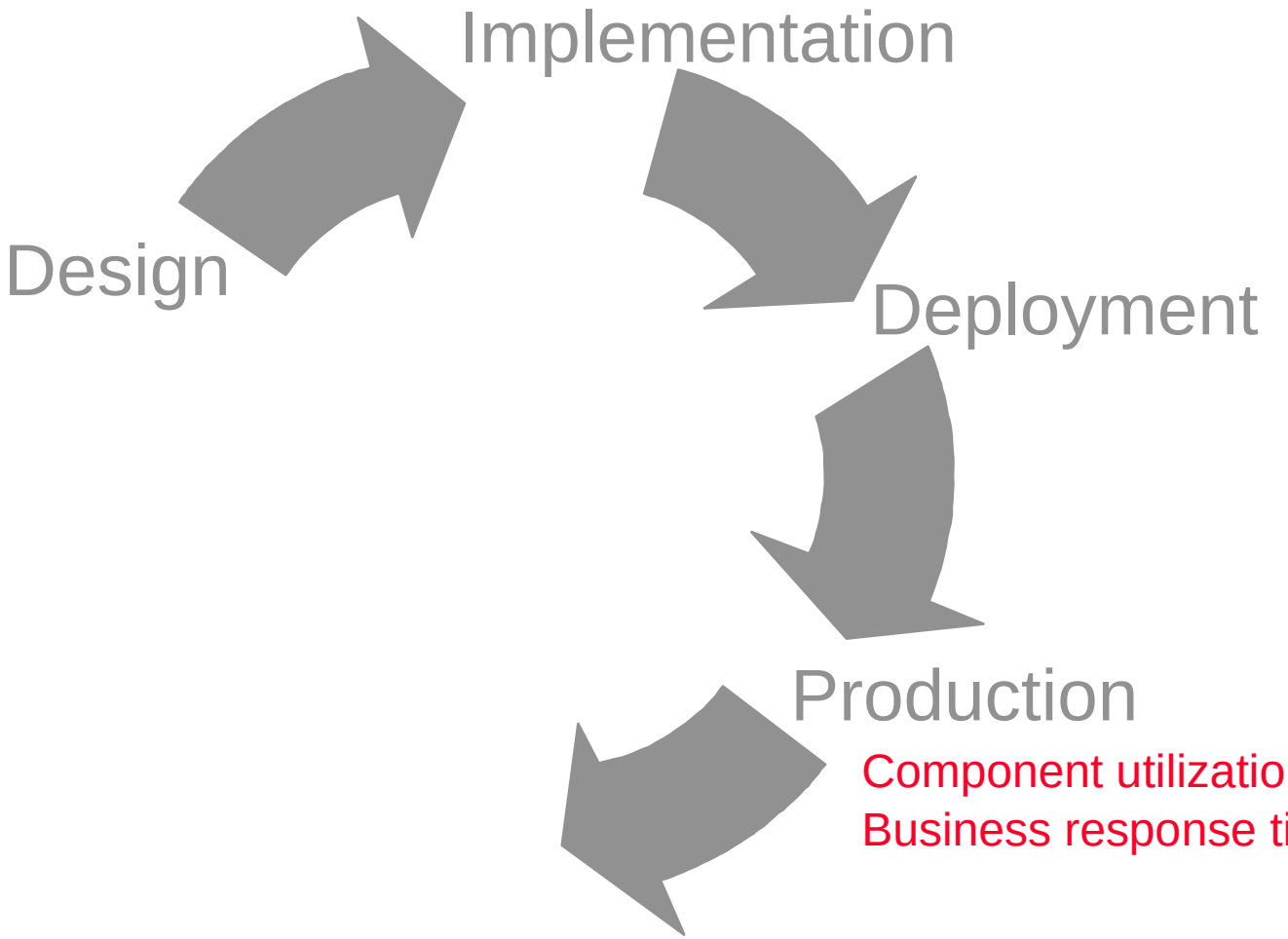

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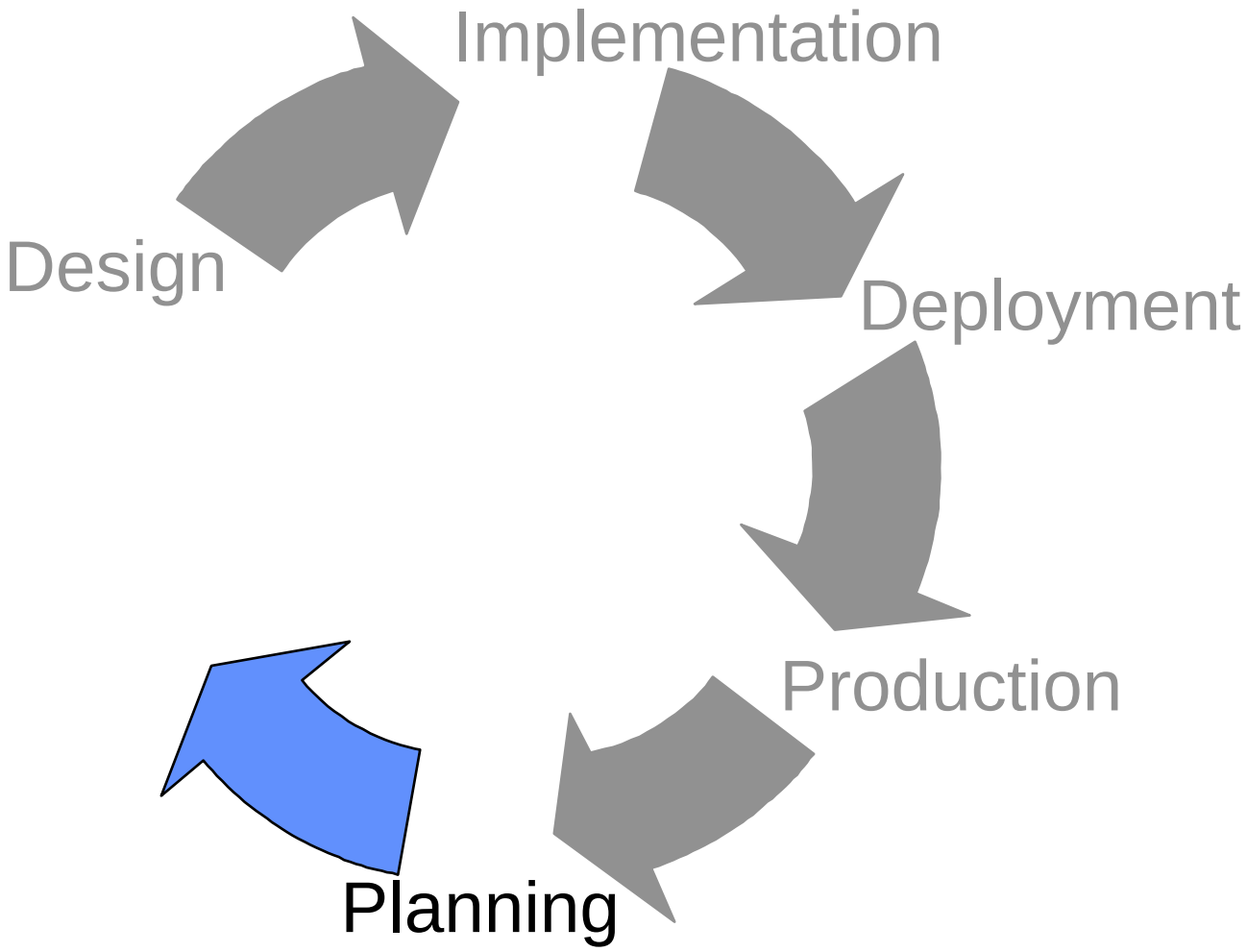

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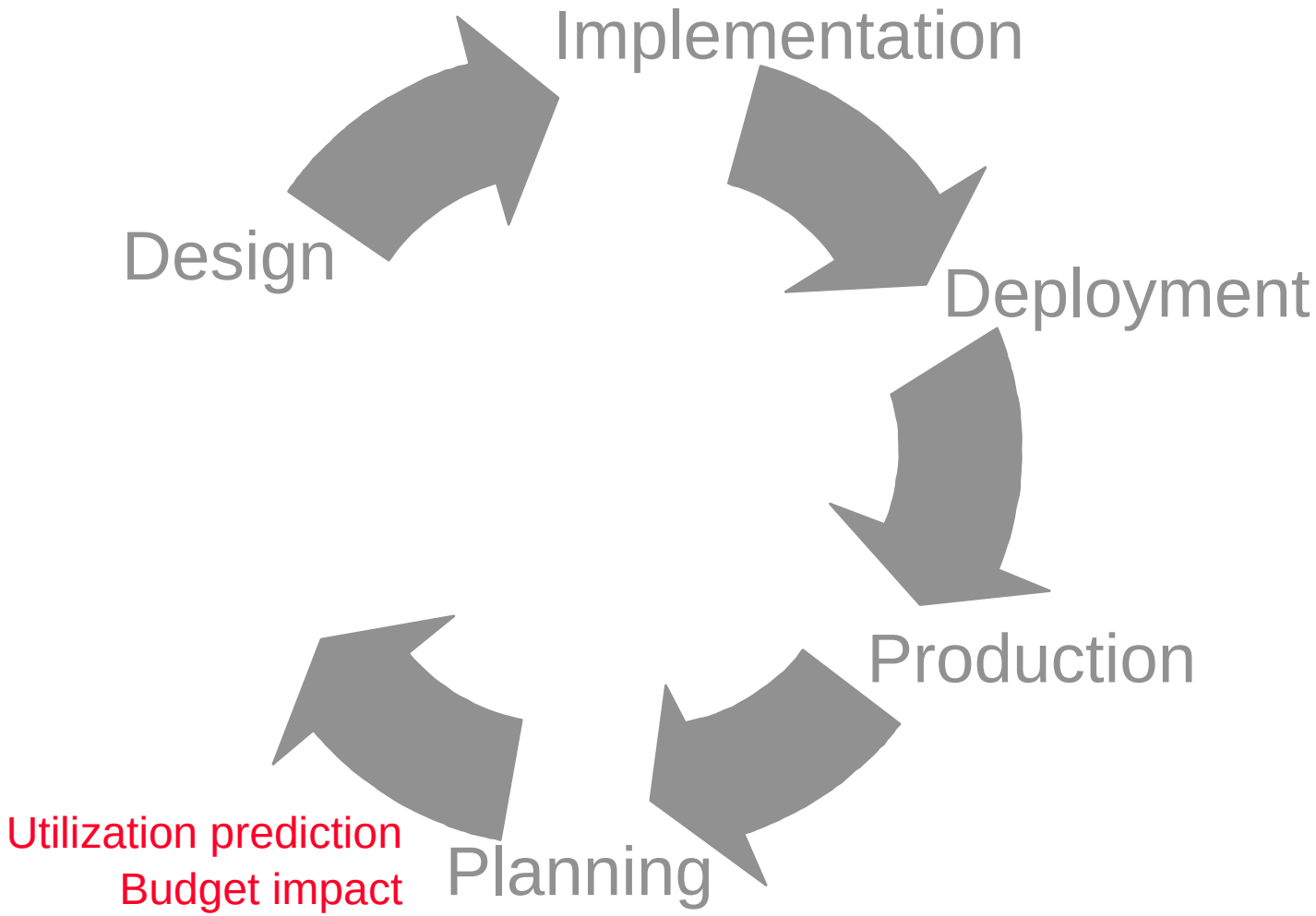

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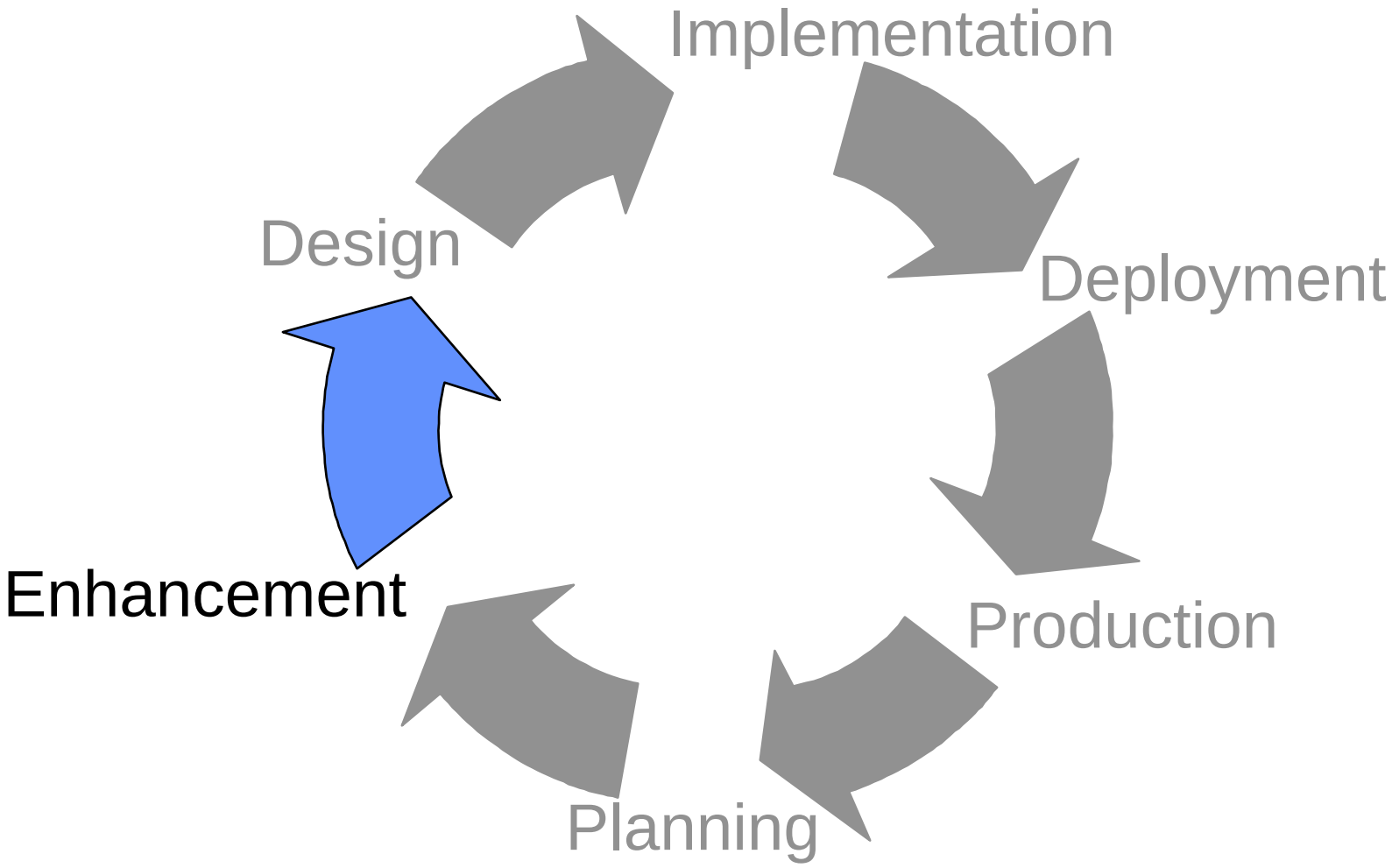

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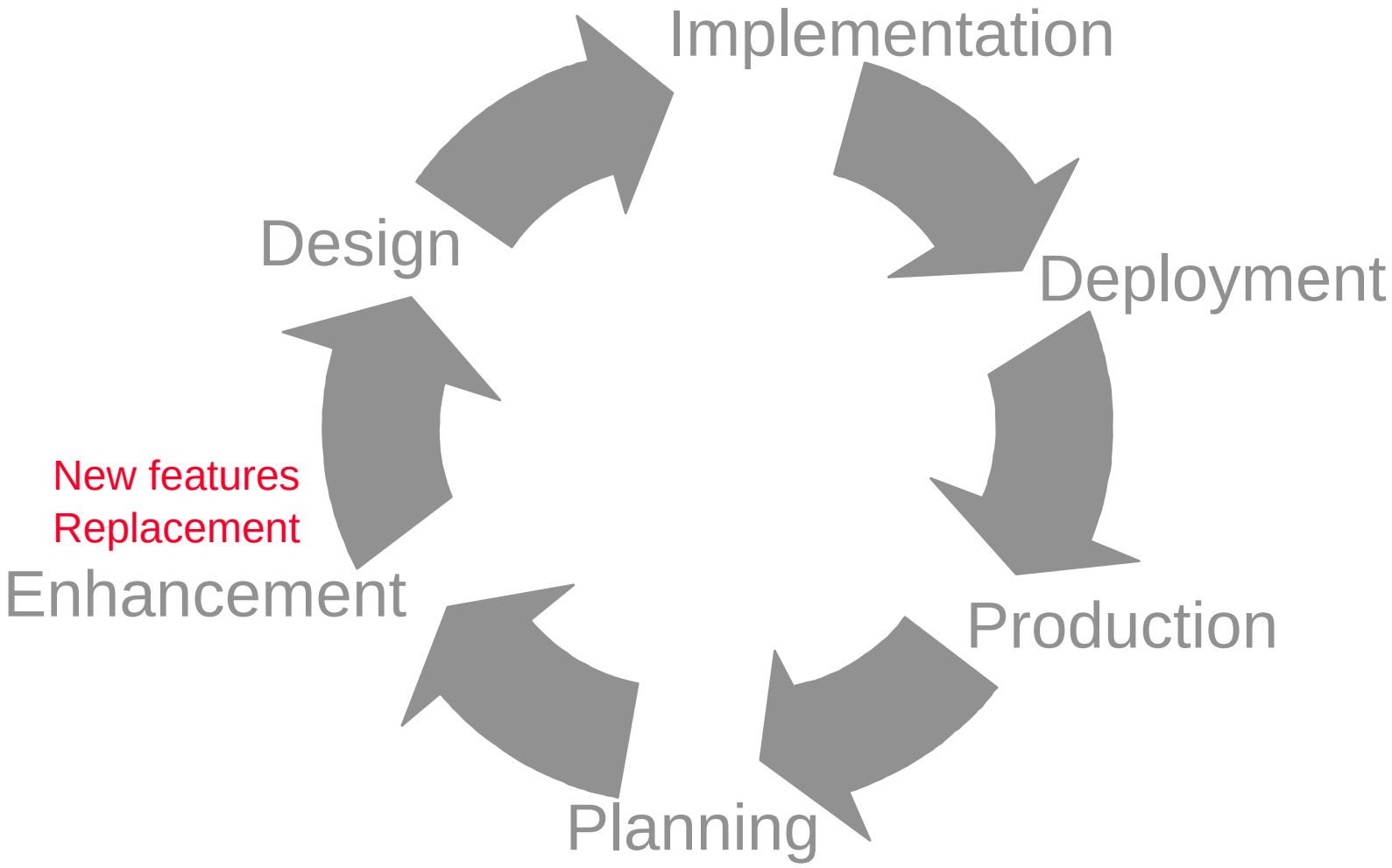

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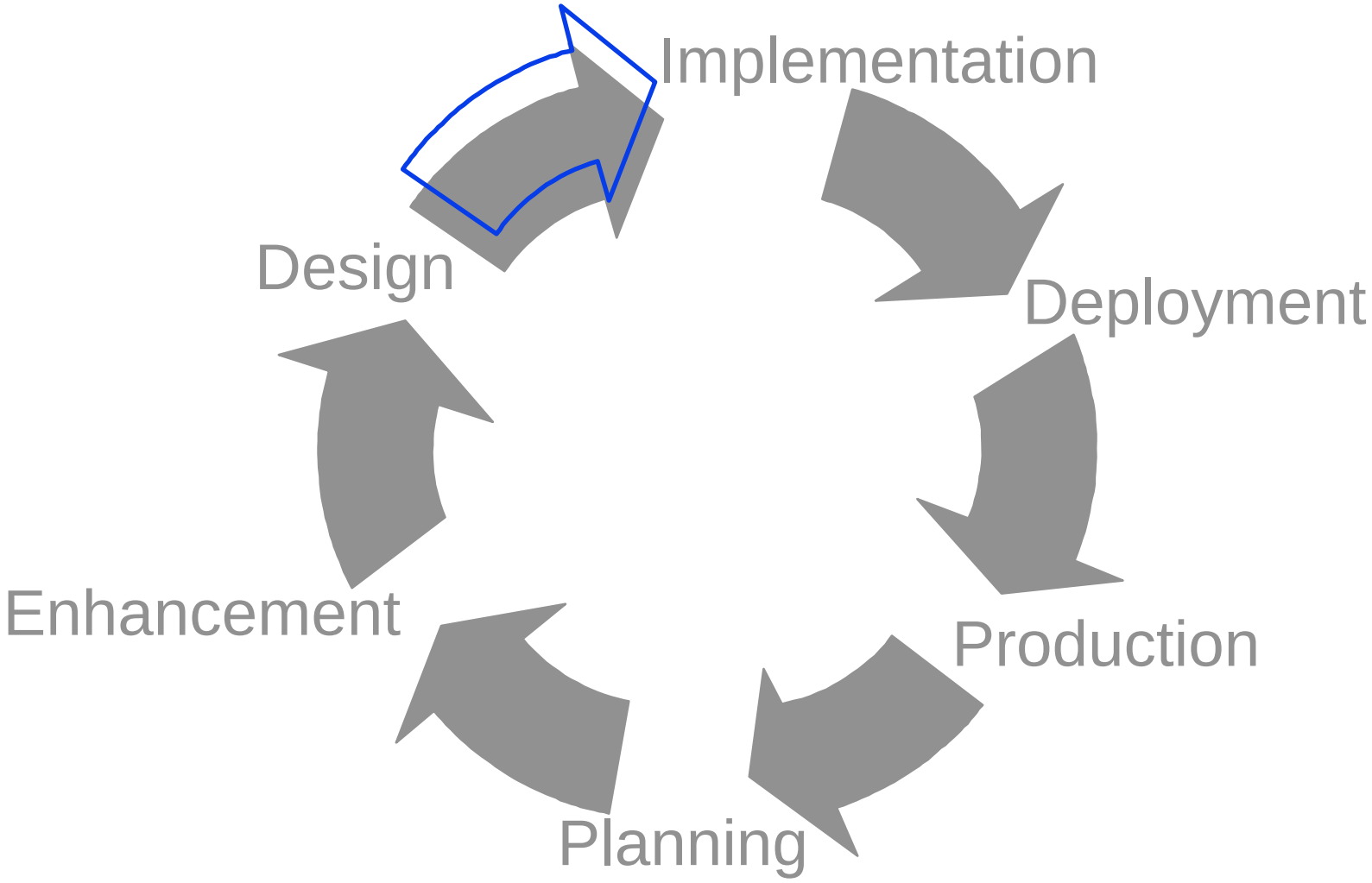
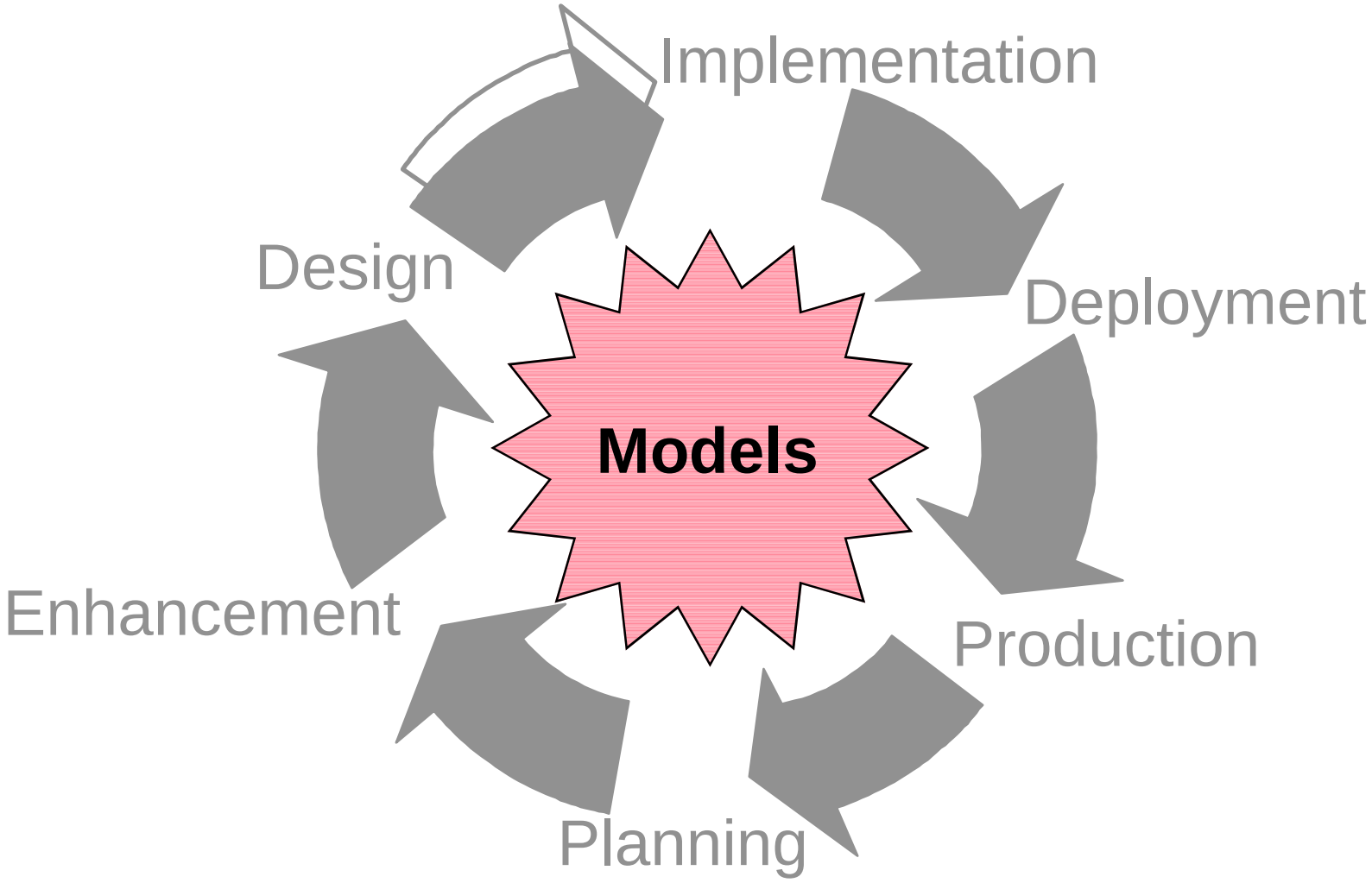
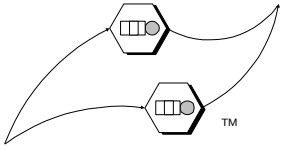


Application Life Cycle

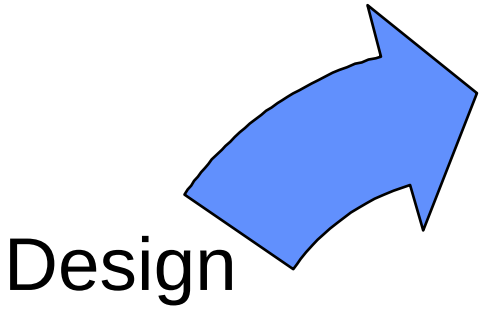




Application Example

- **Modeling an Order Entry Application**
  - Mail-order catalog company
  - Customers call and place orders
  - Operators use Order Entry Application
  - Response time impacts customer satisfaction
  - Resource capacity limits business growth
  - Increased transaction rates based on Marketing plans for new customers and new products
  - New function: replacing paper shipping reports with an on-line transaction

Application Life Cycle Example



Application Life Cycle Example

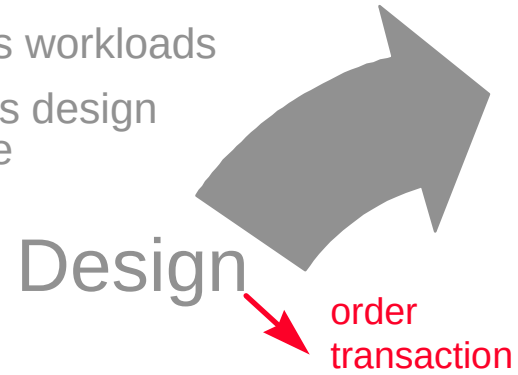
UML defines workloads

SPE predicts design performance

Application Life Cycle Example

UML defines workloads

SPE predicts design performance



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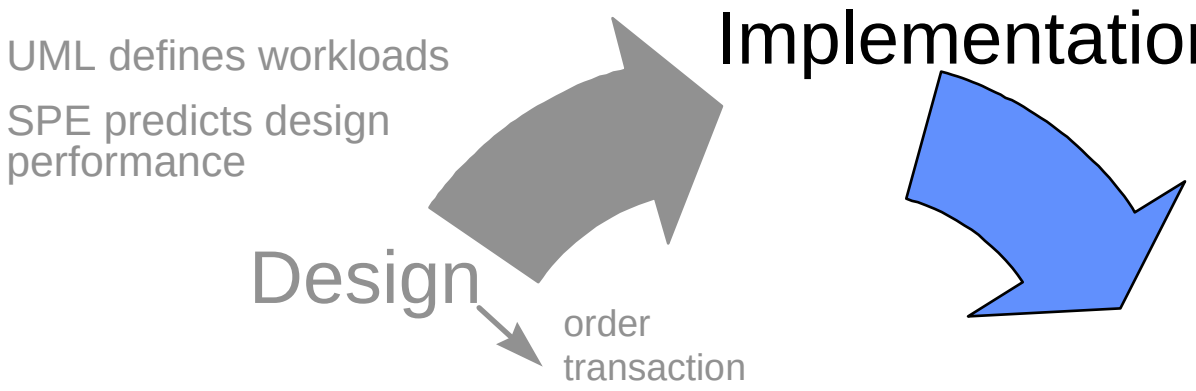

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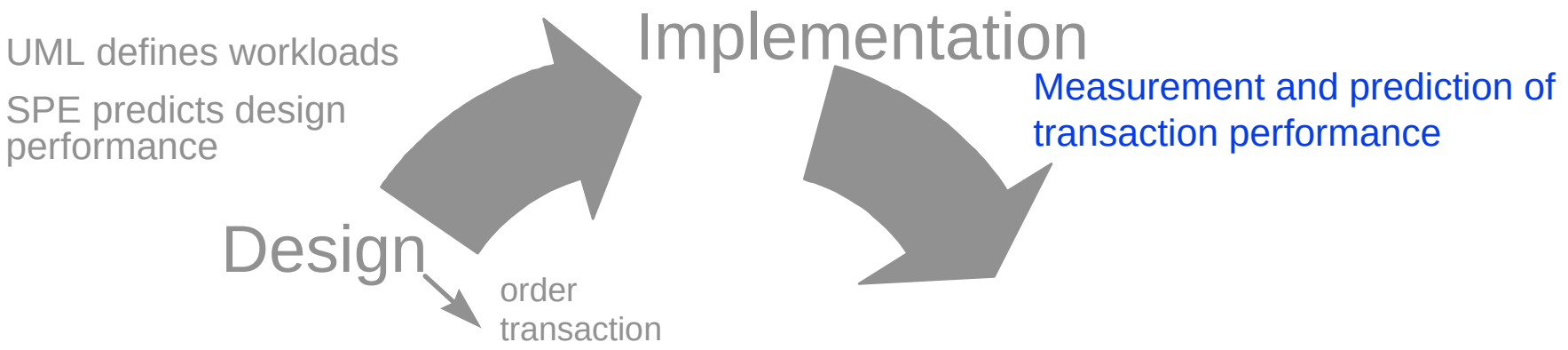

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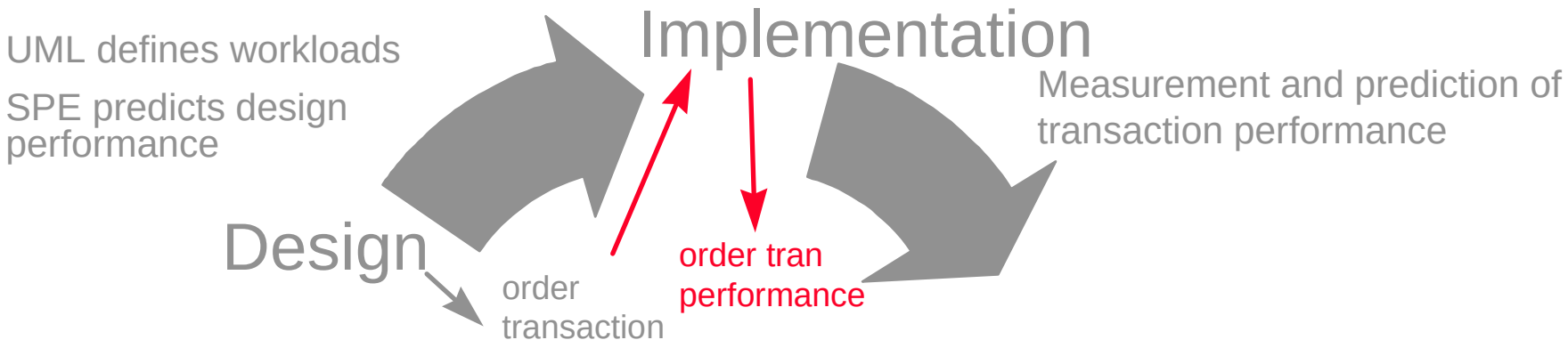

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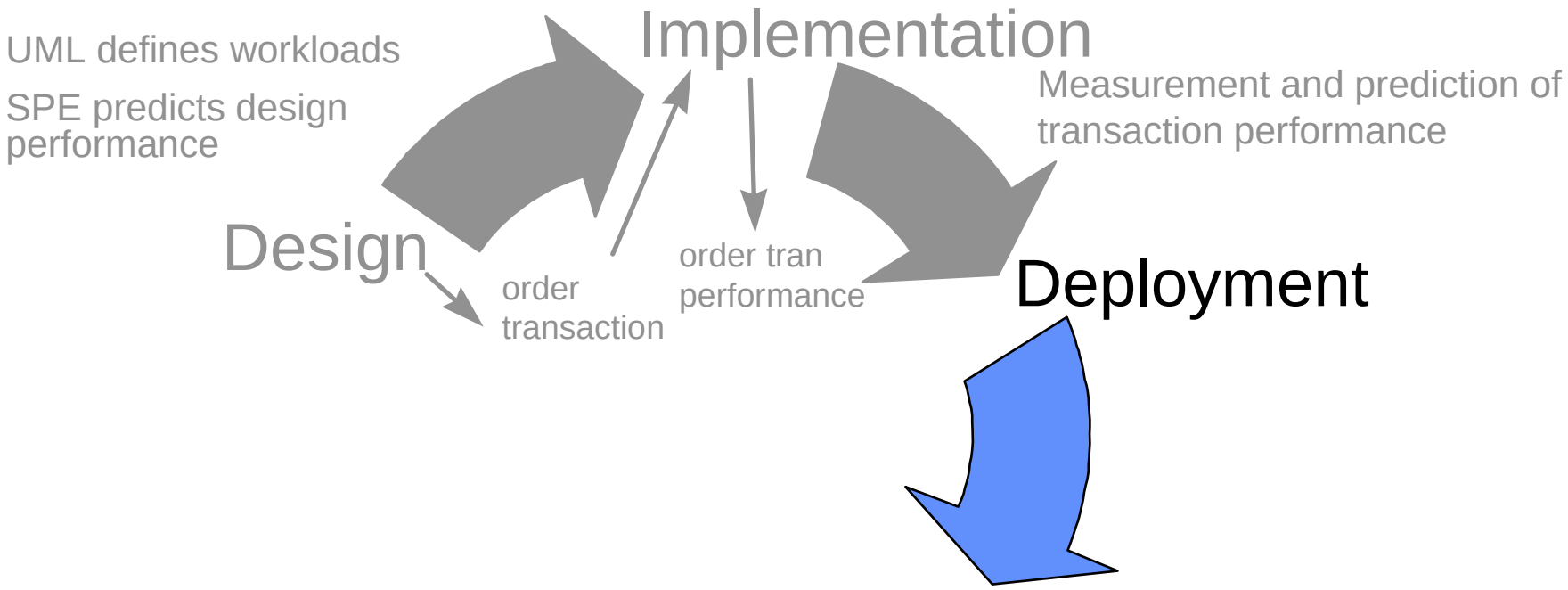

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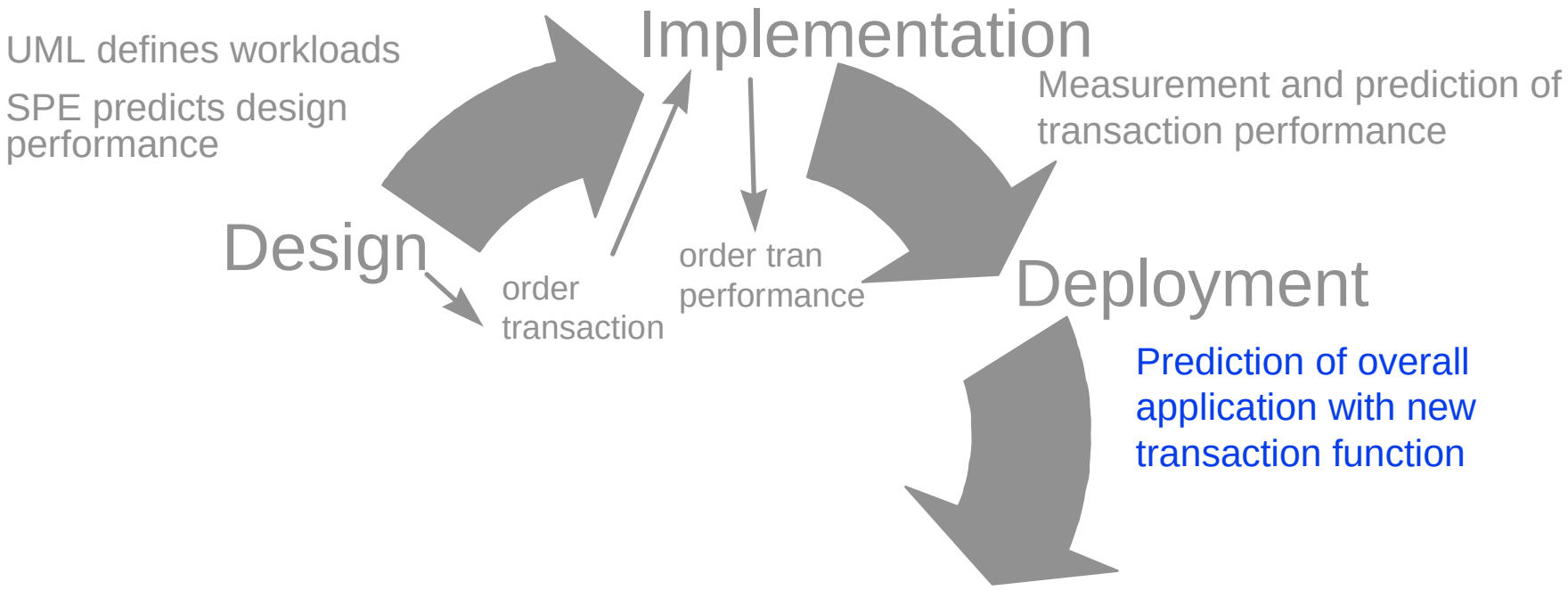

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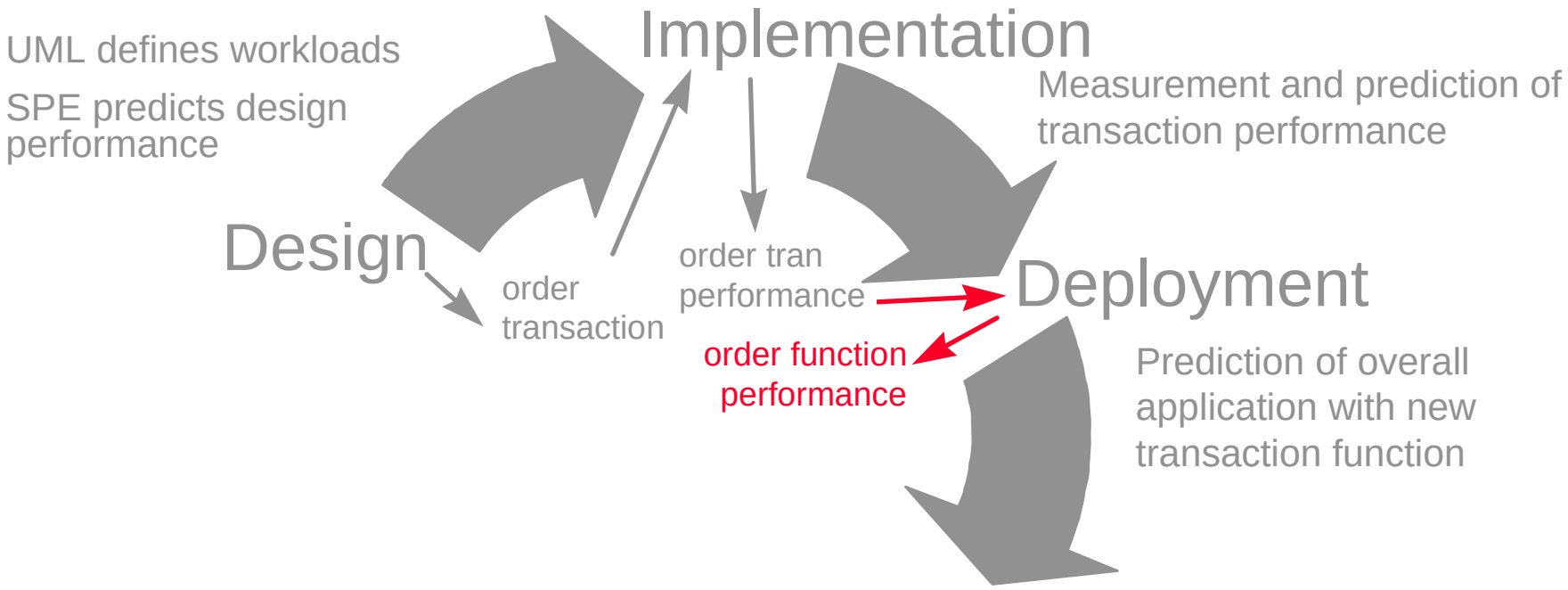

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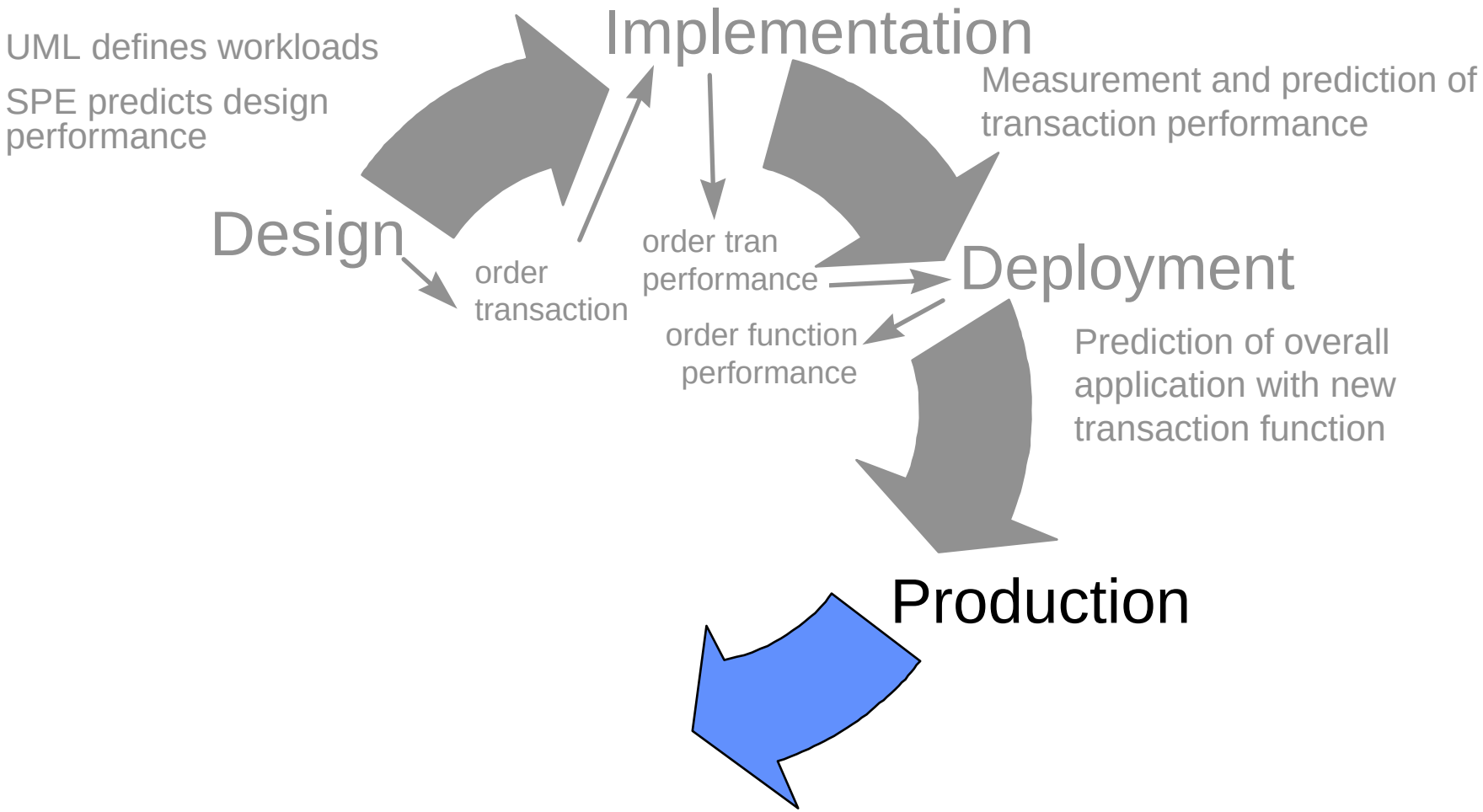

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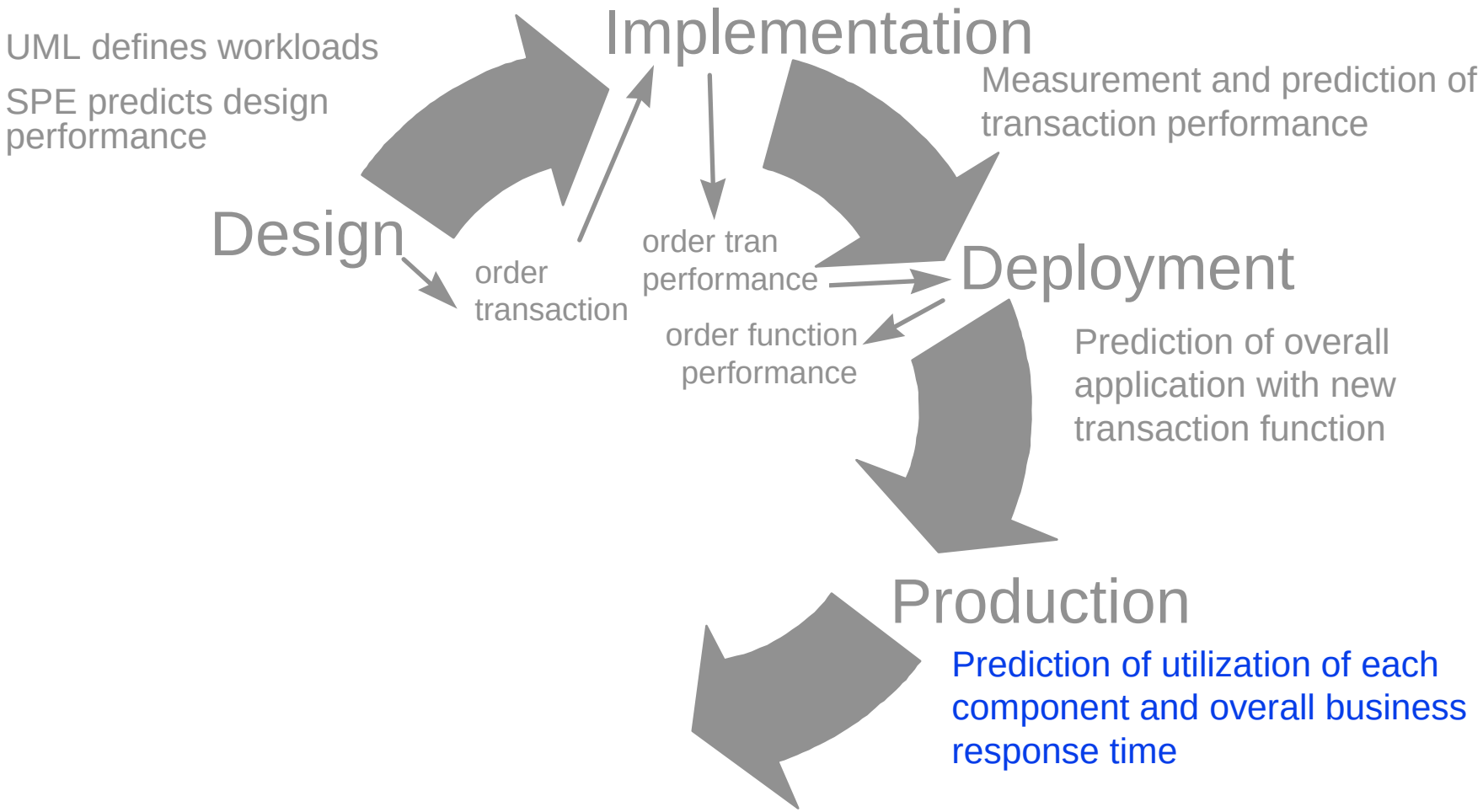

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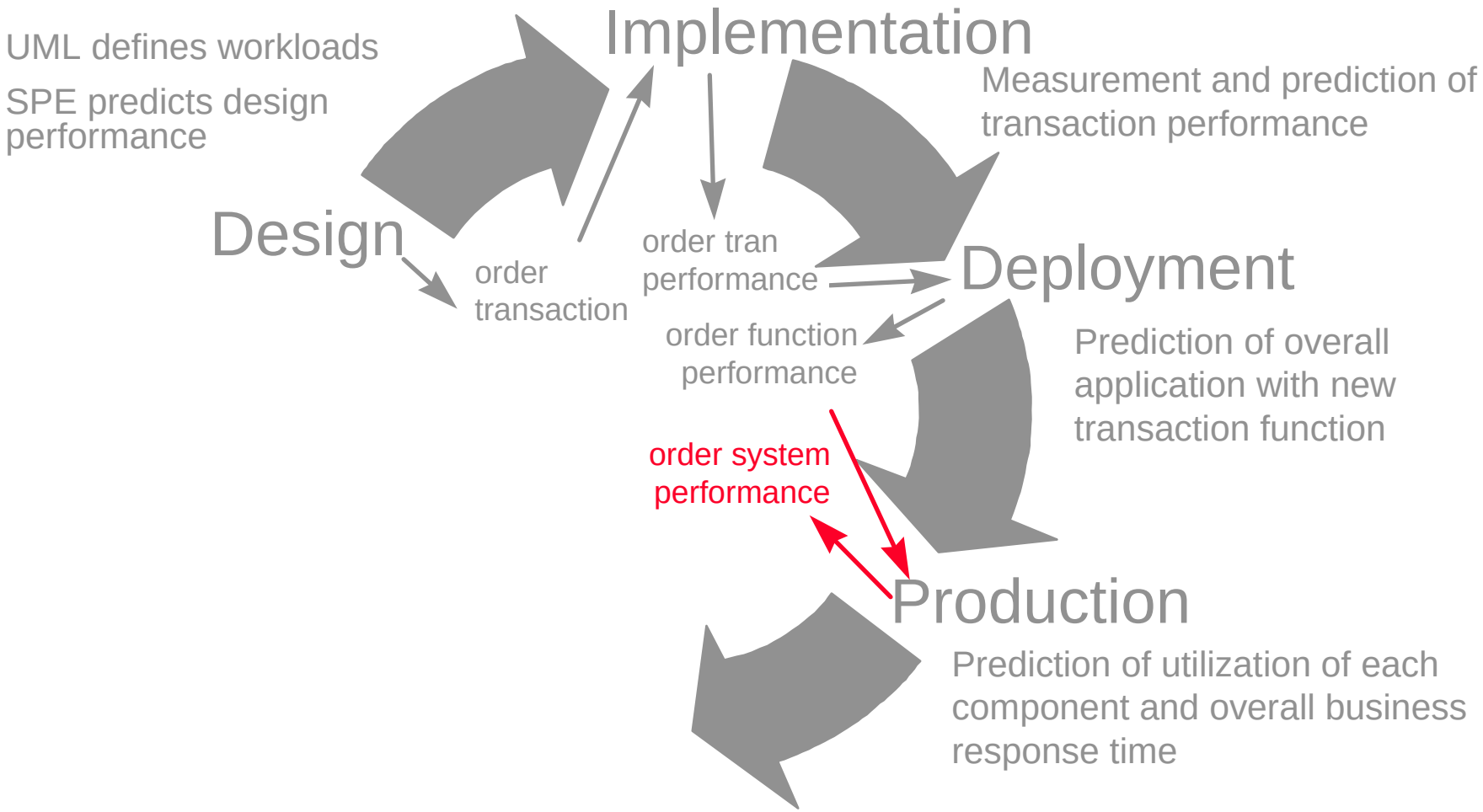

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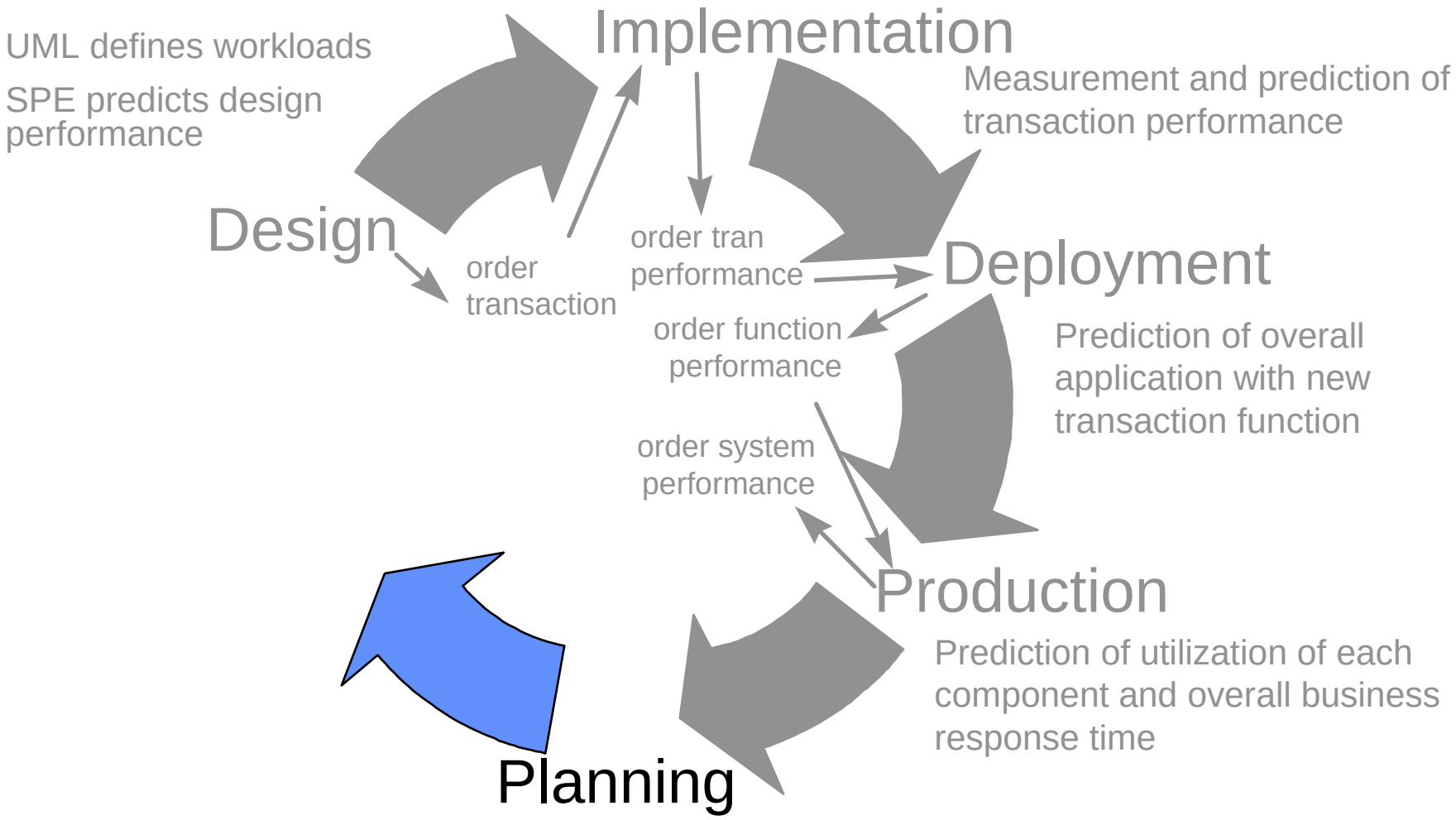

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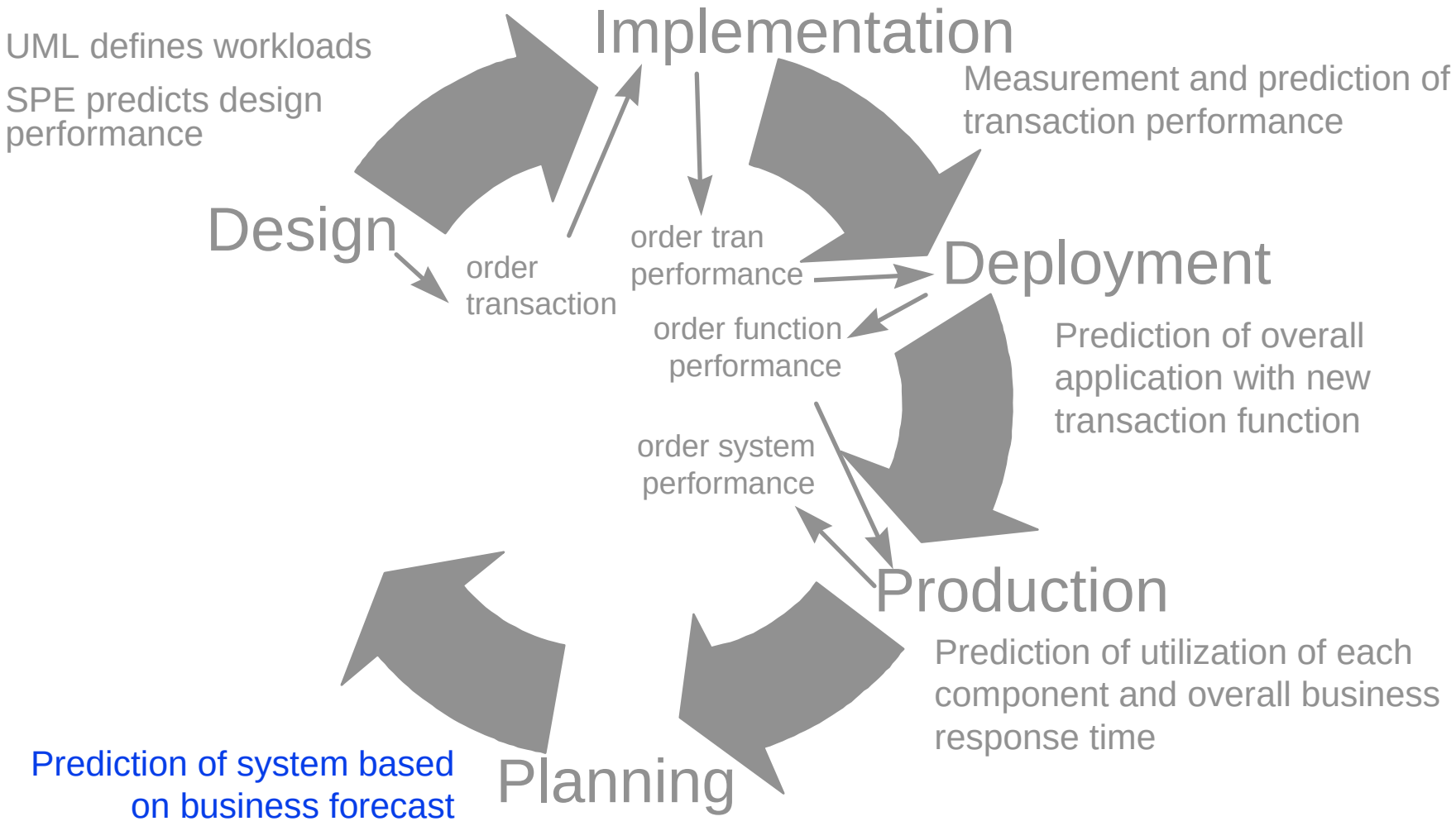

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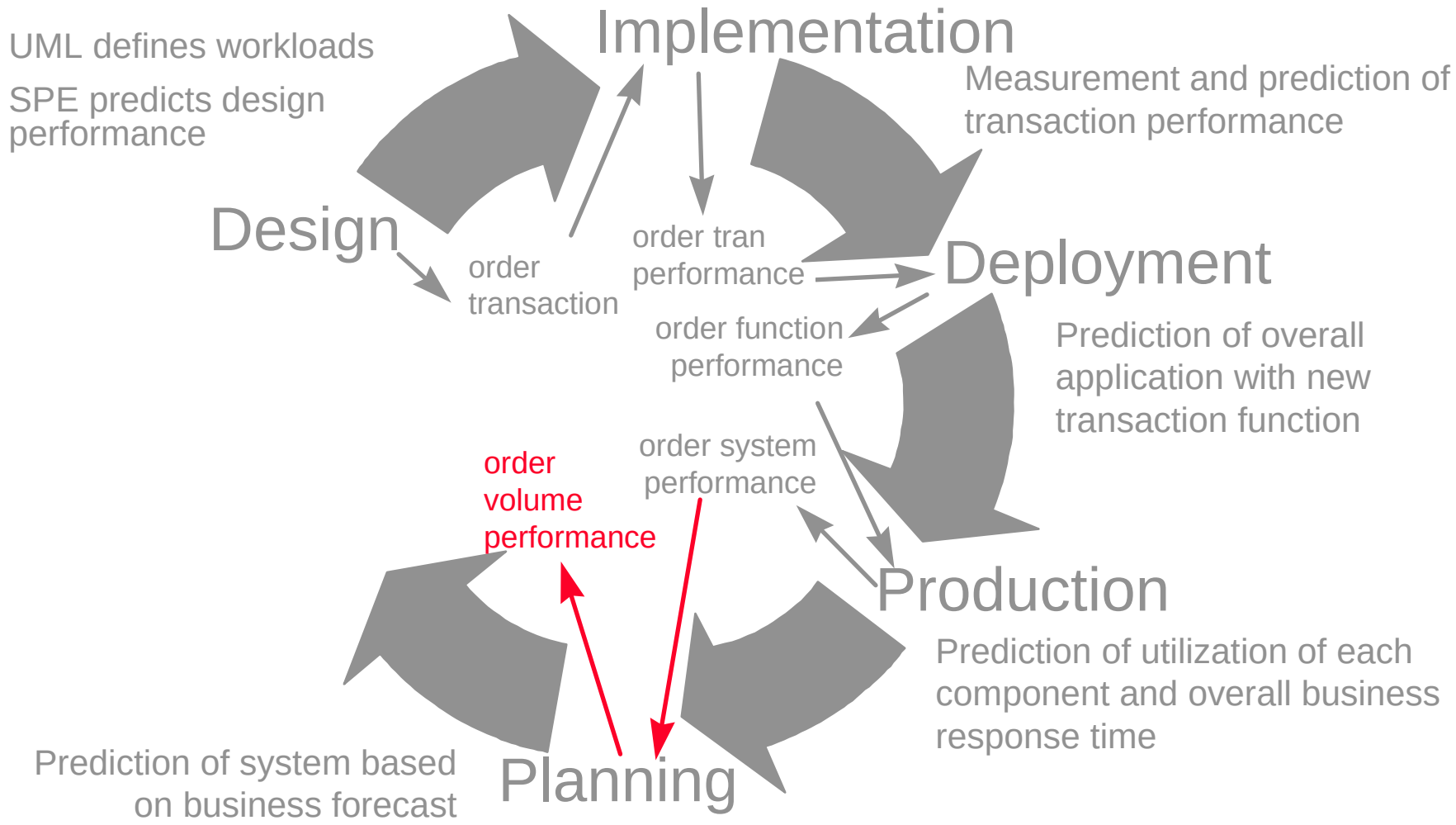

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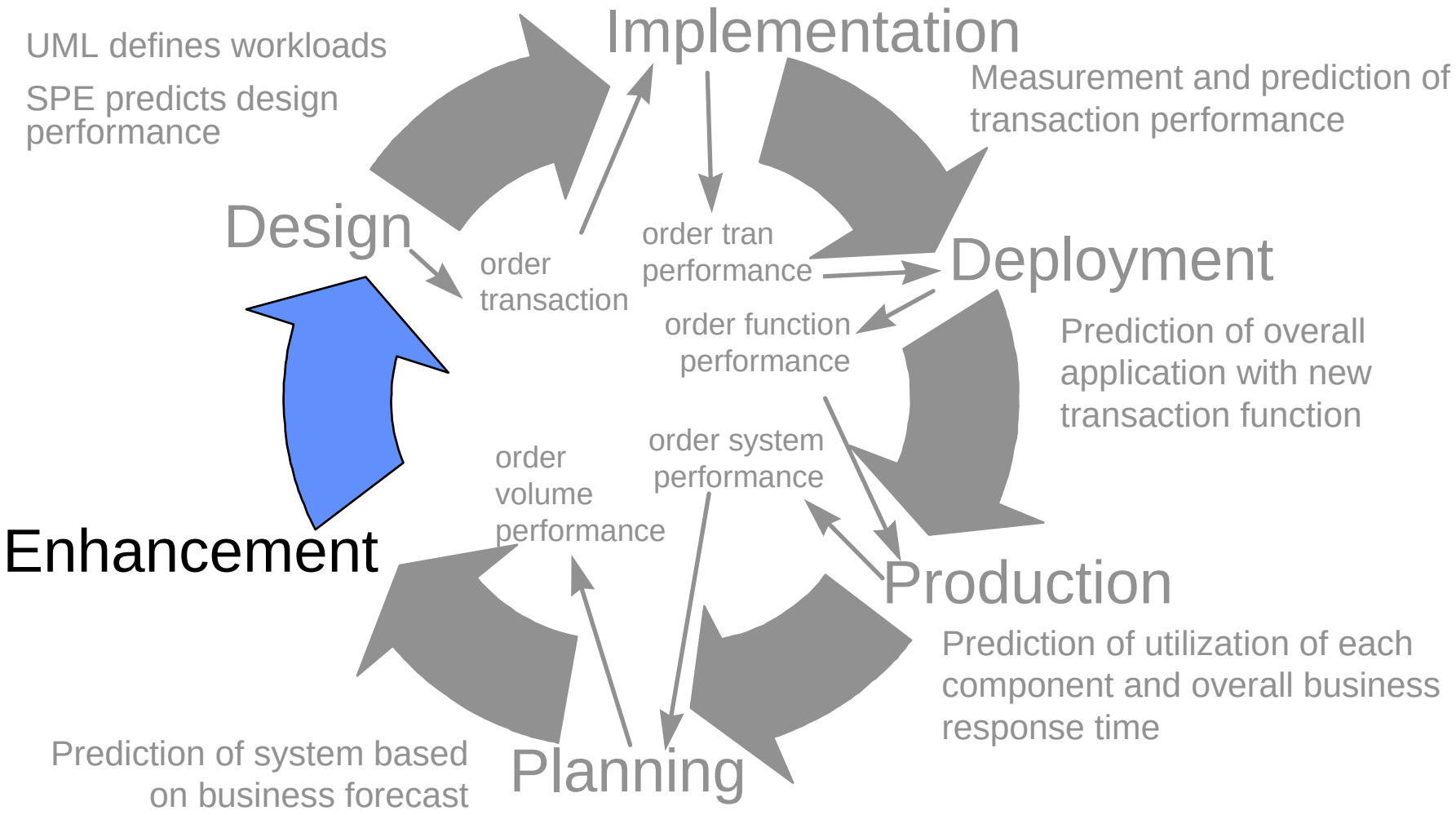

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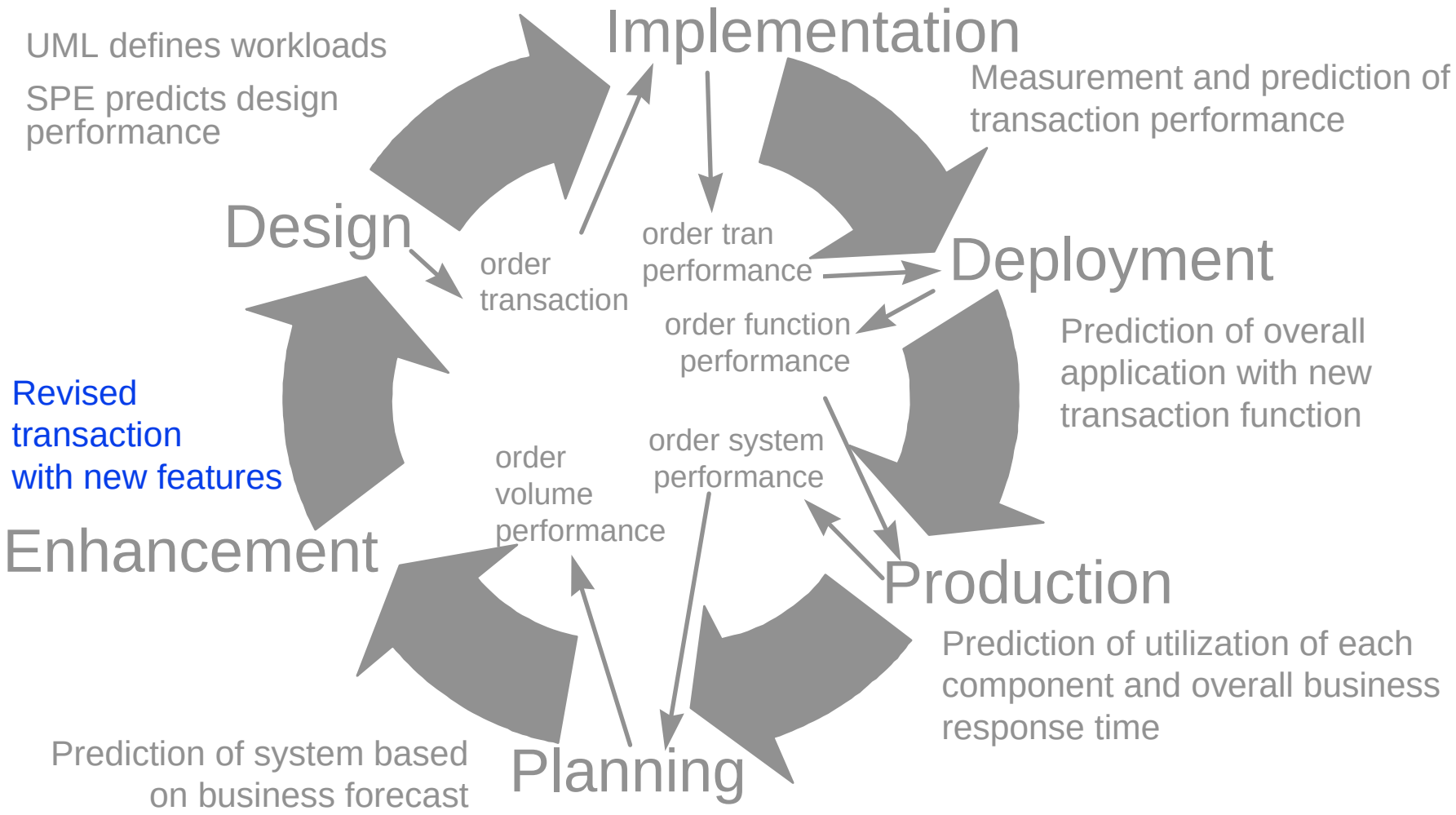

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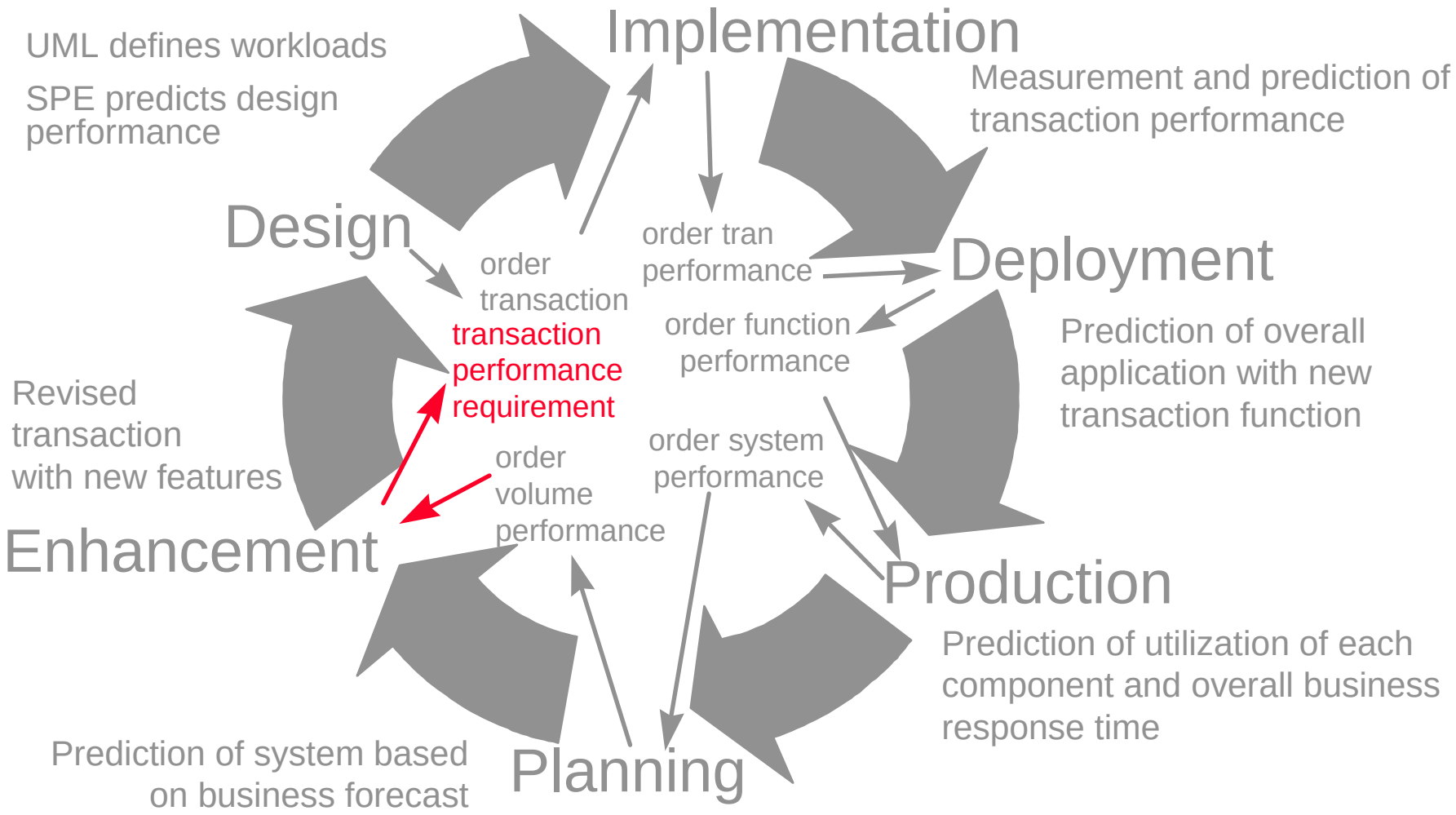

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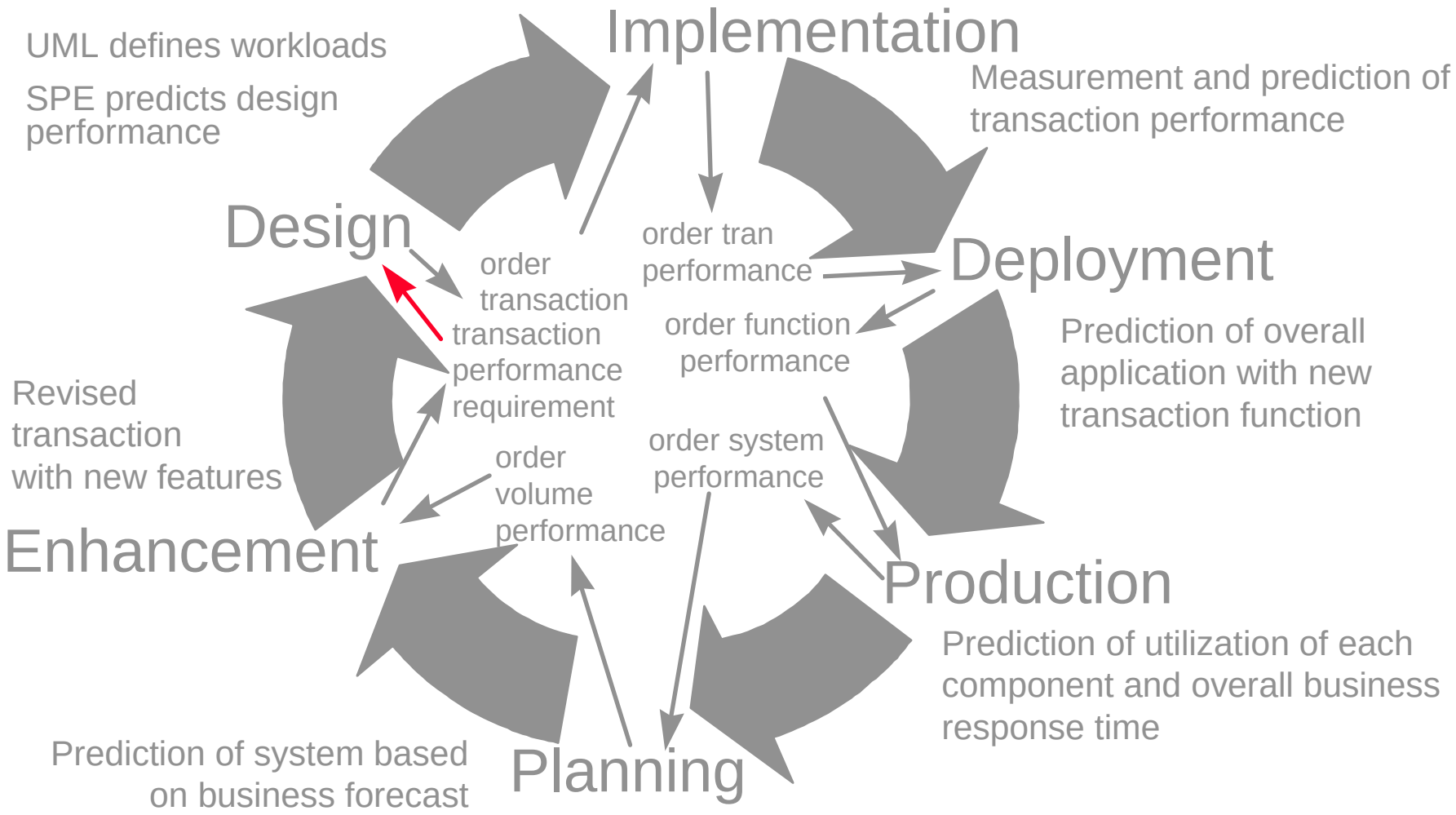
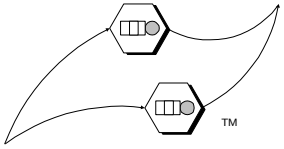
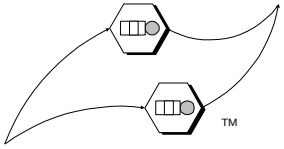




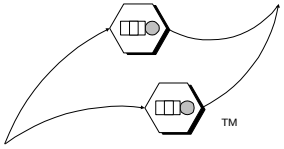
Modeling Techniques

- **General Modeling Tools**
  - Simulation
    - Tokens represent individual transactions
    - Examples:
      - DES - Discrete Event Simulation
      - Continuous Simulation - System Dynamics
  - Analytic
    - Mathematical description of the average transaction
    - Examples:
      - M/M/1Models
      - Queuing Network Models



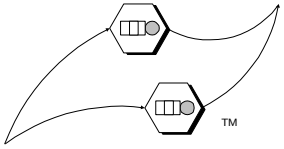
Modeling Techniques

- **Specialized Tools for Modeling**
  - UML - Unified Modeling Language
  - ETE-RT - End-To-End Response Time
  - SPE - Software Performance Engineering
  - Simalytic Modeling Technique
  - Business Models - System Dynamics
  - Node Models
  - Platform-Centric Models



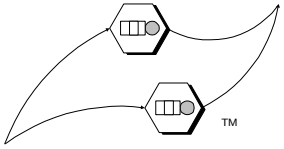
The Modeling Pyramid

- **Strategic Level**
  - Overall view to move an organization forward
    - Marketing or Business Plan
    - Projections by business area
  - Order Entry Example:
    - Customer growth
    - Product line growth
    - Replace paper catalog/orders with online functions
    - Metrics:
      - # customers, # products, # orders, etc.



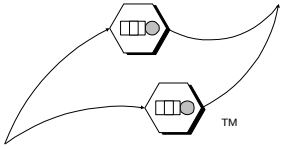
The Modeling Pyramid

- **Business Level**
  - Detailed view of business processes
    - Models predict how the entire process reacts to changes
  - Order Entry Example:
    - Staff to support additional customers
    - IT growth to support additional products/services
    - Metrics:
      - # calls, # operators, # telephone lines, etc.



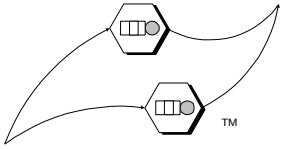
The Modeling Pyramid

- **Application Level**
  - Detailed view of how the application functions
    - Models predict how the application reacts to changes
  - Order Entry Example:
    - Number of OE transactions supported
    - OE transaction response time changes with growth
    - Impact of replacing Shipping paperwork with an on-line function
    - Metrics:
      - # transactions, tran response time, user think time, etc.



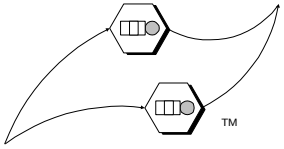
The Modeling Pyramid

- **System Level**
  - Broad view of all applications using specific hardware
    - Models predict system performance and application interactions
  - Order Entry Example:
    - Impact of other loads on OE database
    - Interference caused by system backups
    - Metrics:
      - # DB queries, processor utilization, memory load, etc.



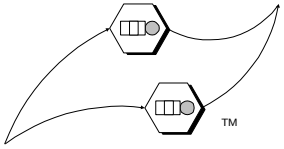
The Modeling Pyramid

- **Infrastructure Level**
  - Detailed view of the interconnections in the system
    - Models predict environment performance and interactions between systems
  - Order Entry Example:
    - RT impact of message latency to Shipping server
    - Impact of transaction growth on message latency
    - Metrics:
      - # DB I/Os, # network I/Os, I/O response time , etc.



The Modeling Pyramid

- **Component Level**
  - Most detailed view of underlying hardware
    - Models predict hardware performance for component selection
    - Components of one system may be systems themselves (i.e. network gateways or disk subsystems)
  - Order Entry Example:
    - RT impact of router or network segment upgrade
    - Metrics:
      - # packets, # router hops, packet latency, etc.



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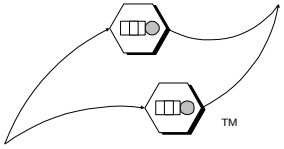
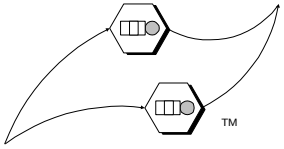


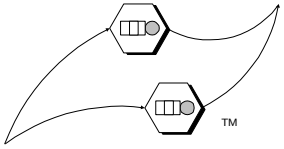
The Modeling Pyramid

More General Models



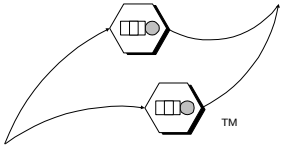
The Modeling Pyramid

More General Models



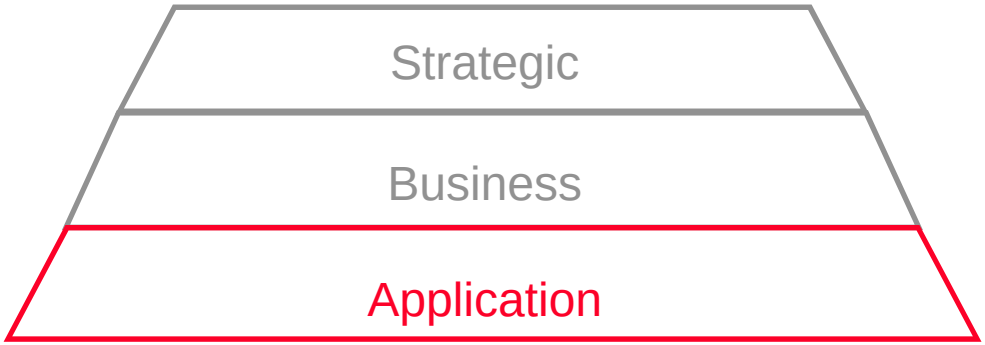
The Modeling Pyramid

More General Models



The Modeling Pyramid

More General Models



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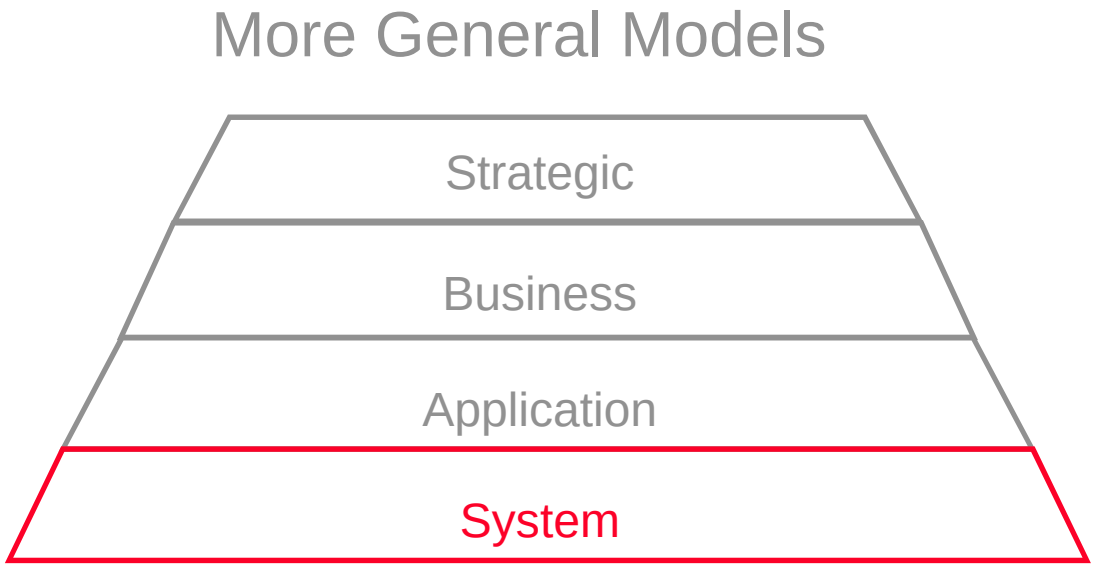

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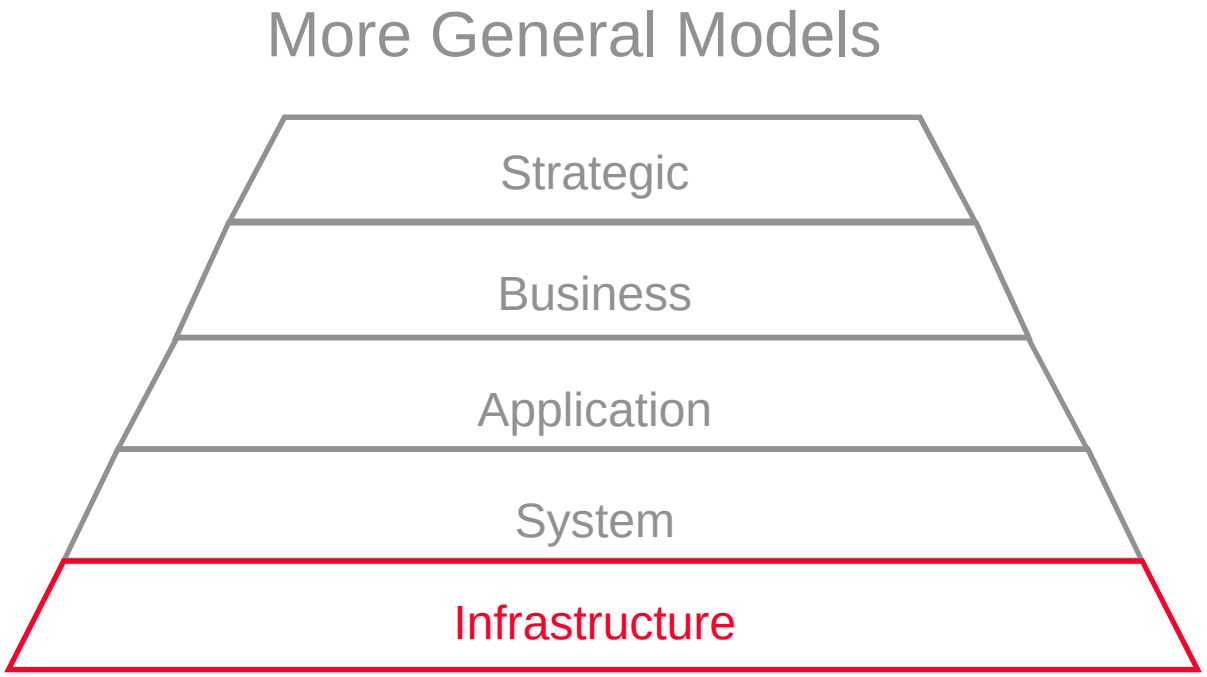

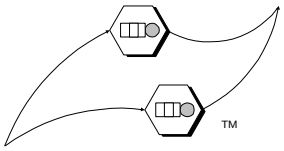

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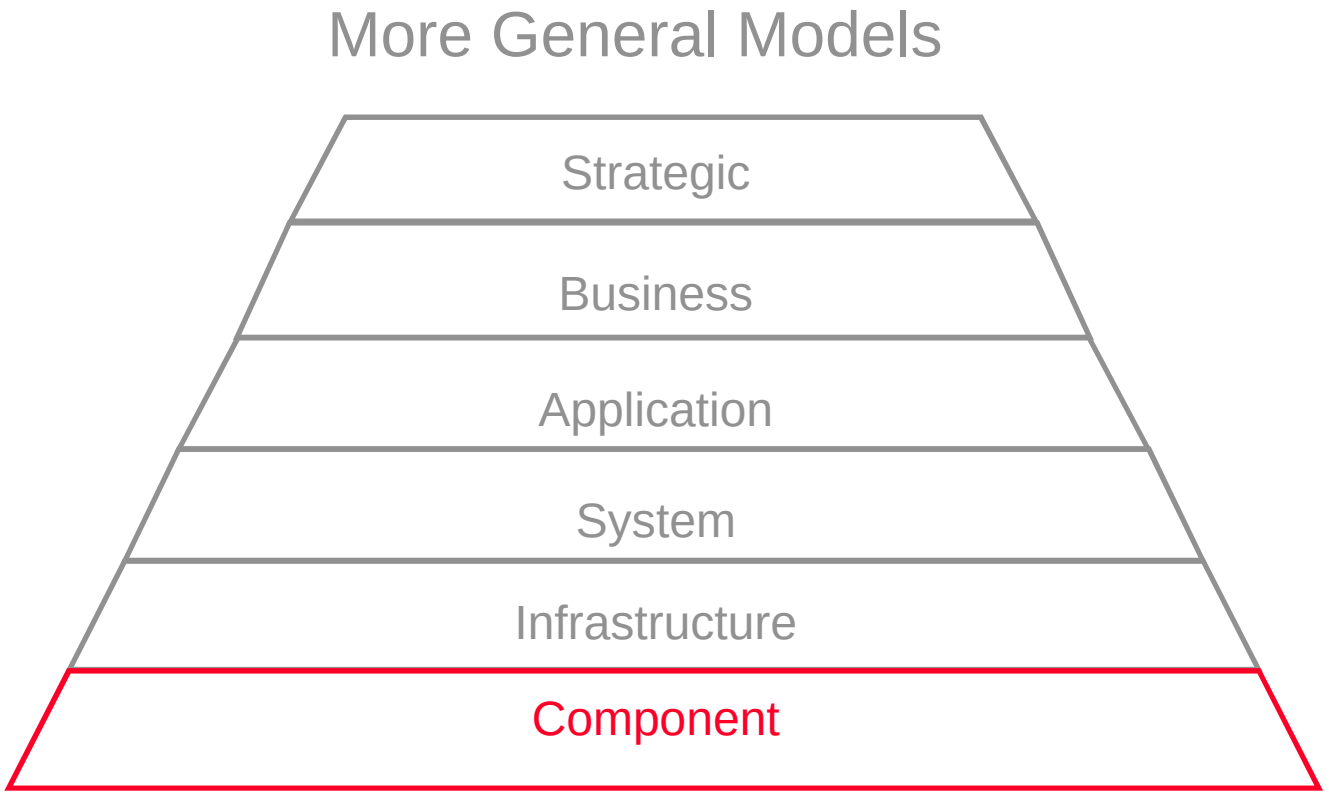
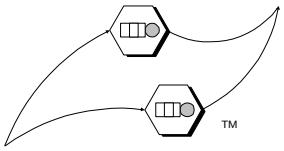
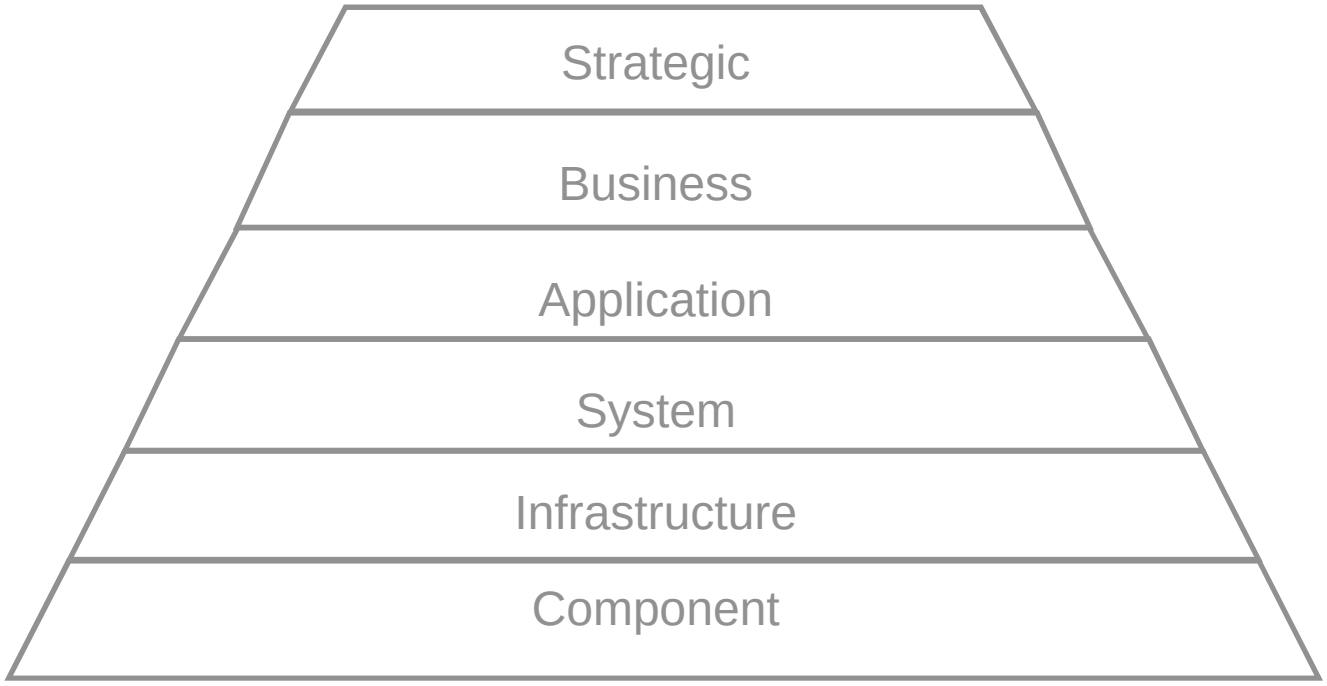




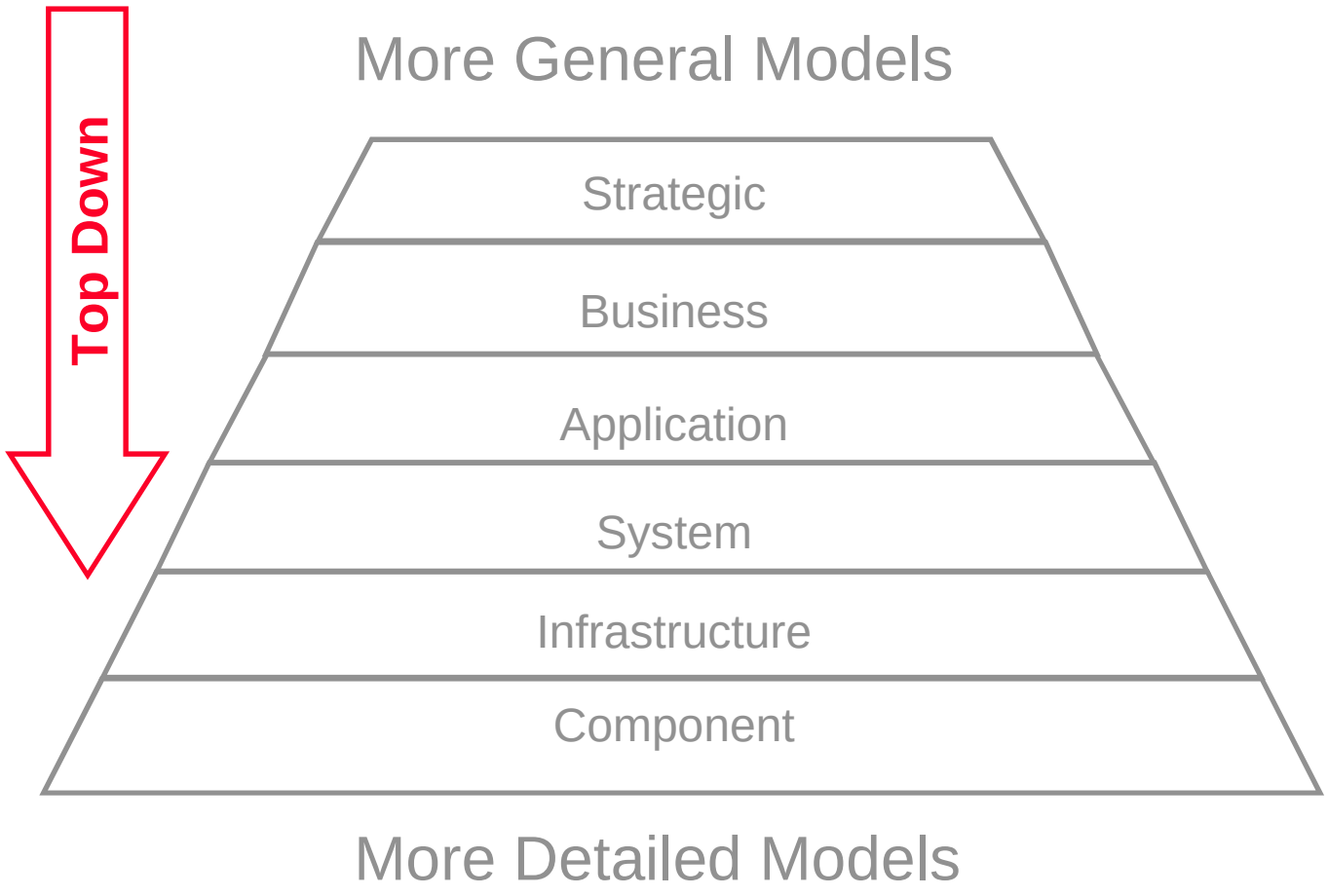
The Modeling Pyramid

More General Models



More Detailed Models

The Modeling Pyramid



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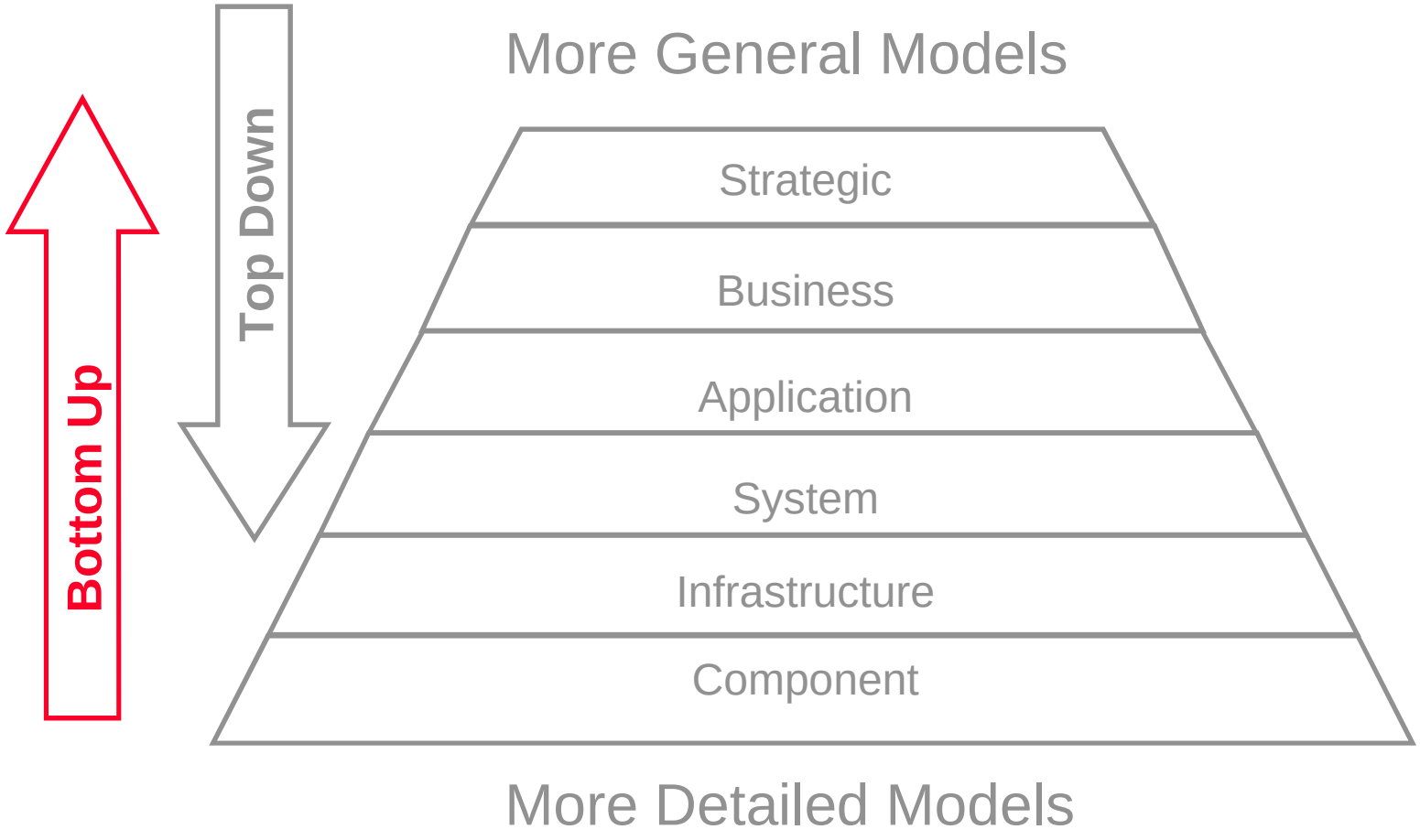

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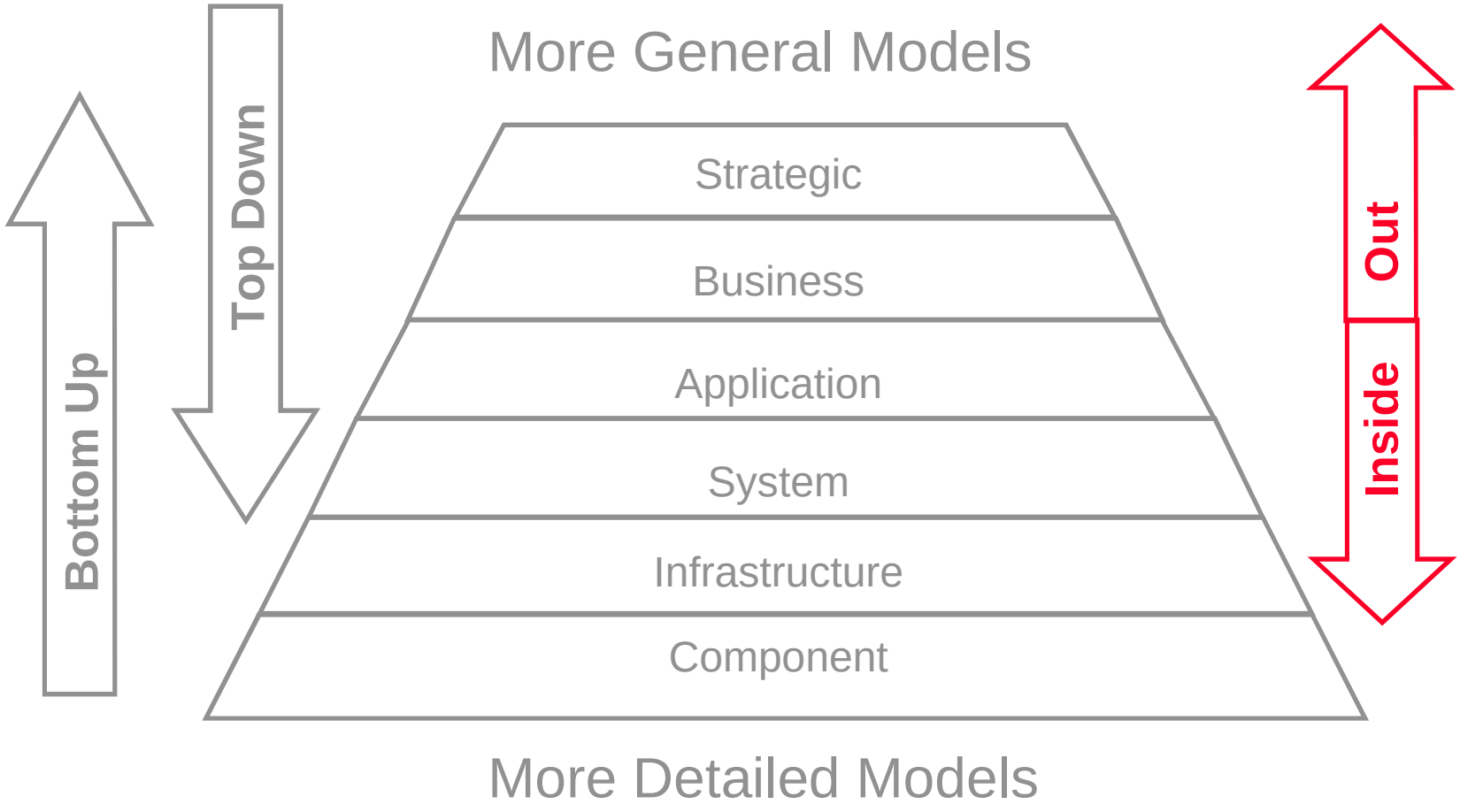

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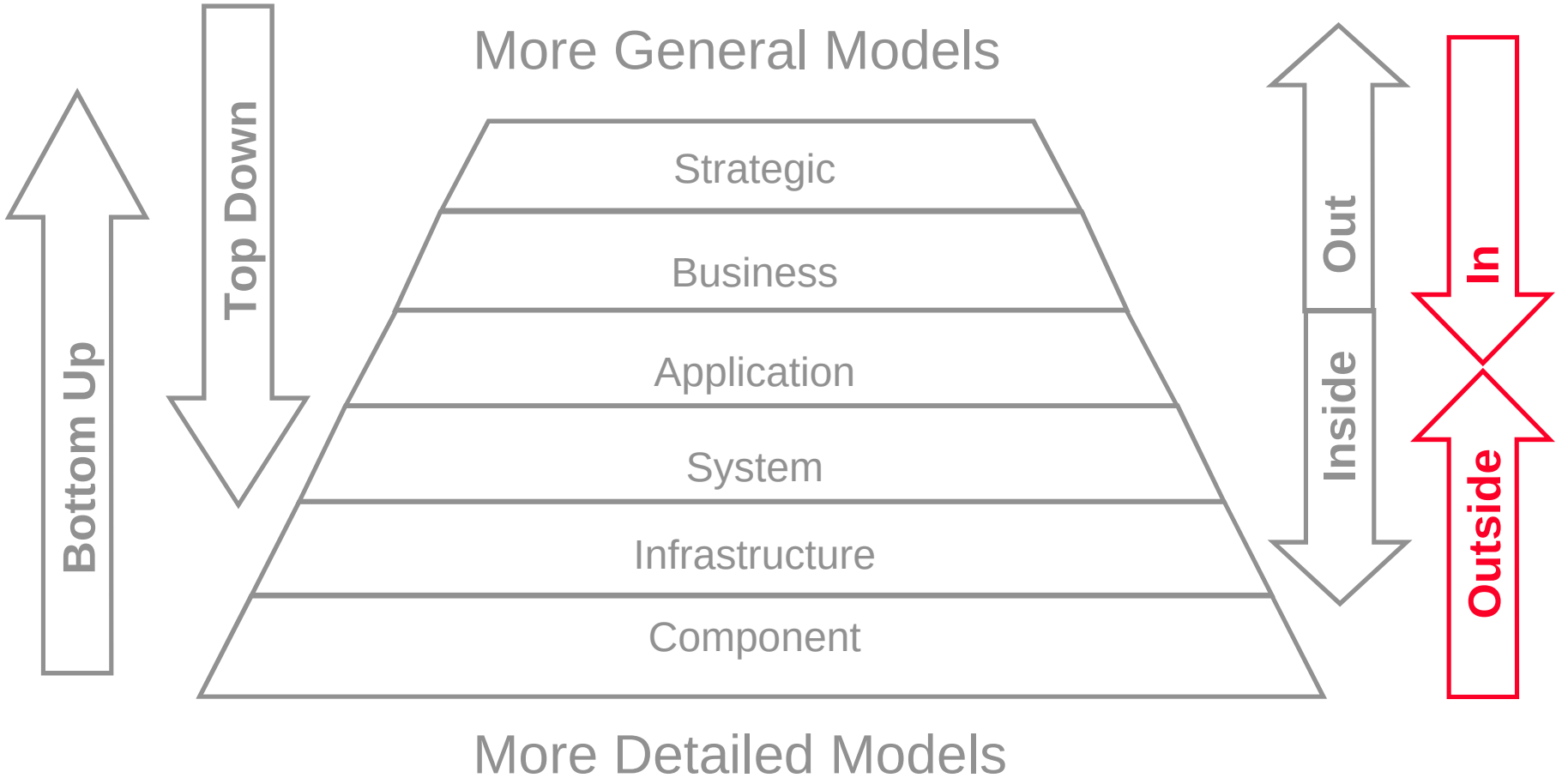
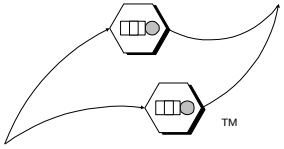
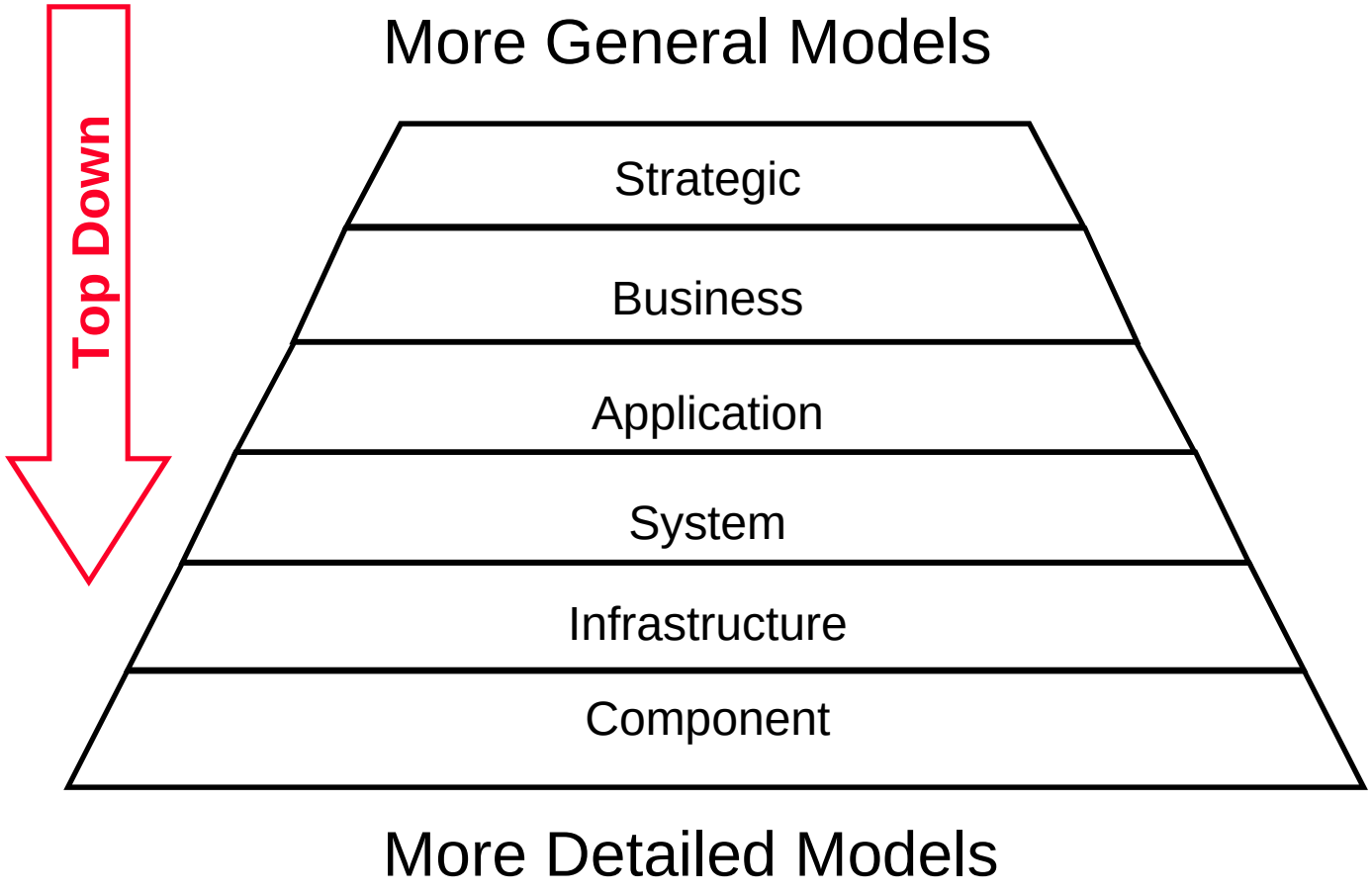




The Modeling Pyramid

- **Modeling Pyramid Implementation**
  - Top Down
    - Start at the most general (Strategic) level
    - Connect the metrics:
      - output of upper level
      - to input of lower level
    - Progress to the detailed (Component) level
      - Stop when the business question is answered
      - Avoid increased detail for its own sake

The Modeling Pyramid



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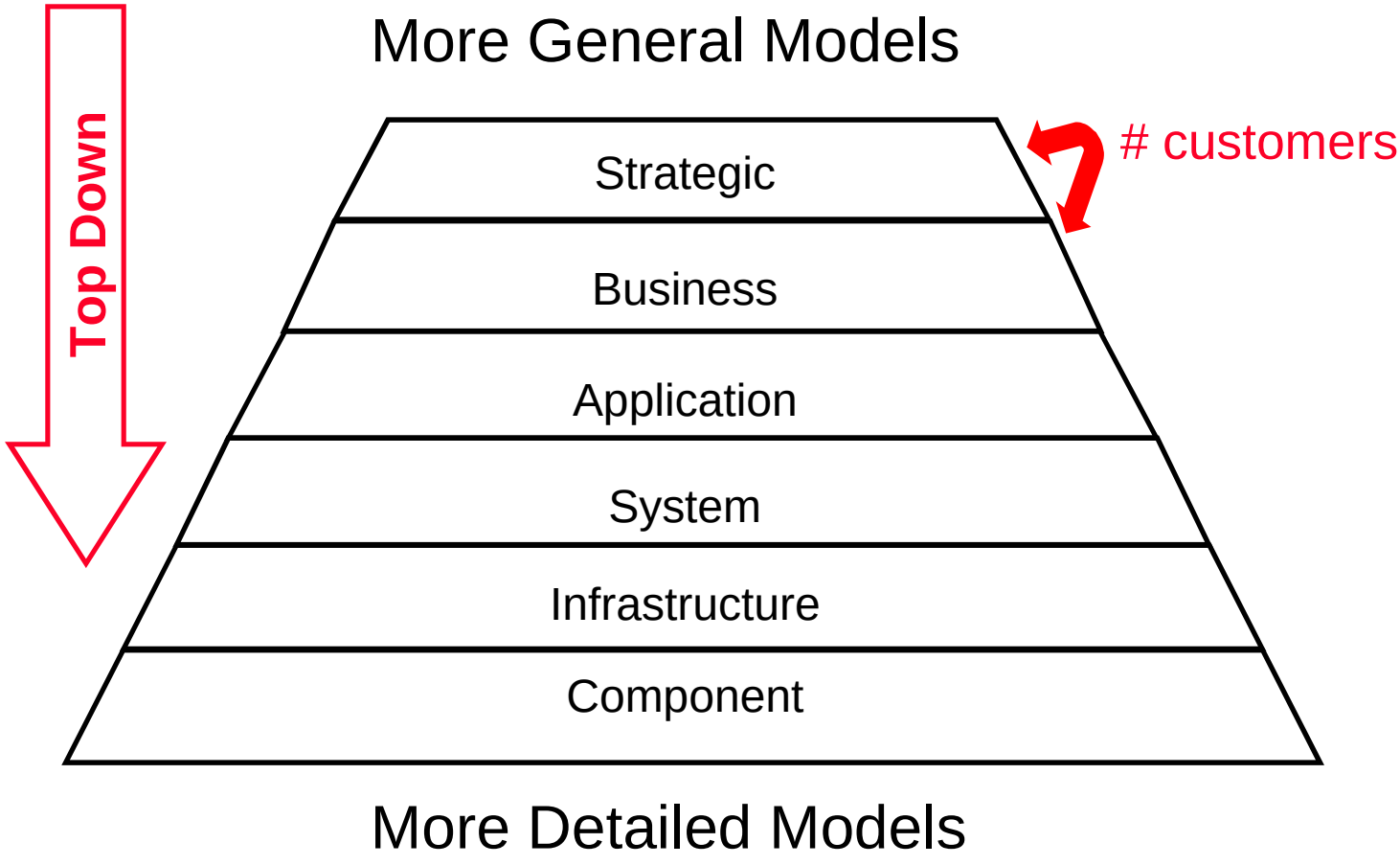

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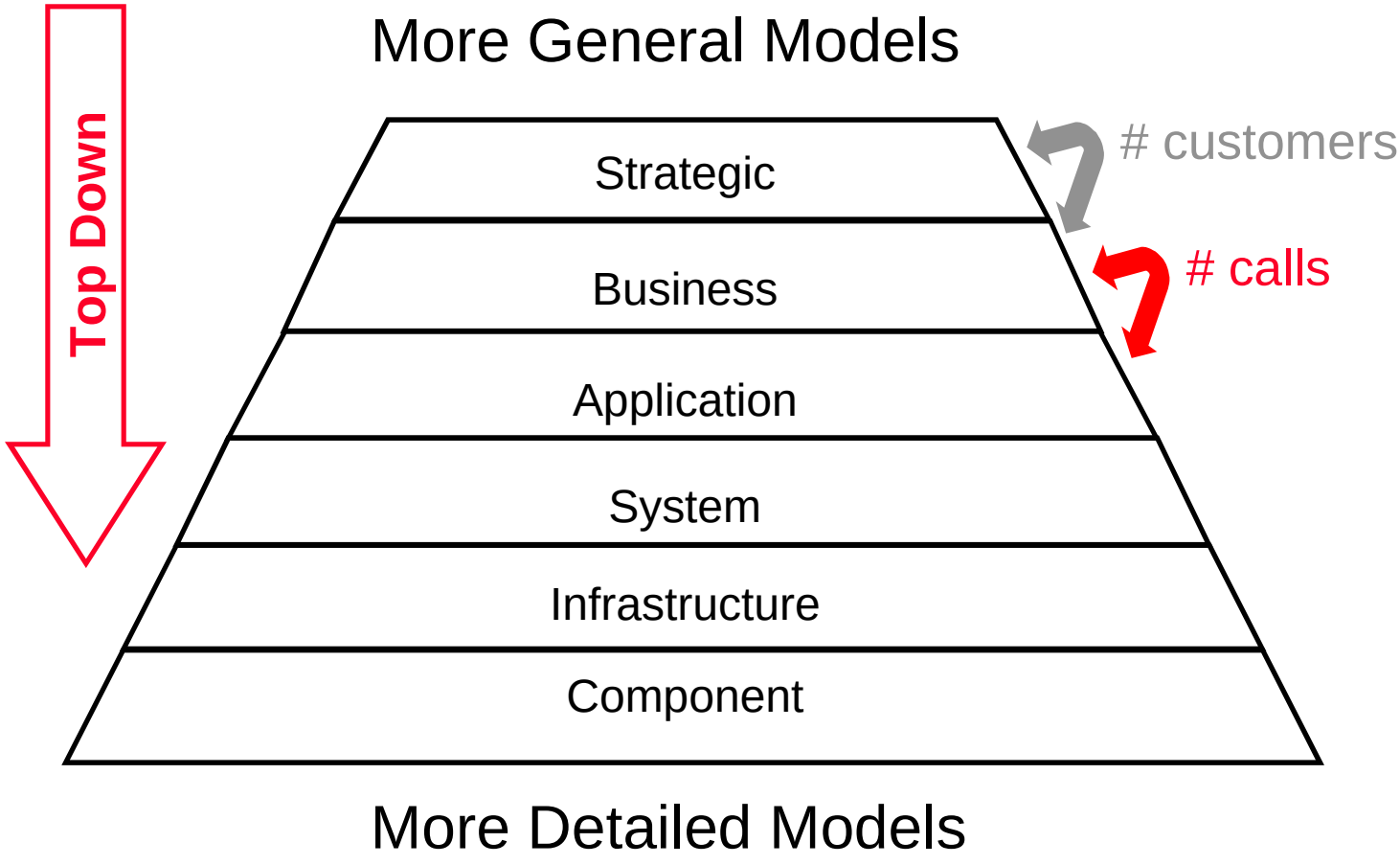

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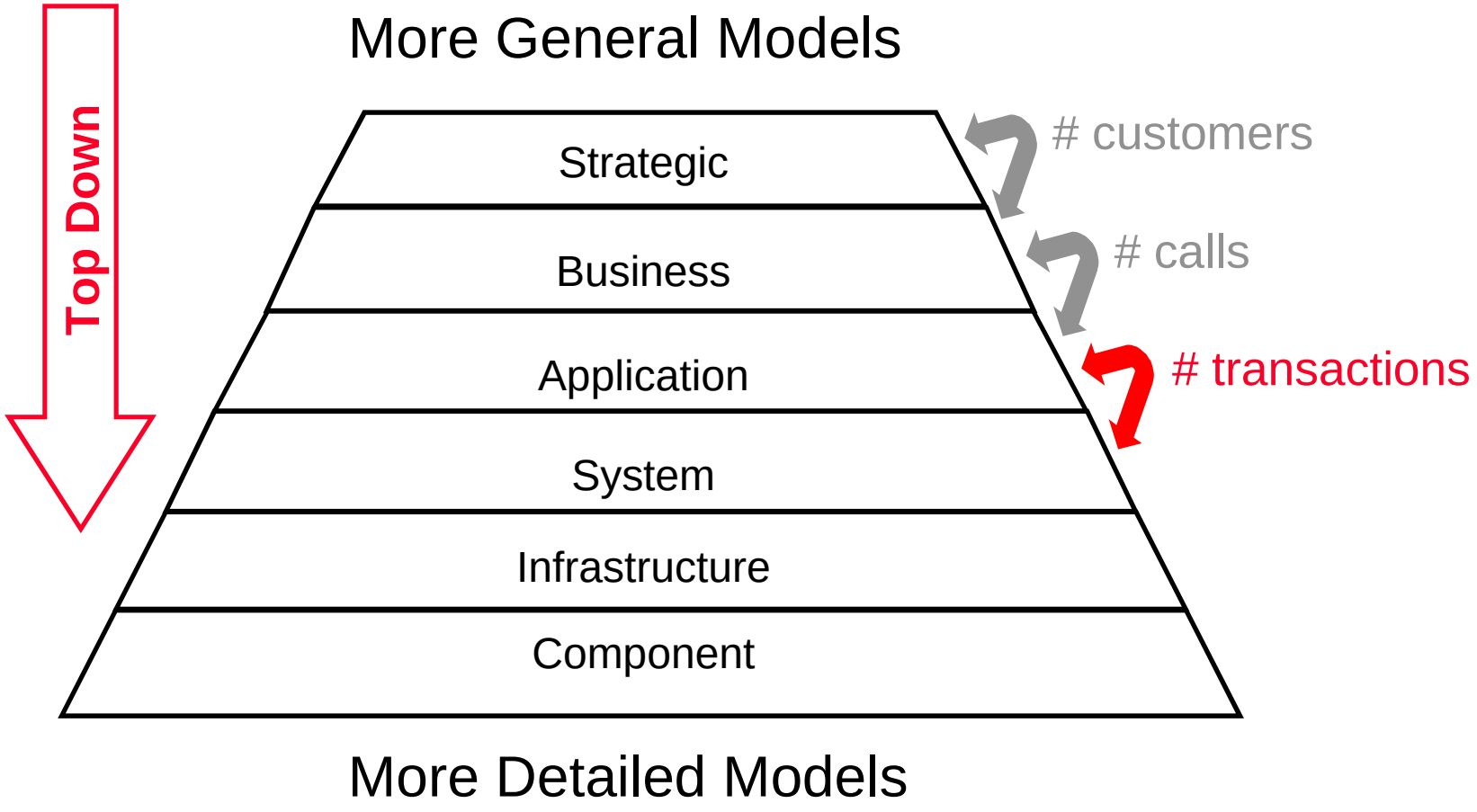

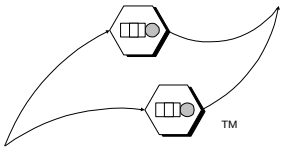

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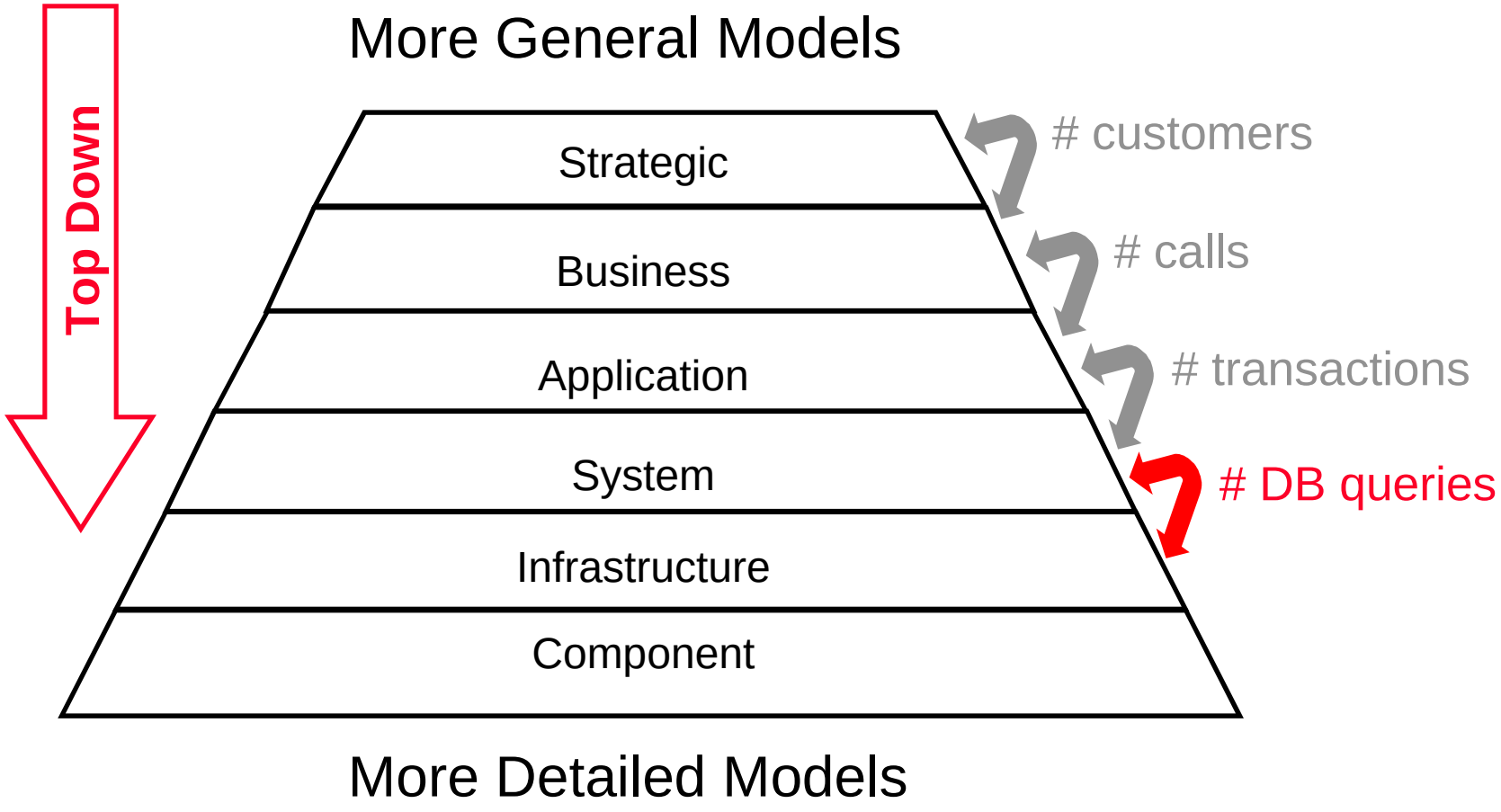

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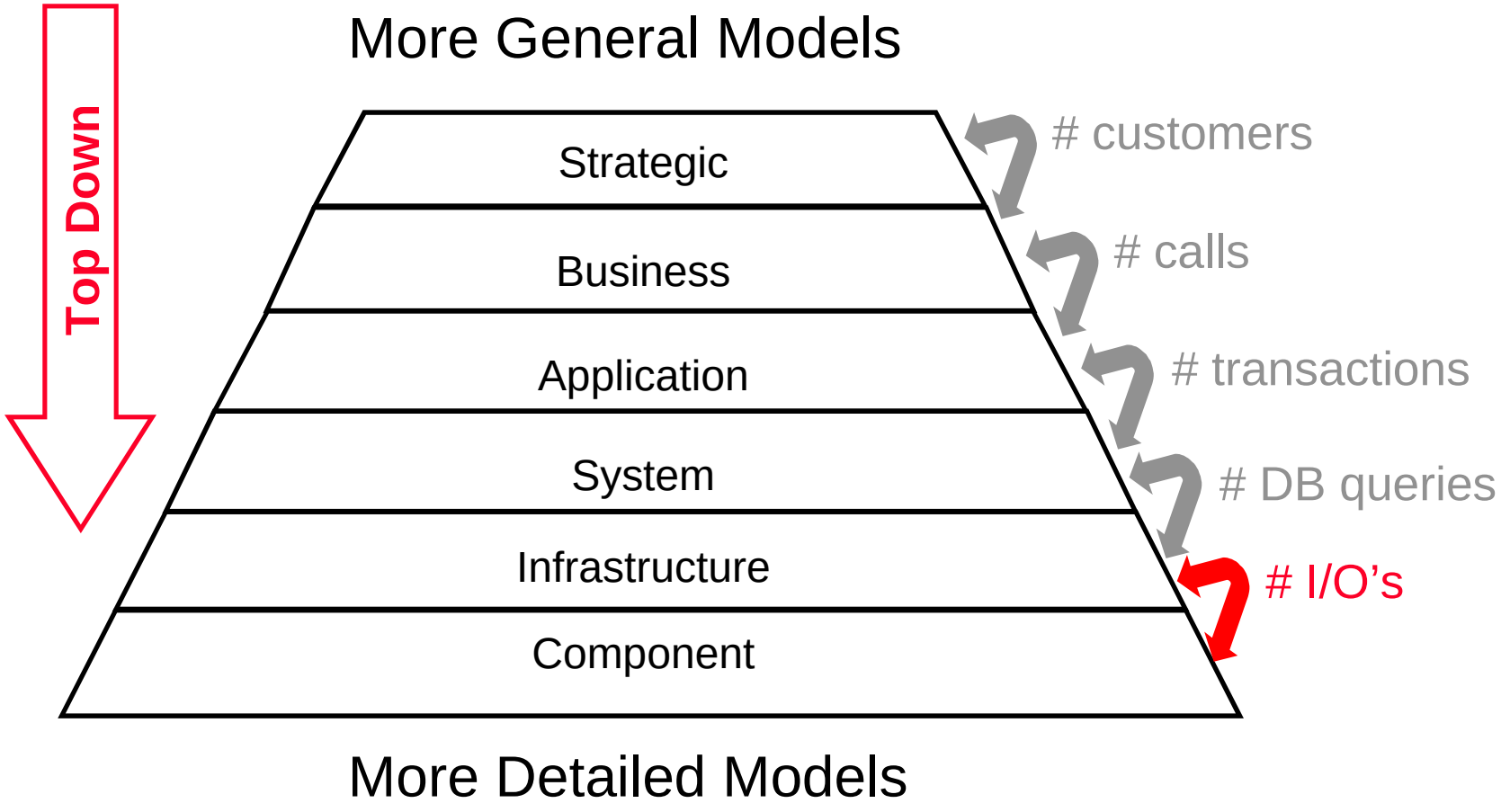

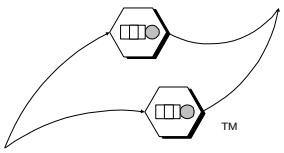

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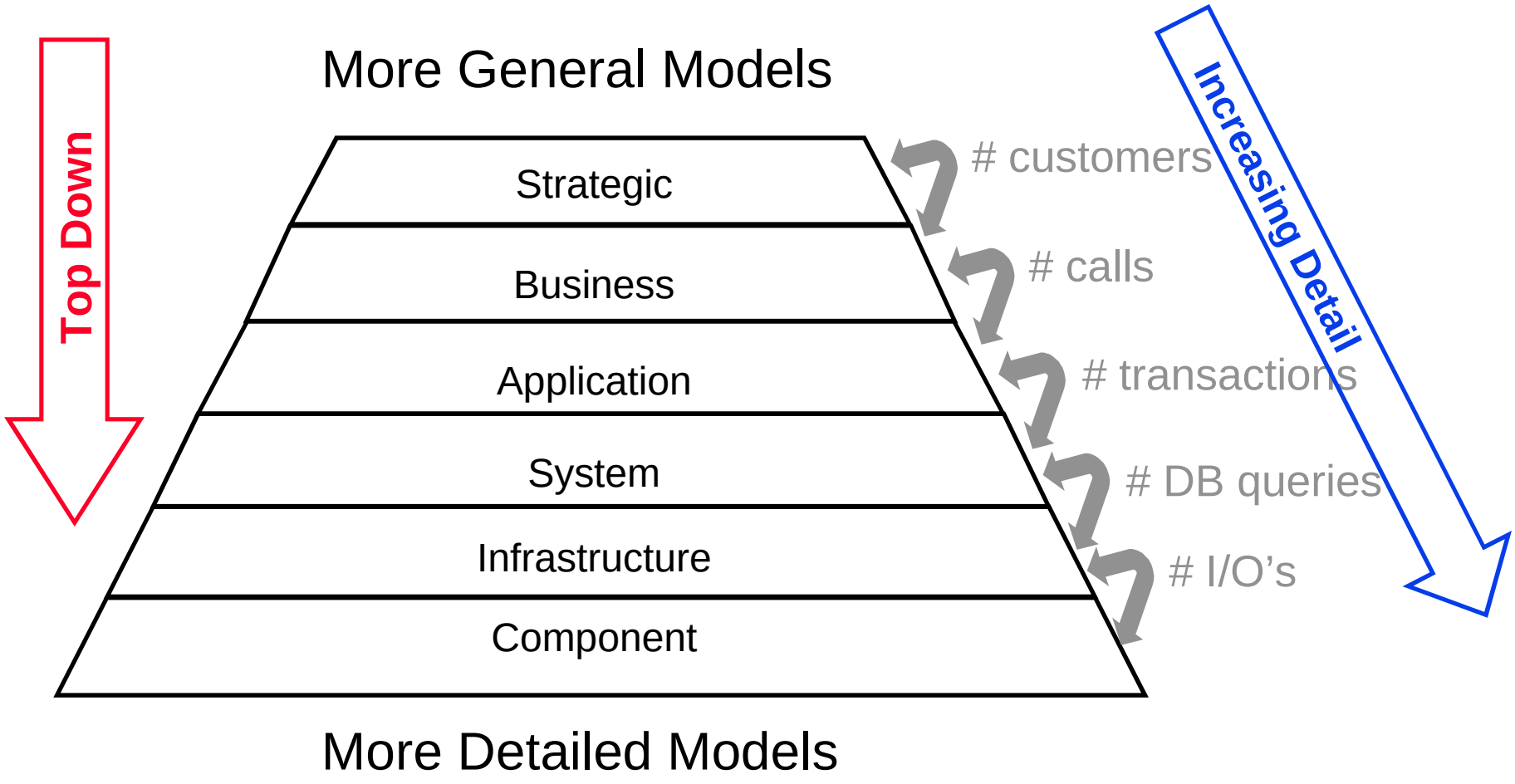
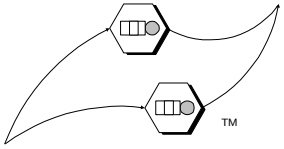
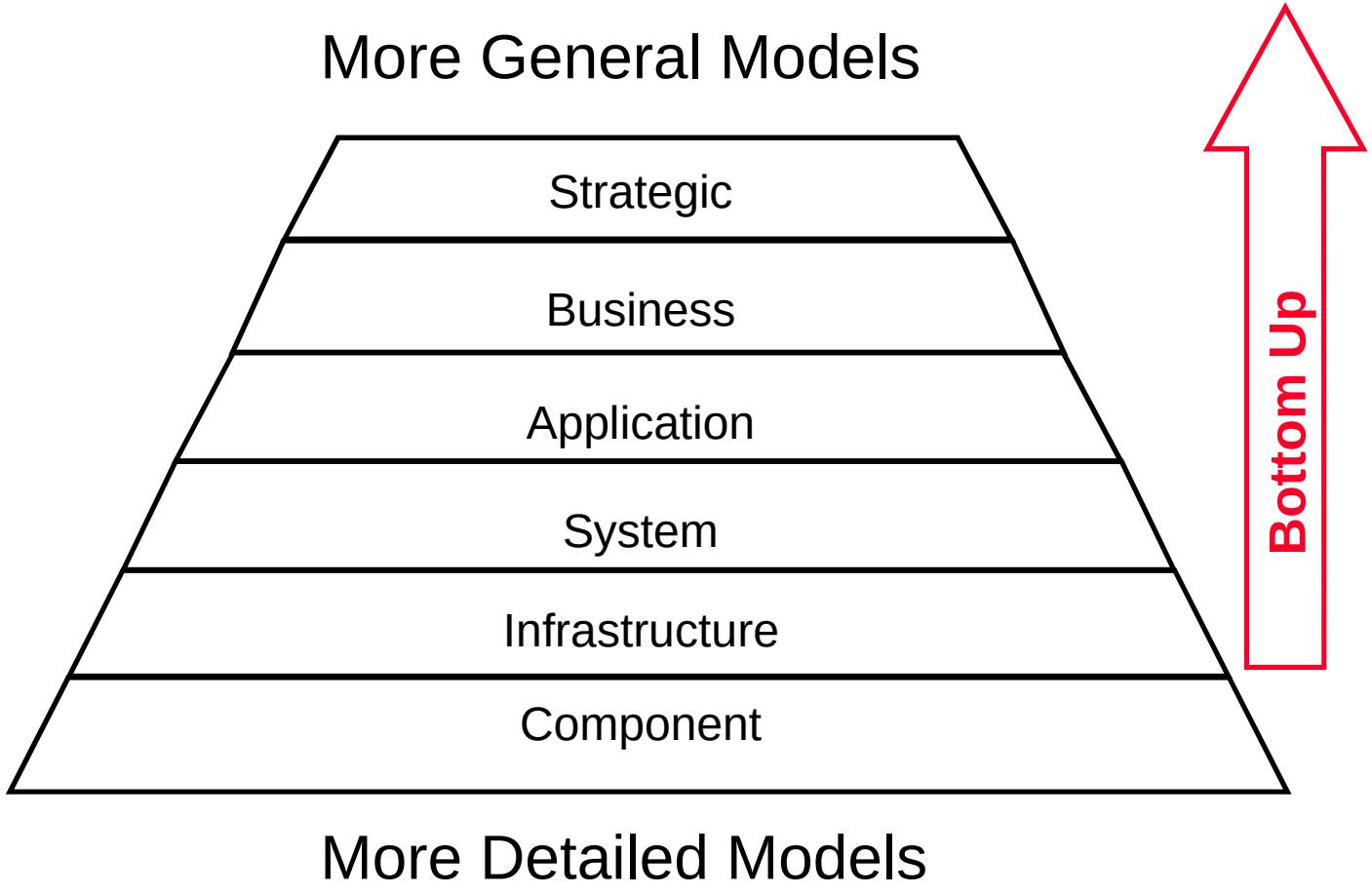




The Modeling Pyramid

- **Modeling Pyramid Implementation**
  - Bottom Up
    - Start at the most detailed (Component) level
    - Connect the metrics:
      - output of lower level
      - to input of upper level
    - Progress to the general (Strategic) level
      - Stop when the technical question is answered
      - Avoid speculation outside of the business objectives
        - A server upgrade would support 100x more customers when the business plan projects 3x growth.

The Modeling Pyramid



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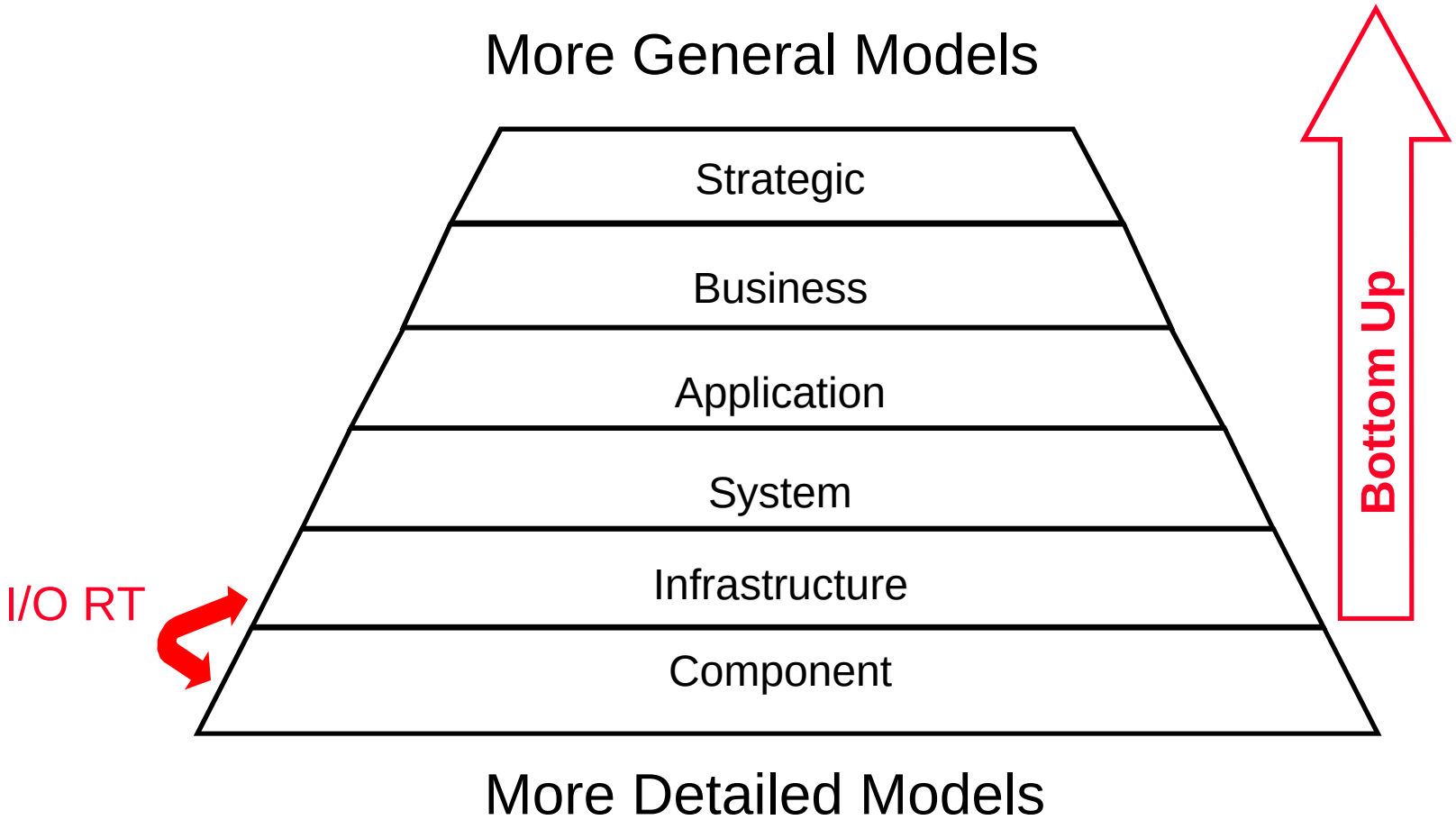

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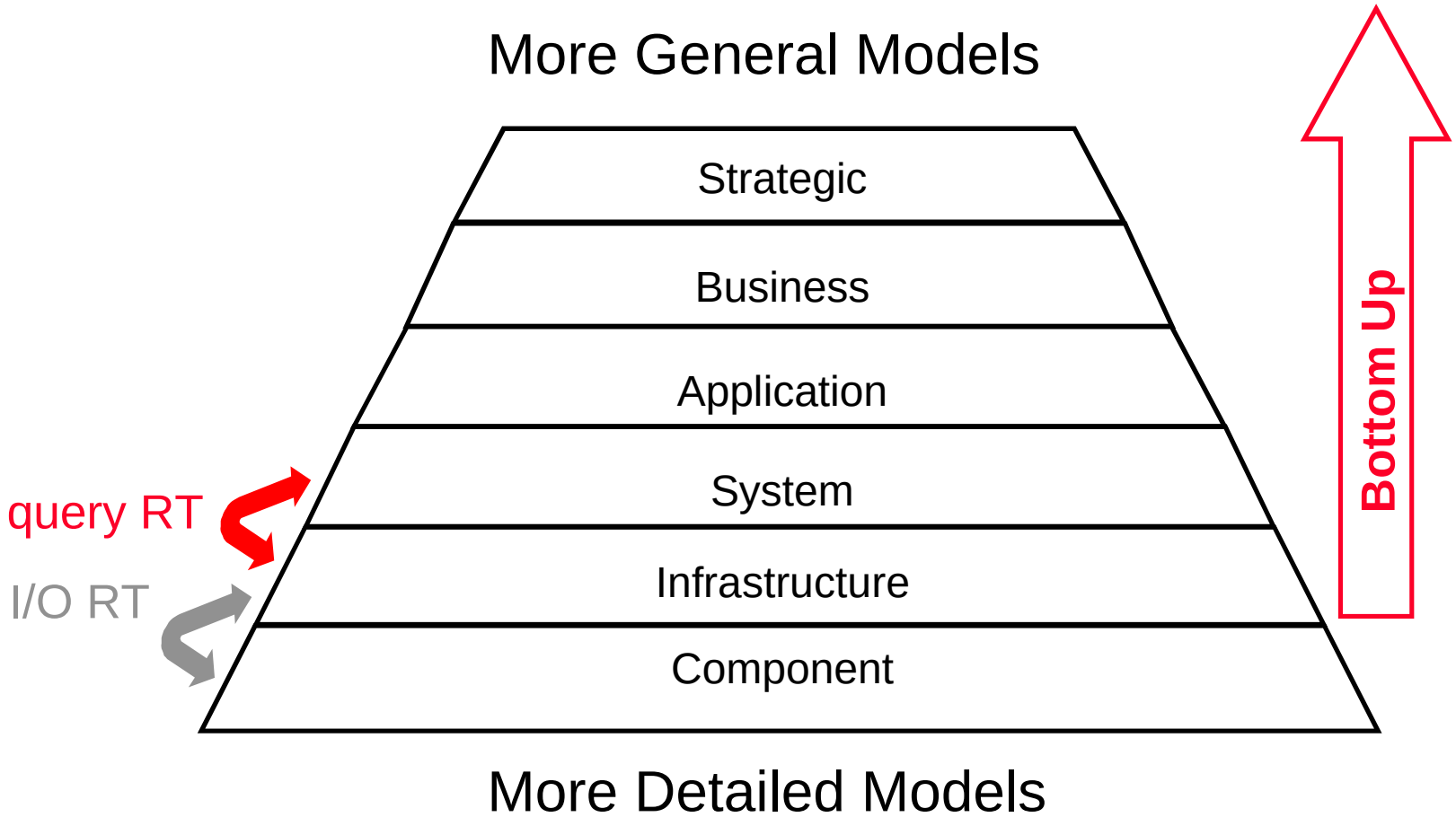

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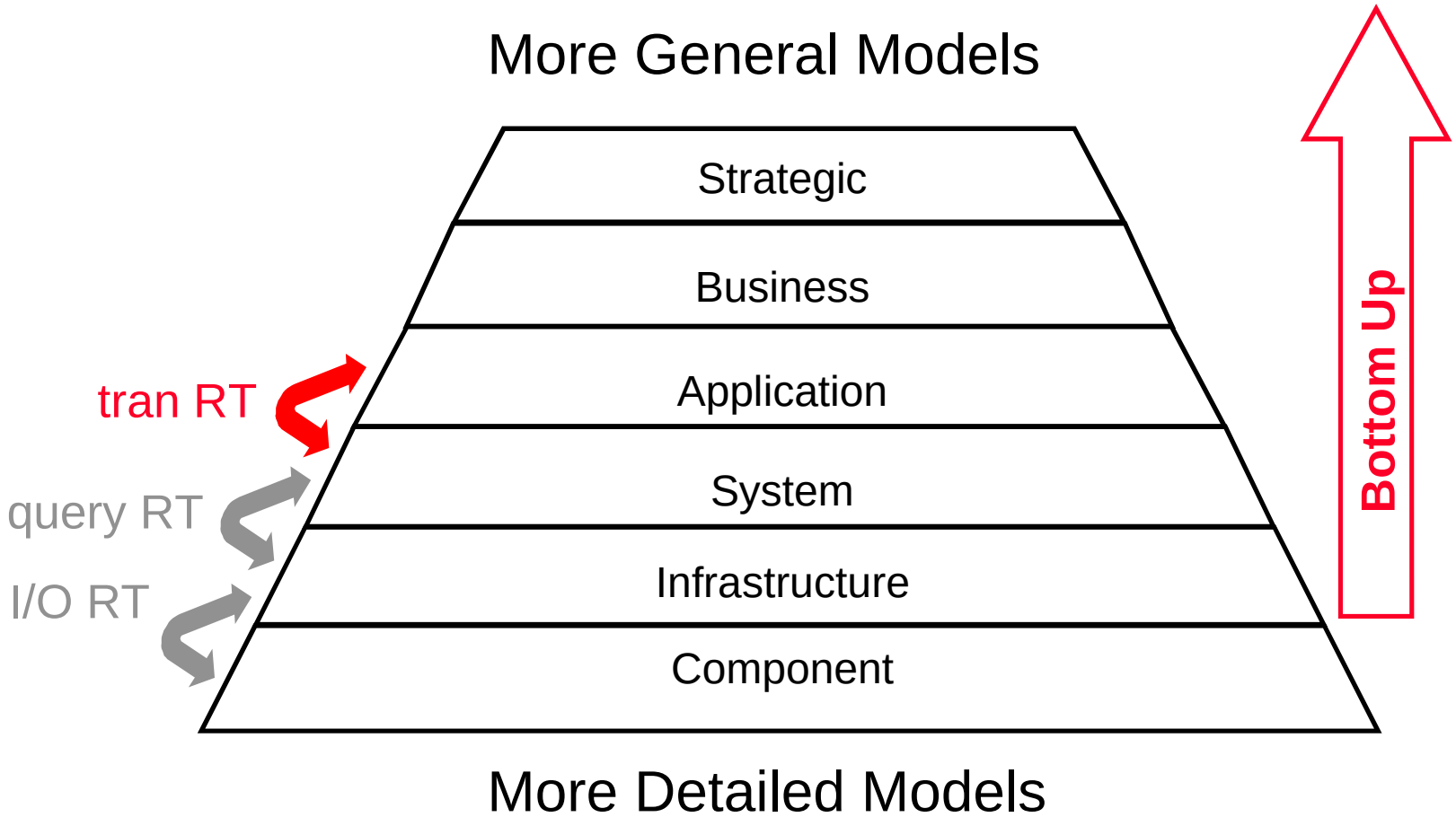

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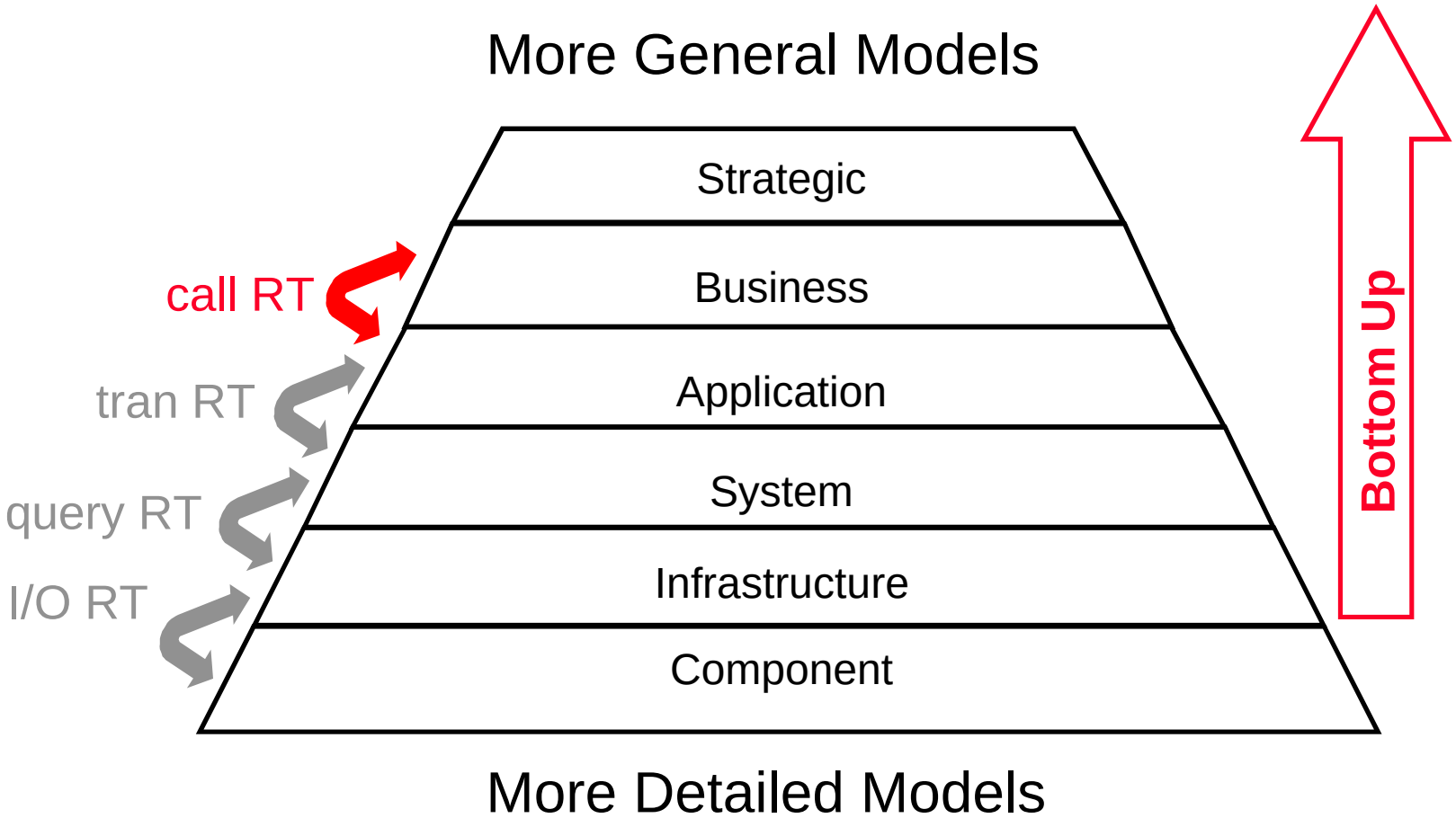

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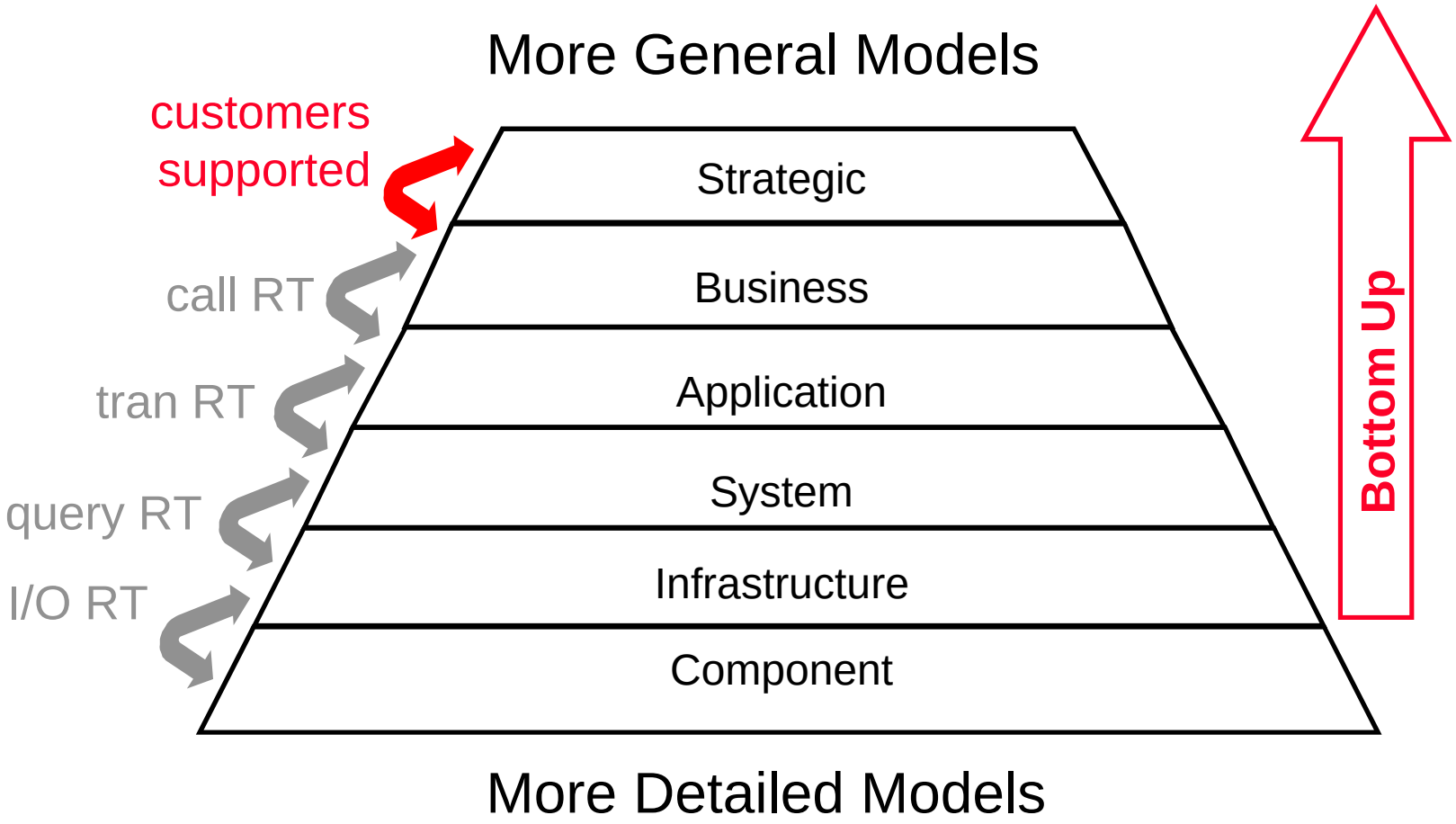

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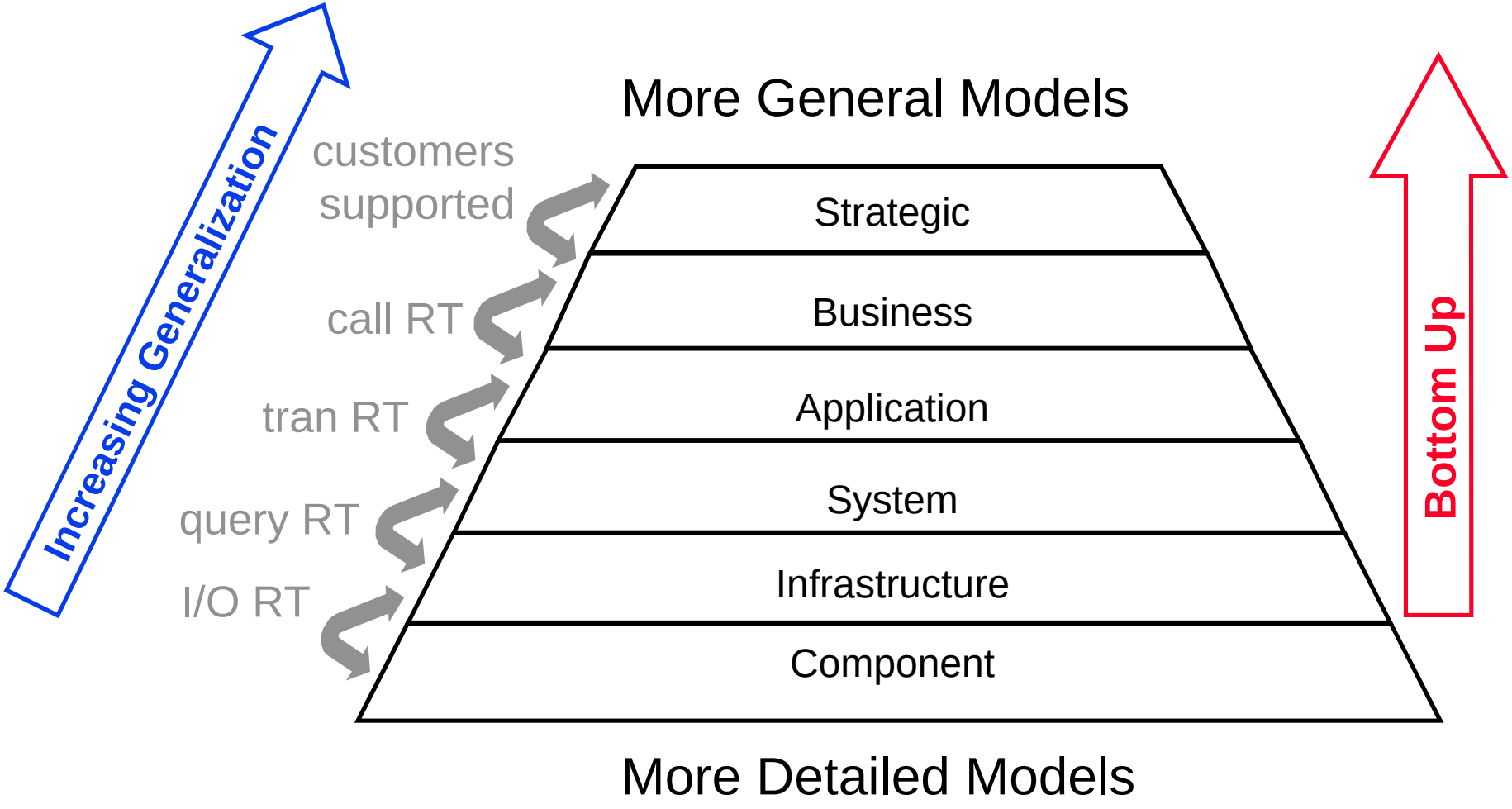
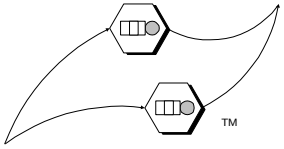
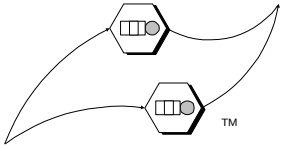




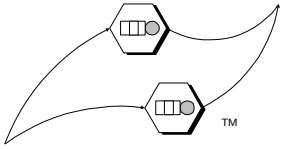
The Modeling Pyramid

- **Modeling Pyramid Implementation**
  - Inside Out
    - Start at a middle (Application) level
    - Quickly addresses Application issues
    - Lacks initial strategic direction or component detail
  - Outside In
    - Start at Top and Bottom levels simultaneously
    - Strategy defined while detailed work gets started
    - Unlikely that the two efforts will actually meet



The Modeling Pyramid

- **Modeling Pyramid Implementation**
  - The Spiral
    - Start with general assumptions for all levels
    - Challenge the assumptions:
      - Use the model at one level to challenge the models at the adjacent levels
      - Roll up to the Strategic Level to keep business focus
    - Refine at each level only when and as needed
    - Overall view (like a street map) where detail is added as needed (city center) and assumptions are used elsewhere (straight line between cities) unless that's a problem (mountain roads).



The Order Entry Model

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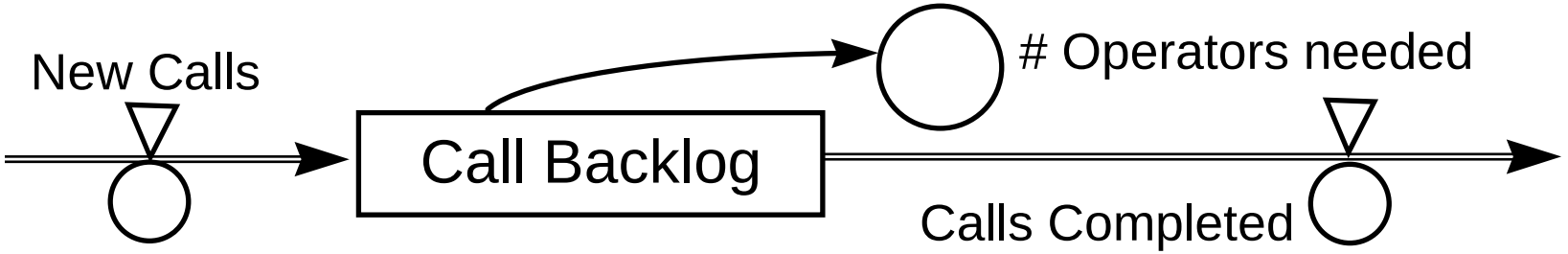

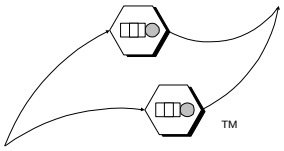

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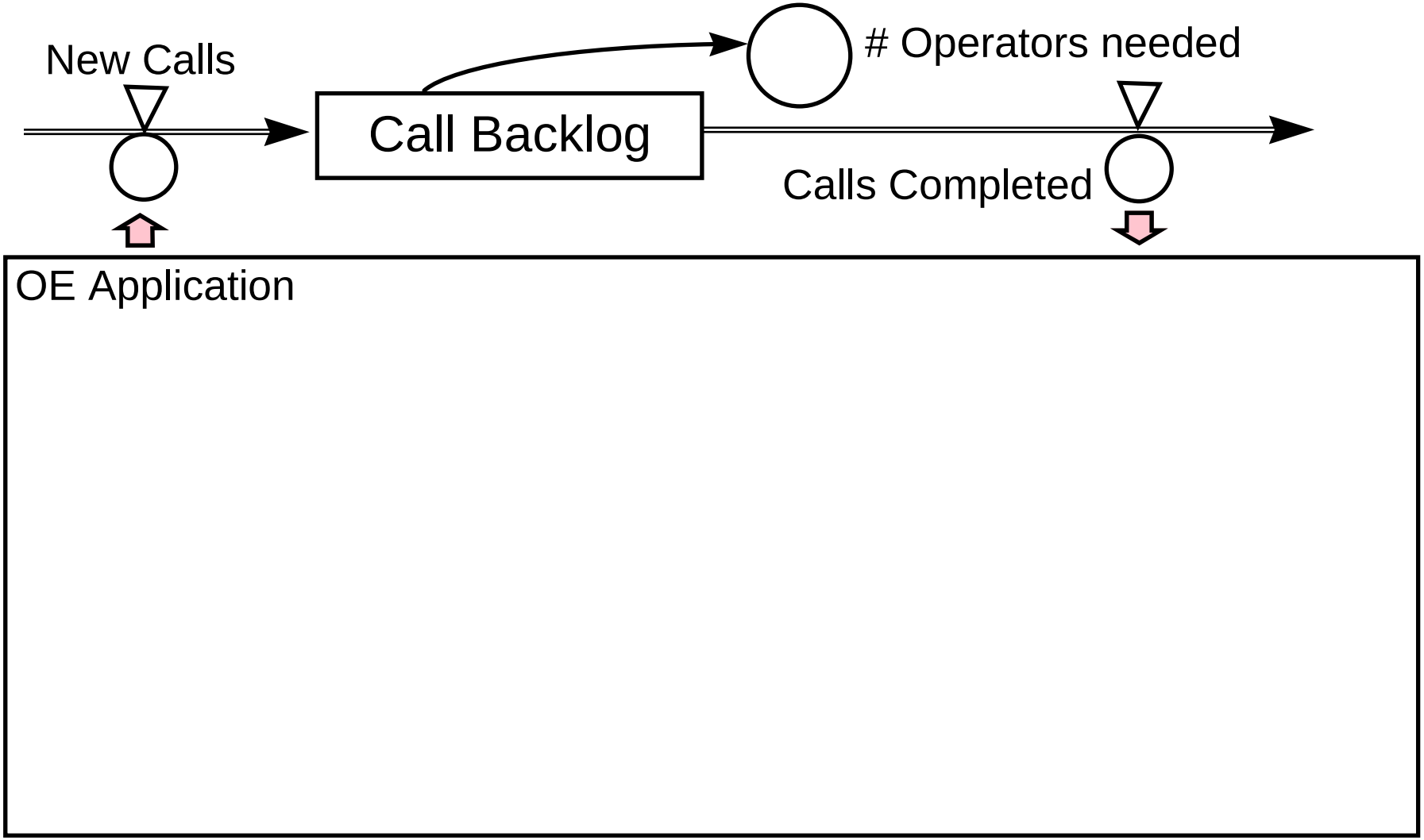

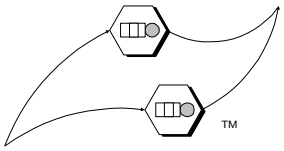

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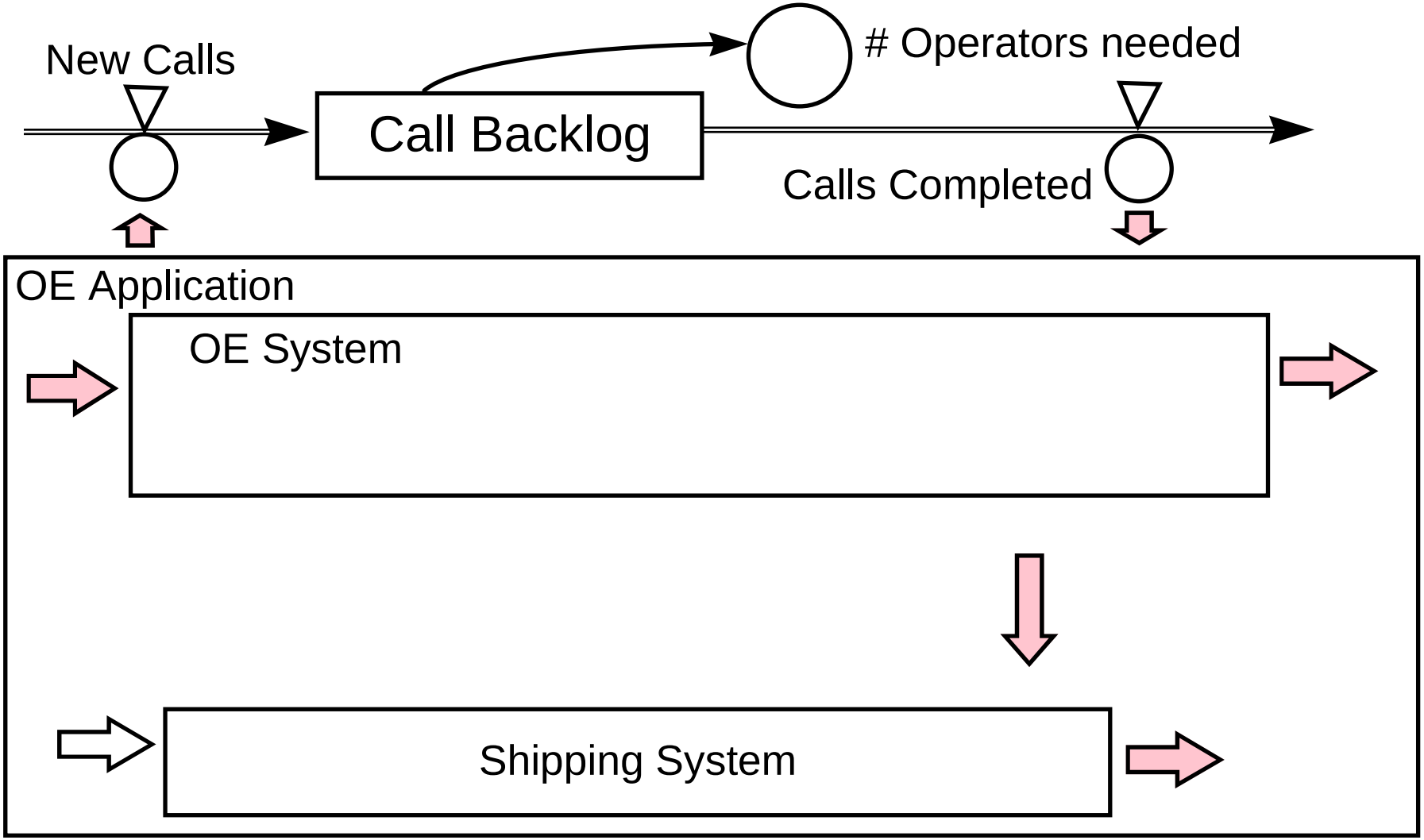

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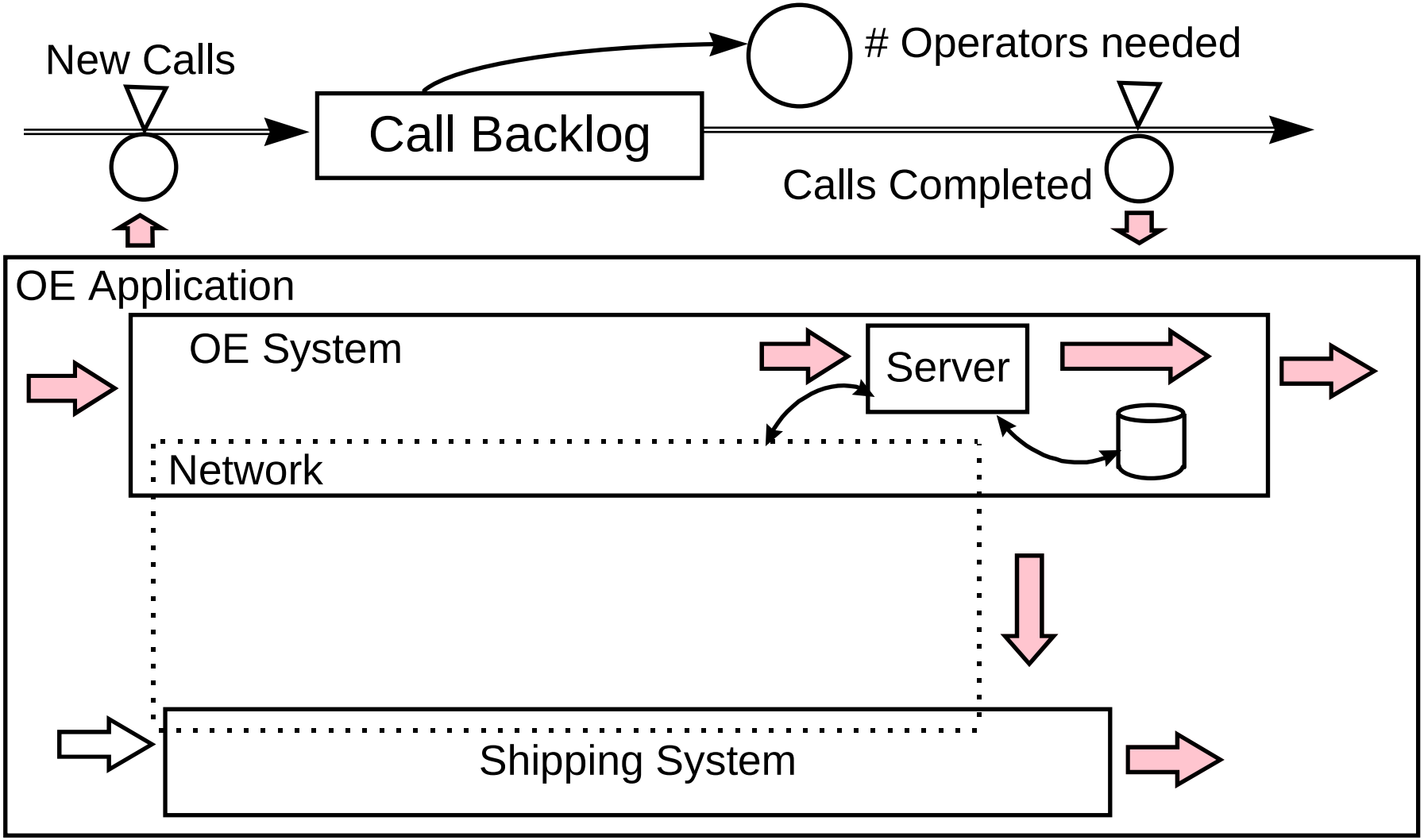

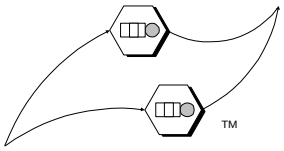

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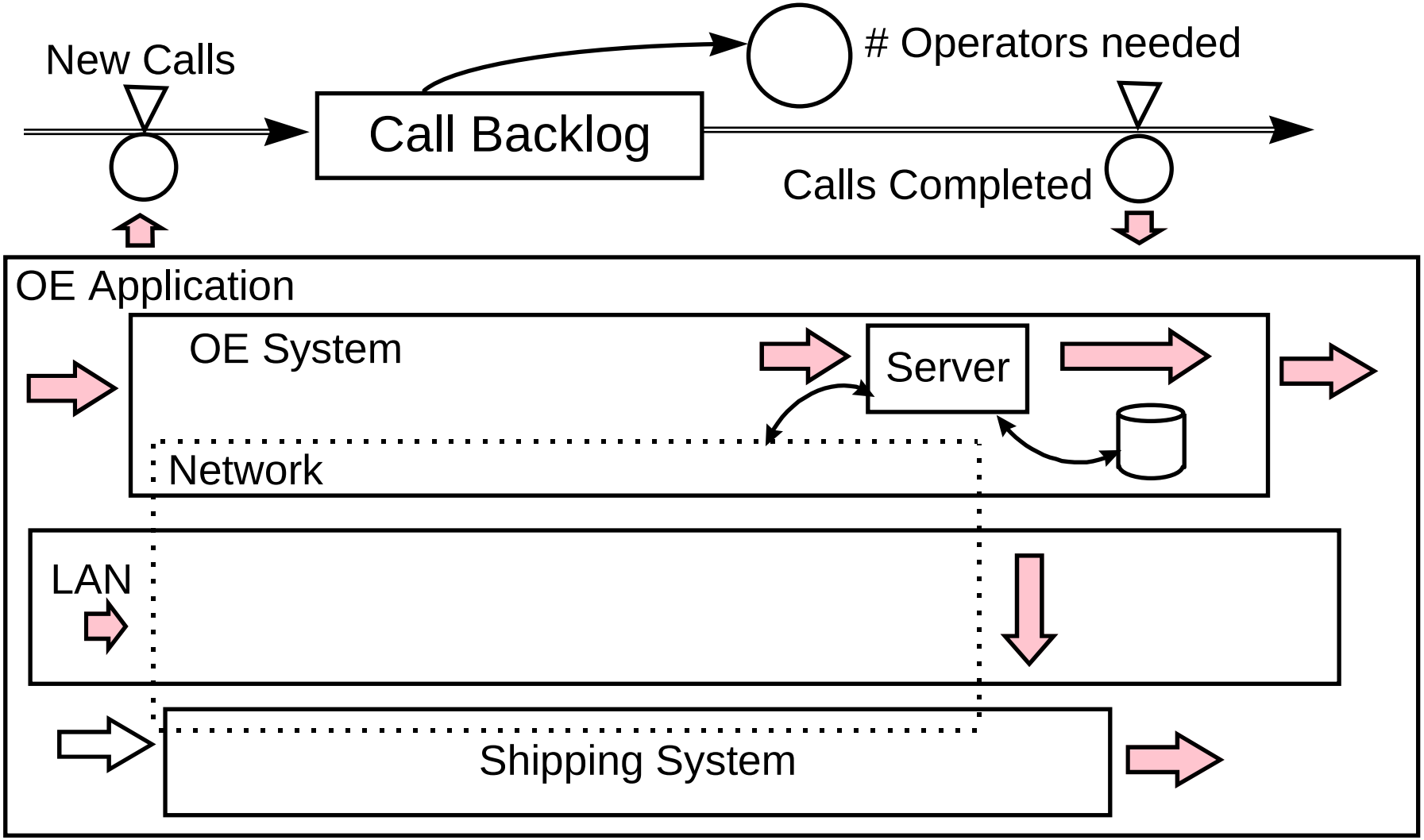

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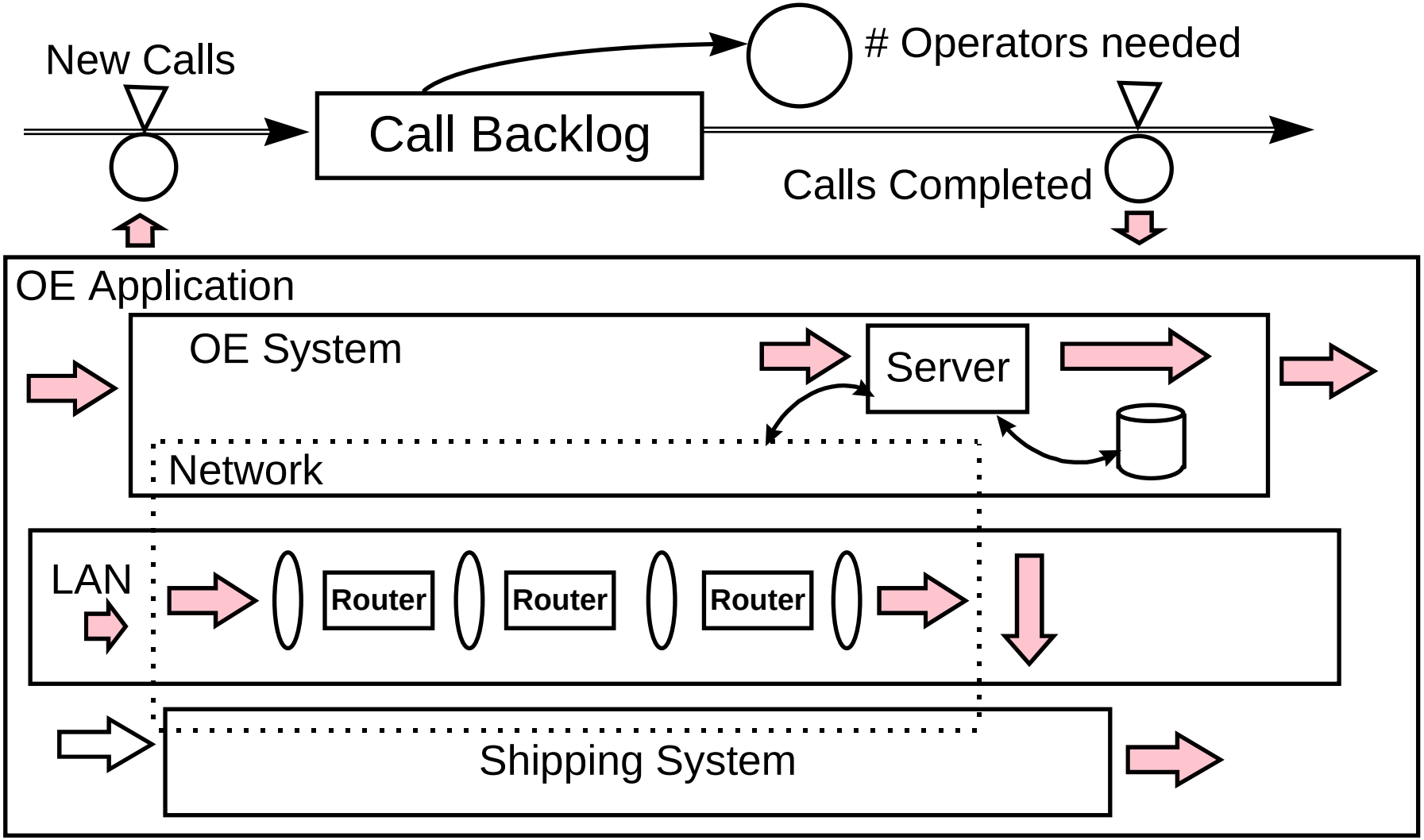
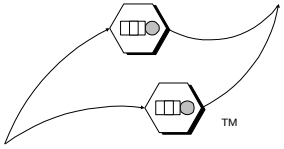
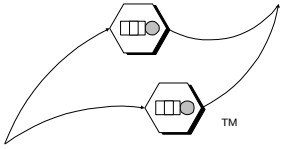




Conclusion

- **Modeling Pyramid is a Technique to:**
  - Apply a uniform strategic direction to all modeling activities
  - See application progression from birth to death
  - Get objective information for business decisions
  - Focus technical efforts on business issues
  - Investigate the relationships between levels
  - Use appropriate tools at each level
  - Enhance each model level only as needed



Questions

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