Spare part demand forecasting using causal information

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Research need

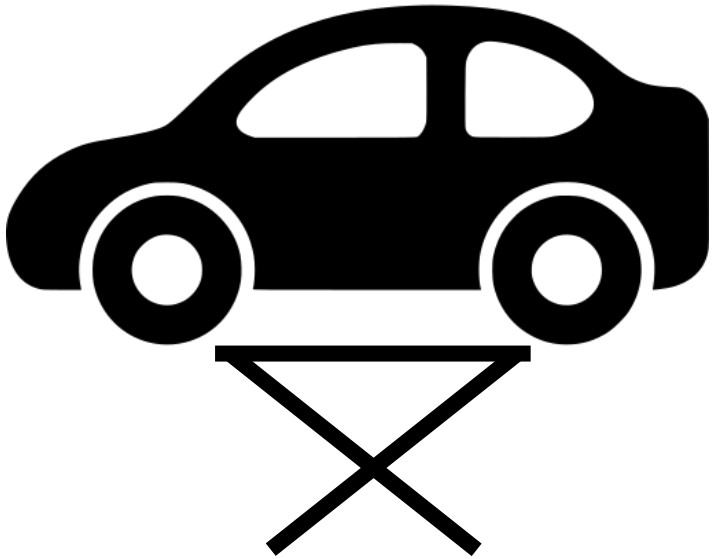
Efficient spare part inventory management requires **high service levels**, whilst limiting the **costs associated**.

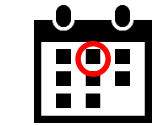
Irregular demand complicates demand forecasting and efficient inventory management.

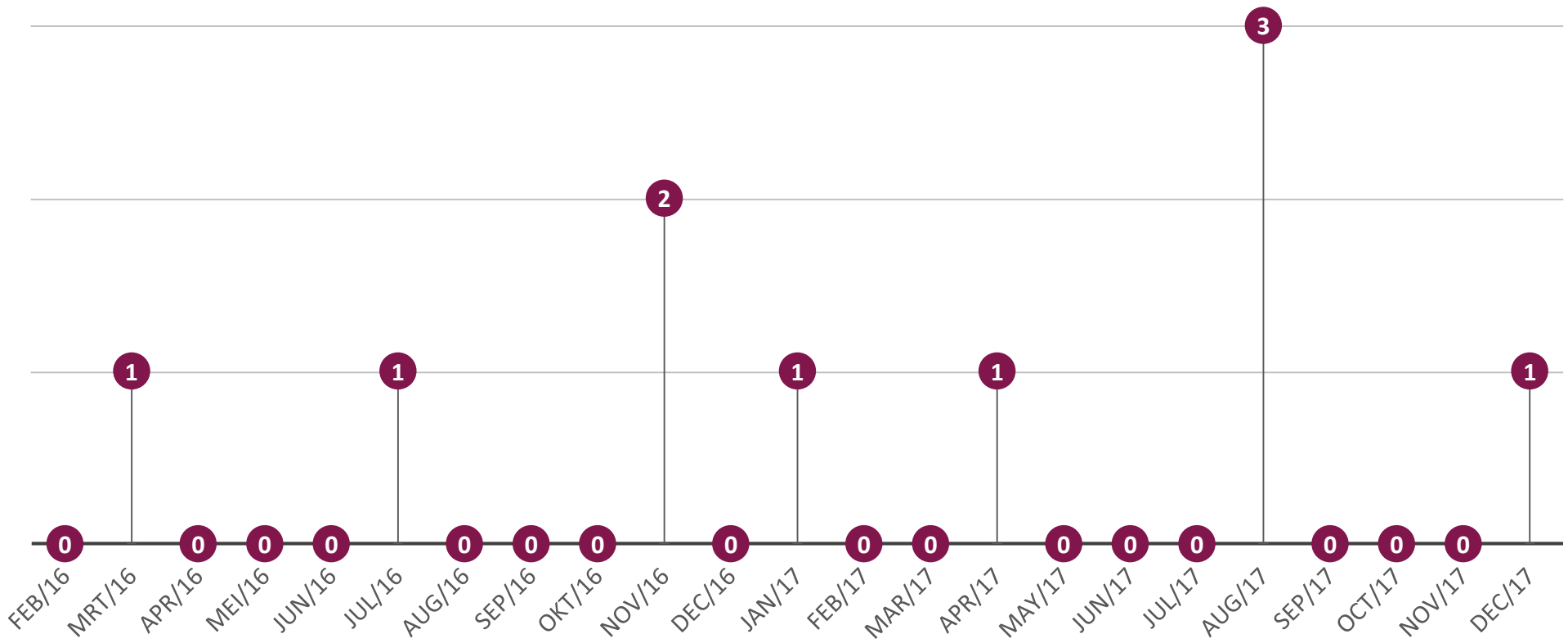
Main findings

Including **causal information** in the inventory decision making improves the **inventory cost performance**.

We can **prioritize** data collection efforts.



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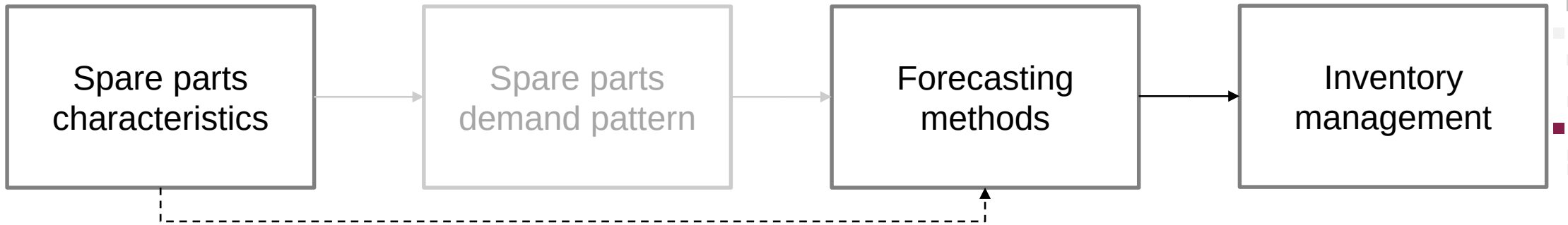
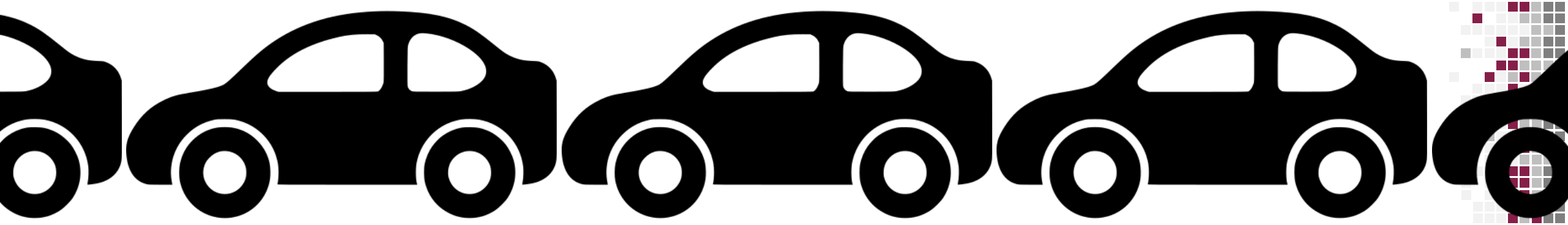
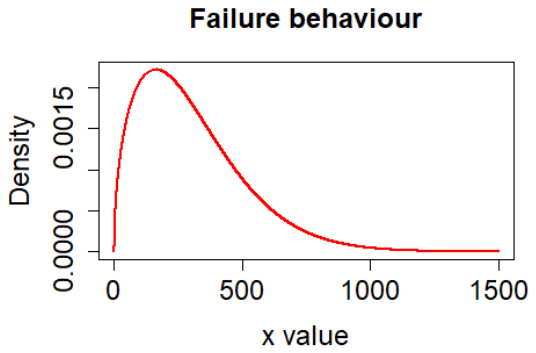
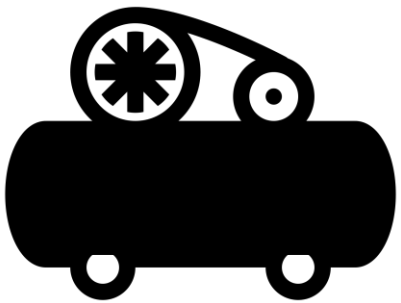
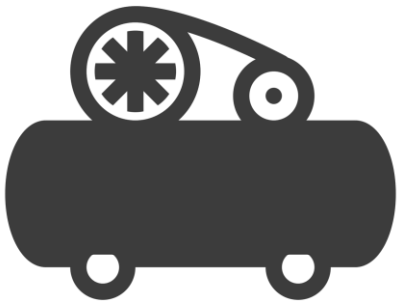
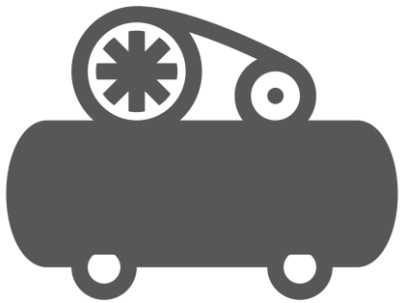
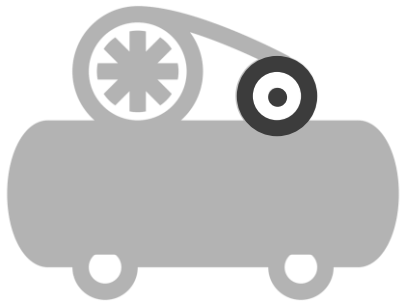

Spare parts characteristics
Spare parts demand pattern
Forecasting methods
Inventory management



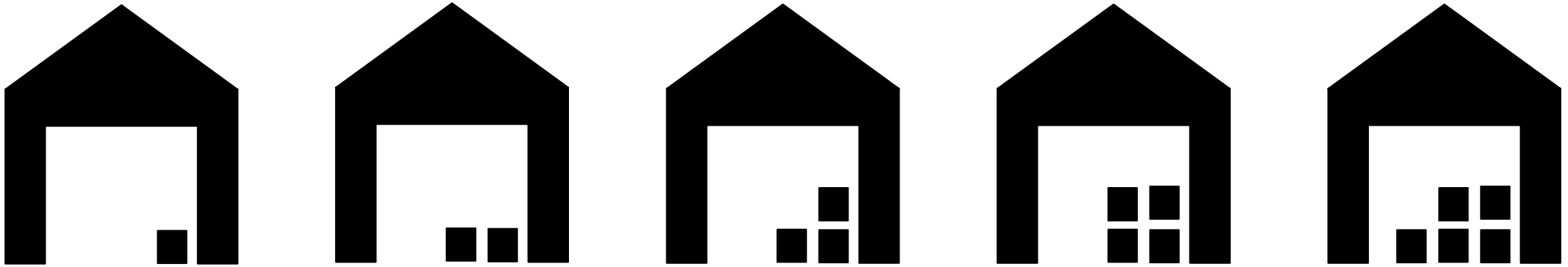
Installed base



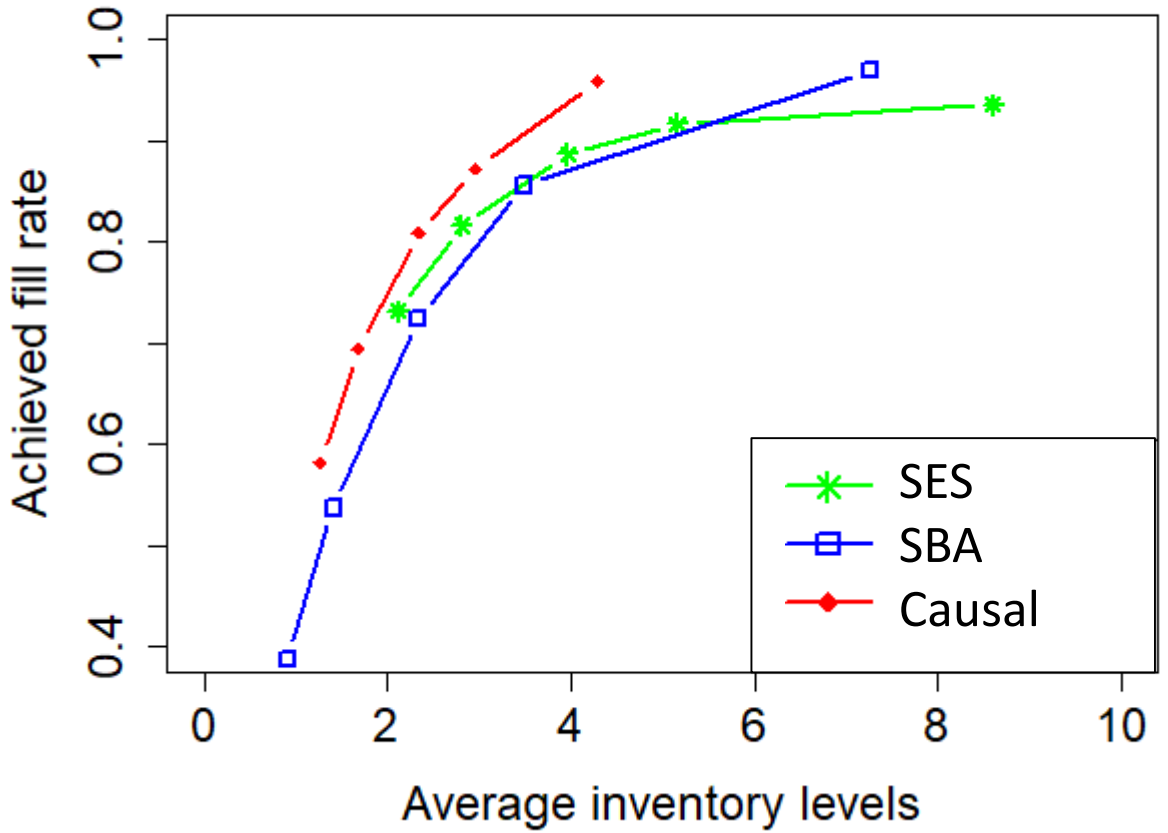





$\hat{P}_1 = 0.1$ $\hat{P}_2 = 0.3$ $\hat{P}_3 = 0.5$ $\hat{P}_4 = 0.2$ $\hat{P}_5 = 0.8$

$\hat{P}(Demand = 0) = 5\ \%$
$\hat{P}(Demand = 1) = 29.2\ \%$
$\hat{P}(Demand = 2) = 41\ \%$
$\hat{P}(Demand = 3) = 20.6\%$
$\hat{P}(Demand = 4) = 4\ \%$
$\hat{P}(Demand = 5) = 0.2\ \%$


34.2 %
75.2 %
95.8 %
99.8 %
100 %

Performance evaluation in a simulation experiment



Size of the installed base

Lifetime of machines

Machine age

Part age

Part reliability

Maintenance policy

Key takeaways

1. Including **causal information** in spare part demand forecasts improves the inventory cost performance compared with approaches based solely on historical data.

2. The greatest implementation **challenge** is the collection of the required data.

3. **Data collection** efforts should focus on characterizing:
   - The installed base size
   - The maintenance policy
   - The part ages and reliability

It can be better to consider a simple causal model, than to incorporate **incomplete/incorrect information** in a complex one.

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