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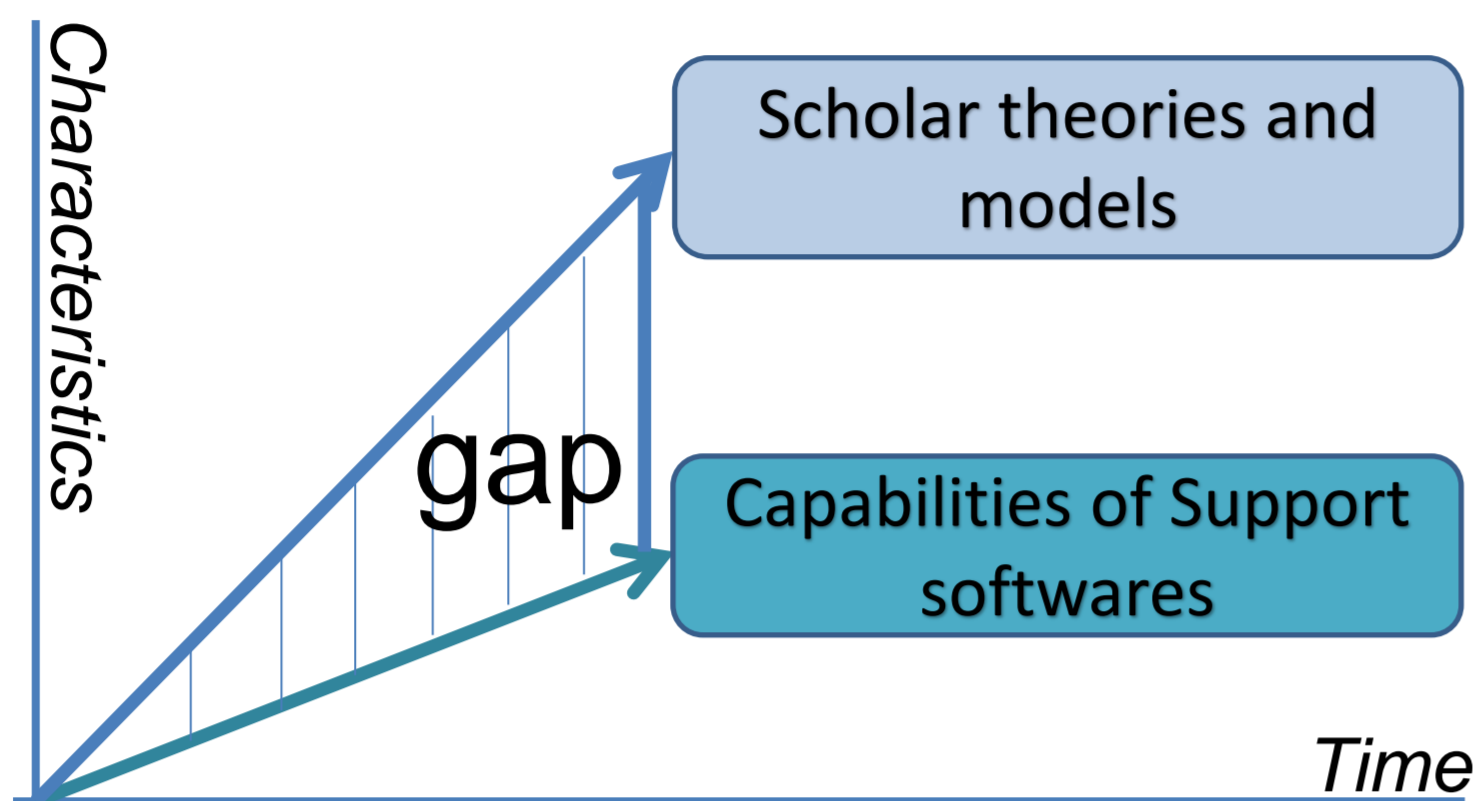
# Identifying and constructing leading indicators for monitoring and controlling performance of engineering projects

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## PMSs (Performance measurement systems)



### PMSs classical models:

- Performance Measurement Matrix (1989);
- Performance Pyramid System (1991);
- Balanced Scorecard (1992, 1996);
- Integrated Performance Measurement System (1997);
- The Performance Prism (2002).

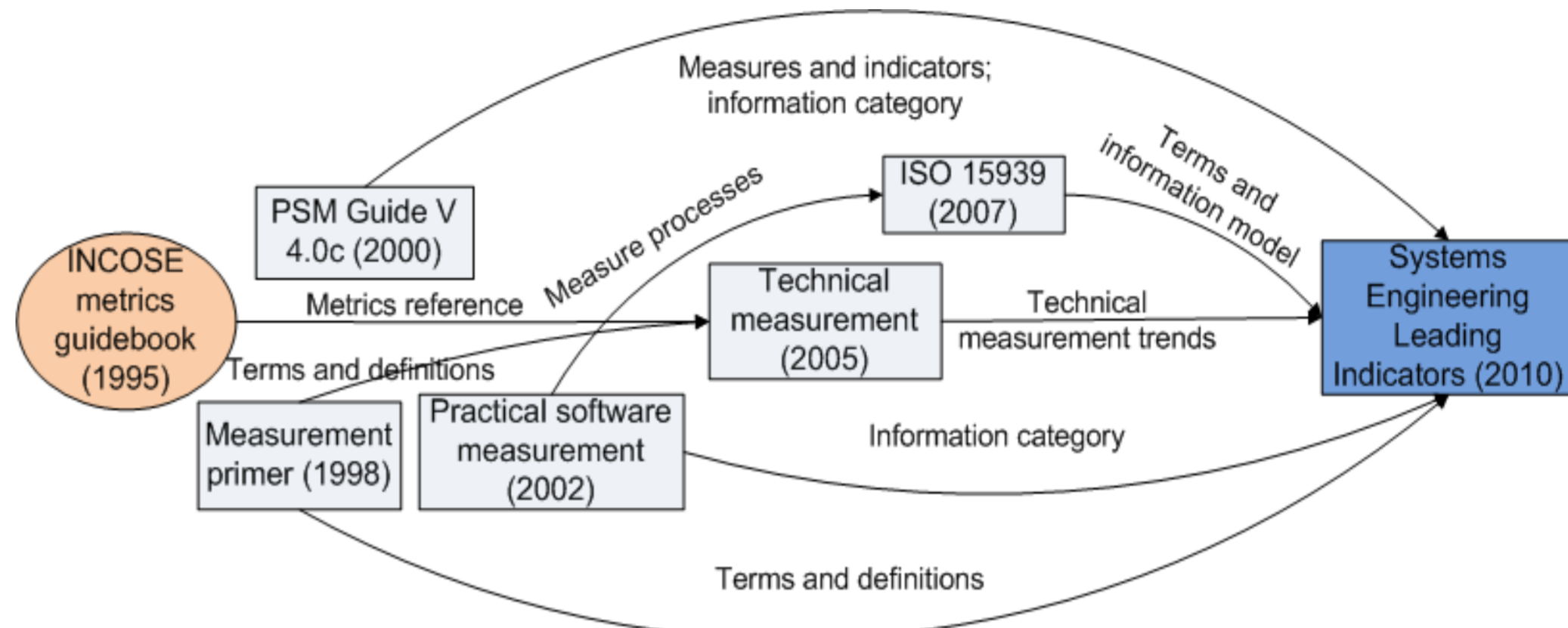
### Gap analysis:

- 1) Balanced scorecard has been used across the world, whereas many other frameworks have tended only to have regional appeal;
- 2) The practices in industries are not following the rapid academic rhythm.

Characteristics	Fitting rates
Multi-perspectives; Connected to Multiple data sources; VPMM; KPIs-based.	High fitting rates ( $\geq 60\%$ )
Balanced; integrated; strategy-relevant; stakeholders focus; Dynamic; PPMS; SCPMM; QM-PMSs; PMSs for SMEs.	Low fitting rates ( $<60\%$ )

## Model input

## SEM (Systems engineering measurement)



### Characteristics:

- Providing **visibility** into expected project performance and potential **future states**;
- Providing **predicative analysis** based on **trend information** or **significant correlation**.

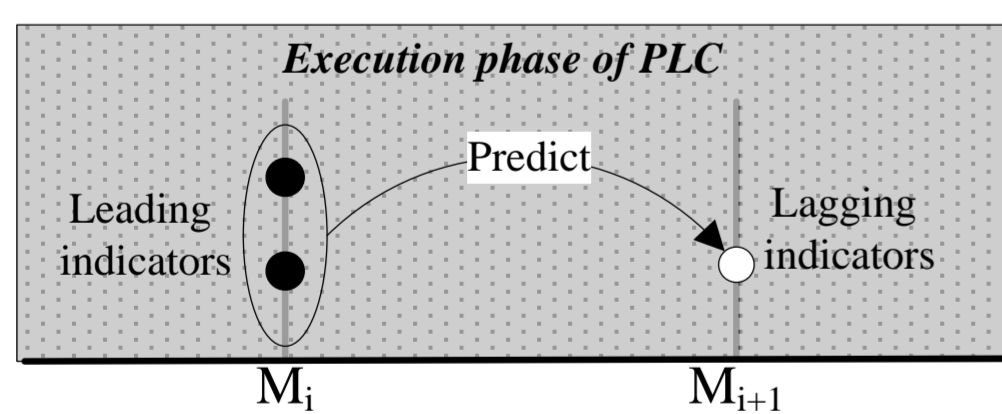
### 18 SE Leading indicators

Requirements Trends	Risk treatment trends
System Definition Change Backlog Trend	Systems engineering staffing and skills trends
Interface Trends	Process compliance trends
Requirements Validation Trends	Technical Measurement Trends
Requirements Verification Trends	Facility and equipment availability trends
Work Product Approval Trends	Defect/ error trends
Review Action Closure Trends	System affordability trends
Technology Maturity Trends	Architecture trends
Risk Exposure Trends	Schedule and cost pressure

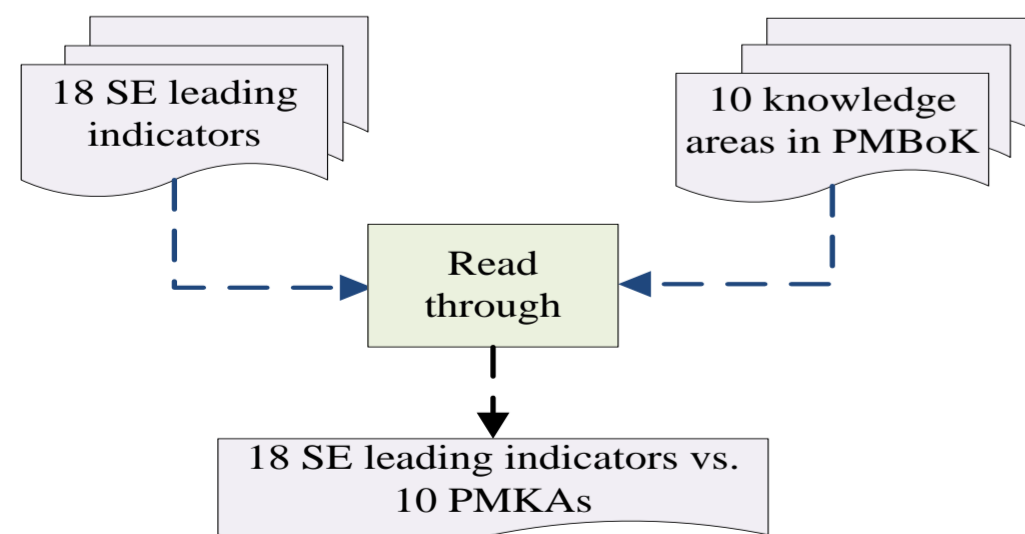
## Indicators input

# Improving Project Performance Measurement

### Relationship between lagging and leading indicators



Lagging indicators are dominant in the PPM, but leading indicators are not yet well developed.



---> Input information flow  
- - -> Output information flow

### 10 Knowledge areas (PMBoK)

	Project Integration Management	Project Scope Management	Project Time Management	Project Cost Management	Project Quality Management	(...)	Project Stakeholder Management
Requirements trends		X					
System definition change backlog trend	X	X	X				
Interface trends		X					
Requirements validation trends		X					
Requirements verification trends		X					
Work product approval trends			X				
Review action closure trends			X				X
Technology maturity trends		X					
Risk exposure trends			X	X			
Risk treatment trends			X				
Systems engineering staffing & skills trends				X			
Process compliance trends							
Technical measurement trends		X					
Facility and equipment availability trends			X	X			
Defect/ error trends					X		
System affordability trends			X	X			
Architecture trends					X		X
Schedule and cost pressure			X	X			

### Preliminary mapping result after reading through

It can be concluded that it's feasible to apply some measurement methods in Systems Engineering like SE leading indicators in the general project management.

