

TECHNOLOGY ADOPTION STRATEGY FOR IMPROVING ELECTRICITY UTILITY COMPANY'S PERFORMANCE

Putrajaya, 21 – 22 November 2017

2017 IERE – TNB Putrajaya Workshop



PLN



BACKGROUND - THEORITICAL

1. **Organizational Behavior perspective;**

“Technology is a part of organization”.

2. **Strategic Management practices;**

- Environmental scanning; Technology is one of external analysis factors (eg. PEST etc.).
- Technology is one of secondary basic activities of organization (eg. Porter’s Value chain etc.).
- Most empirical study found that technology adoption affect significantly firm’s performance

3. **“RBV” and Technology-Intensive firms context;**

“Technology is one of the determinant factors of firm’s competitive advantages”.

BACKGROUND - PRACTICAL

- Some past studies found that the adoption of the technology is significantly contributed to the firm's performance (eg. Abramovitz, 1956 etc.). It is not only improve the efficiency but also increases the effectiveness (eg. Sabbaghi and Vaidyanathan, 2008 etc.), could be a key factor in the ability to maintain profitability (eg. Bressler et al; 2011 etc), helps in achieving effective and efficient work of firm (eg. Sinha and Noble, 2012 etc.).
- However there are some studies that show a negative correlation between technology adoptions with a profit rate of the firms (eg. Jawabreh et al., 2012 etc.).



Research Question:

What are the determinant factors of technology adoption to improve the firm's performance (in utility industry)?

CONTEXT OF STUDY; WHY (INDONESIA) UTILITY COMPANY?

1. PLN is highly technology-intensive firm;
 - Assets; PLN total assets of US\$ 94 billion, 87% or US\$ 82 billion of assets is in the form of electric power production facilities mainly power plants (2013 PLN annual report).
 - Expenditure; PLN also spend a budget of US\$ 12.3 billion for technology-related expenses such as: fuel, maintenance, spare part etc., from its total operation cost of US\$ 15.5 billion a year.
2. Business model of utility industry in Indonesia is more closely to RBV (*Resource Based View*) perspective;
 - As a utility company within highly regulated regulation, PLN isn't driven by market; nor effect of supply demand and generic strategy (price or differentiation).
 - Technology is determinant factors of the total cost production.

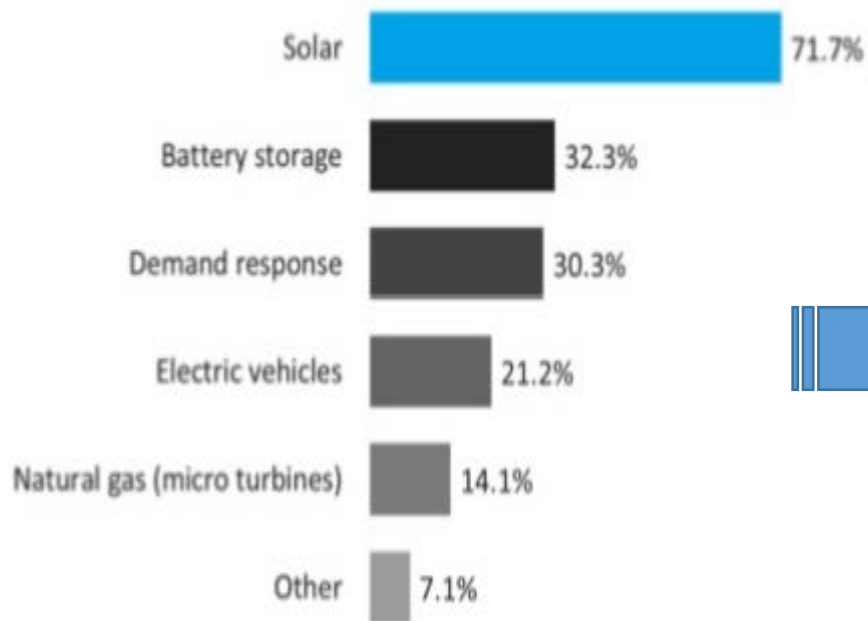
TECHNOLOGY CHARACTERISTIC

	Variables	Definition
Technology Variability	Generation	All technology related to produce electricity such as: turbine (steam, gas, wind, hydro), boiler (sub-critical, super critical, ultra super critical, CFB), generator, Coal gasification, Coal water slurry, CNG, LNG, Coal bed methane, Synthetic Natural Gas, Compressor (Air, Gas), Solar cell/PV, Biomass etc.
	Transmission	All technology related to transmit the electricity produced by power generation in high voltage 70-500 kV such as: High Voltage cable, Extra High Voltage cable, Polymer insulation, Non magnetic CT, SCADA, HVDC, GIS etc.
	Distribution and retail	All technology related to deliver the electricity power to end users or costumers such as: Smart Grid, Pre-paid meter, AMR, Super conductor, distribution transformer, Online monitoring, internet payment, Electric Vehicle, Online-Substation, Call centre etc.
	Supporting	All technology supporting the electricity business processes such as: Six Sigma, Malcolm Baldrige, ISO series, OPI, OHSAS 18000, SMK3, Auto CAD, CFD, Gate Cycle etc.
Technology Adoption Content	IT	All IT technology supporting the electricity business processes such as: online payment, call centre, web services, sms centre, online monitoring etc.
	Non-IT	All non-IT technology supporting the electricity business processes include all above cored-technology (generation, transmission and distribution)
Technology Adoption Process	Top Down	The technology is adopted by the committee of PLN Head Office then it is diffused to all units.
	Bottom Up	The technology is adopted by business unit then it is evaluated by the committee of PLN Head Office. If the technology is feasible and useful for some units then it is diffused to all units.
Organizational variability	Project unit	The organization which manage the construction of new electricity facility projects.
	Generation unit	The organization which produce the electricity power.
	Transmission unit	The organization which transmit and distribute the electricity power from the power generation to all sub stations.
	Distribution and retail unit	The organization which distribute and deliver the electricity power to end user or costumers.
	Supporting unit	The organization which not related directly but support significantly the electricity business process such as: corporate university, engineering centre, research institute, certification services, workshop service centre etc.

OTHER ISSUES - DISRUPTIVE TECHNOLOGY

FACTORS THAT WILL IMPACT ELECTRIC UTILITIES MOST

B&V's 2015-16 Survey of 206 Electric Utilities



Source: 2015-16 Strategic Directions: Smart Utilities/Smart Cities Survey Results, Black & Veatch Global Insights, published Feb. 2016.

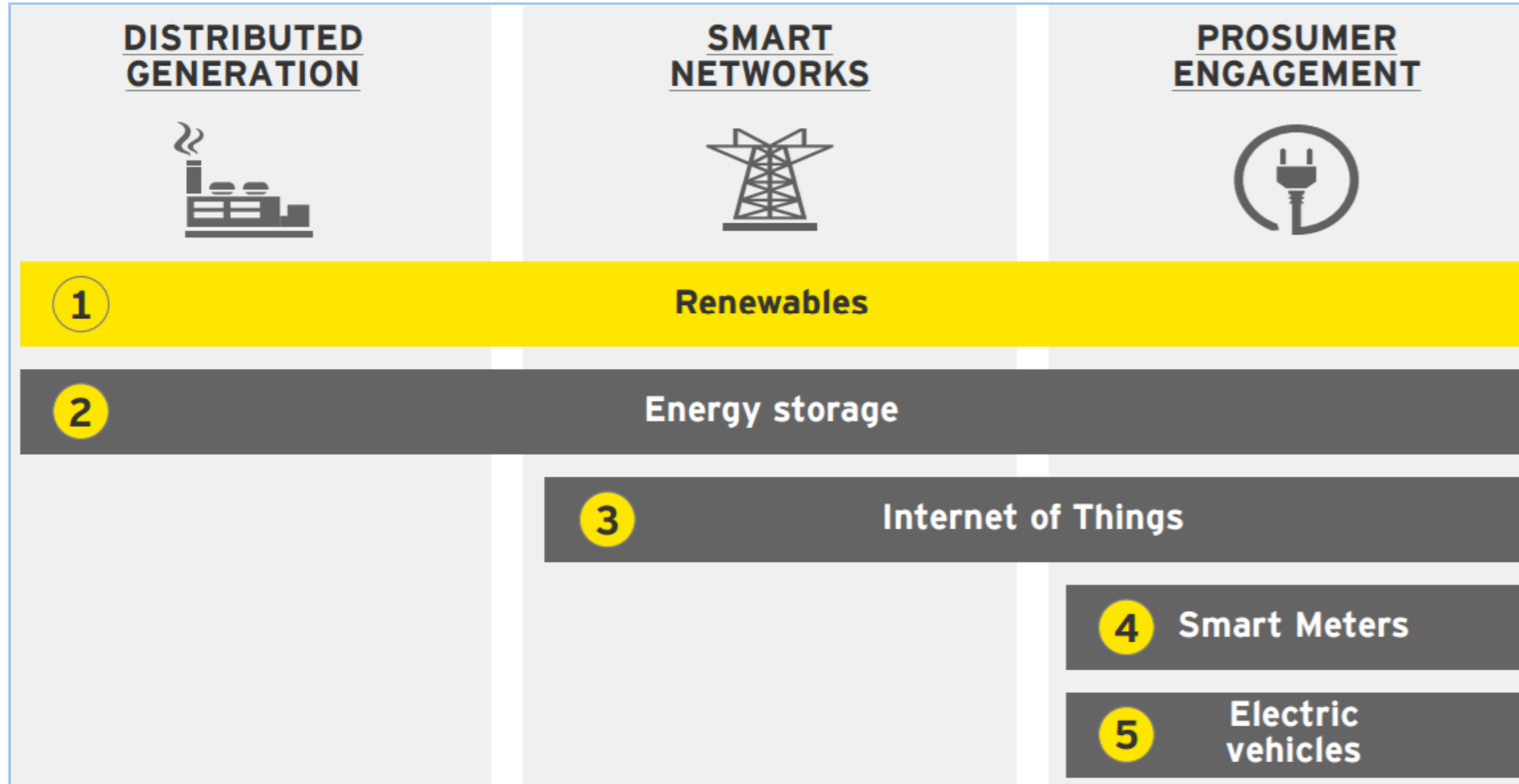


Net Zero Energy House

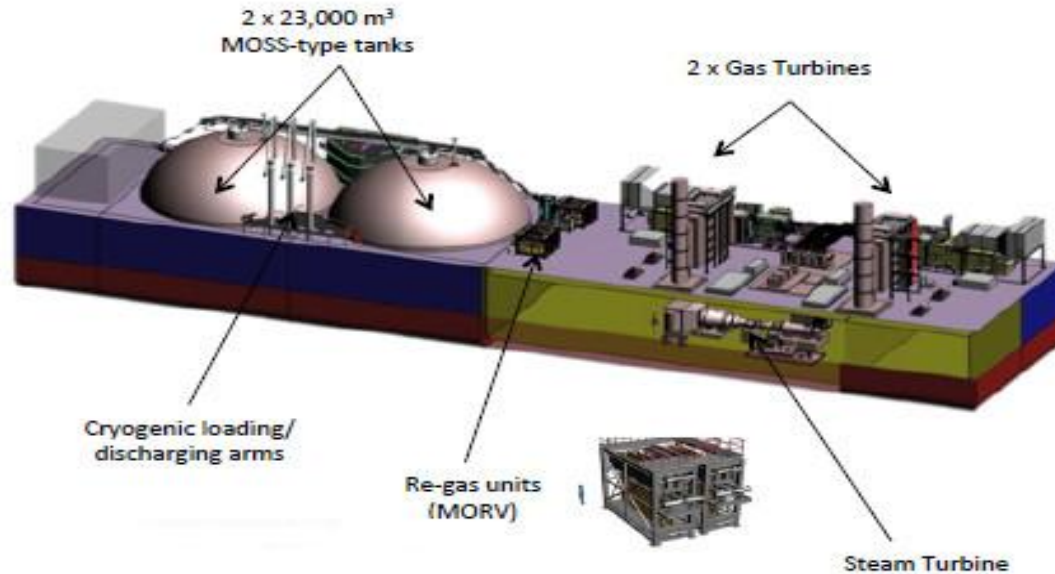


**Distributed
Power
Generation**

Five Disruptive Technologies



OTHER ISSUES – PROMISING TECHNOLOGY



Daiho has commissioned Mitsubishi to develop the LNG Power Barge

▪ Specifications:

- ✓ Integrating LNG Storage, Regasification & Power Generation
- ✓ Electrical Power 250MW
- ✓ High Electron Efficiency (53.6%)
- ✓ Combined Cycle Plant (2 gas turbines + 1 Steam Turbine)
- ✓ 2 x 23,000m³ LNG storage tanks
- ✓ Cryogenic loading/unloading arms

GREEN TRANSFORMERS



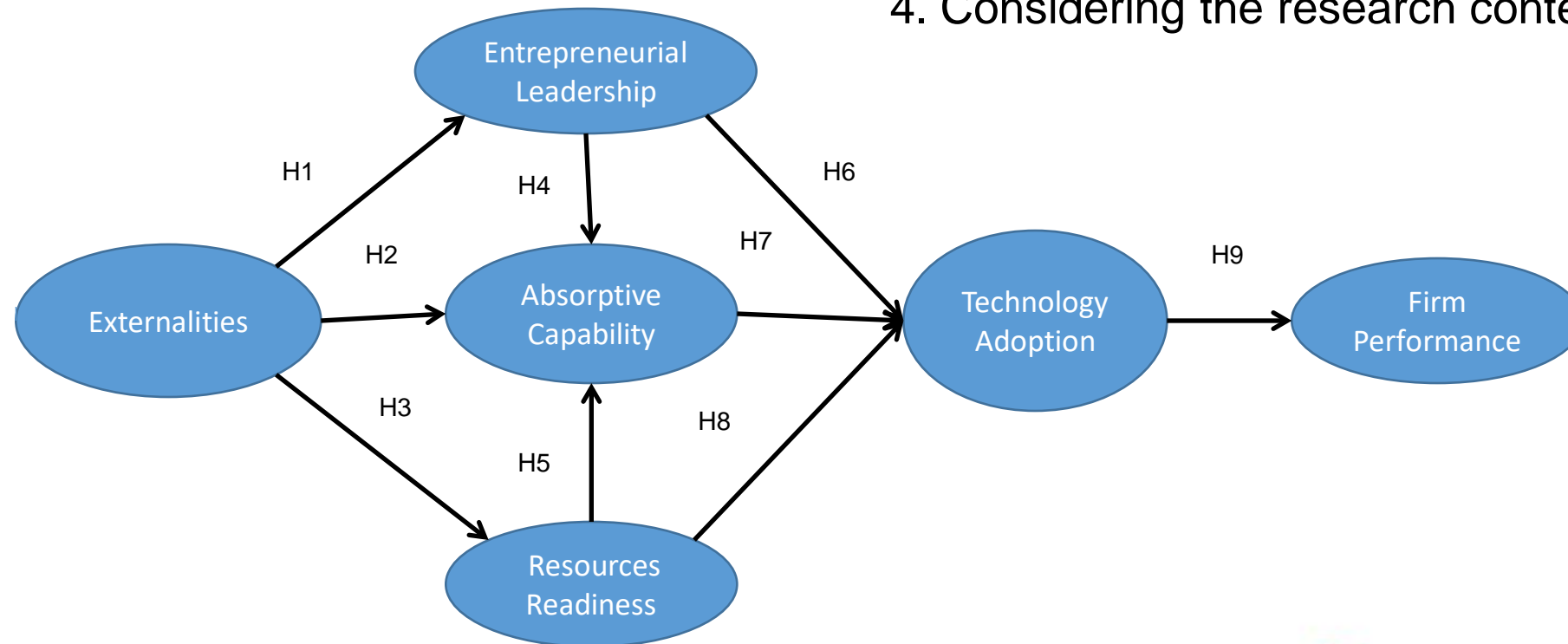
LOW SPEED SMALL WIND TURBINE



CONCEPTUAL MODEL

Defining a “robust” research model:

1. Based on the theoretical background
2. Referring to the determinant factors of TA
3. Further literature review
4. Considering the research context



QUESTION AND HYPHOTESES

“What are the determinant factors of technology adoption strategy to improve the firm’s performance in utility electricity industry?”

“What are technological factors affecting the successful adoption of technology to improve the company’s performance?” → H8, H9

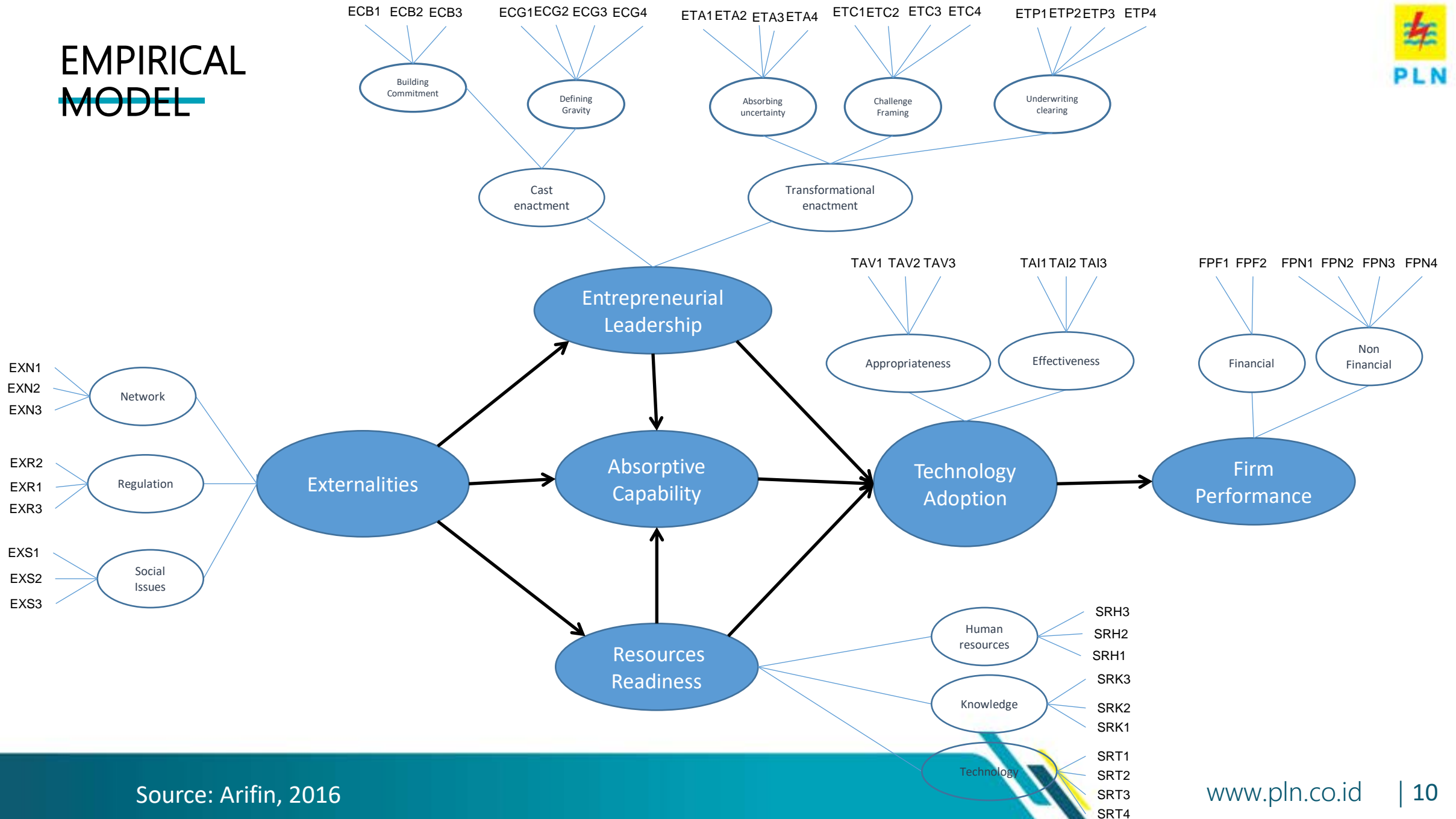
“What are organizational factors affecting the successful adoption of technology to improve the company’s performance?” → H4, H6, H7

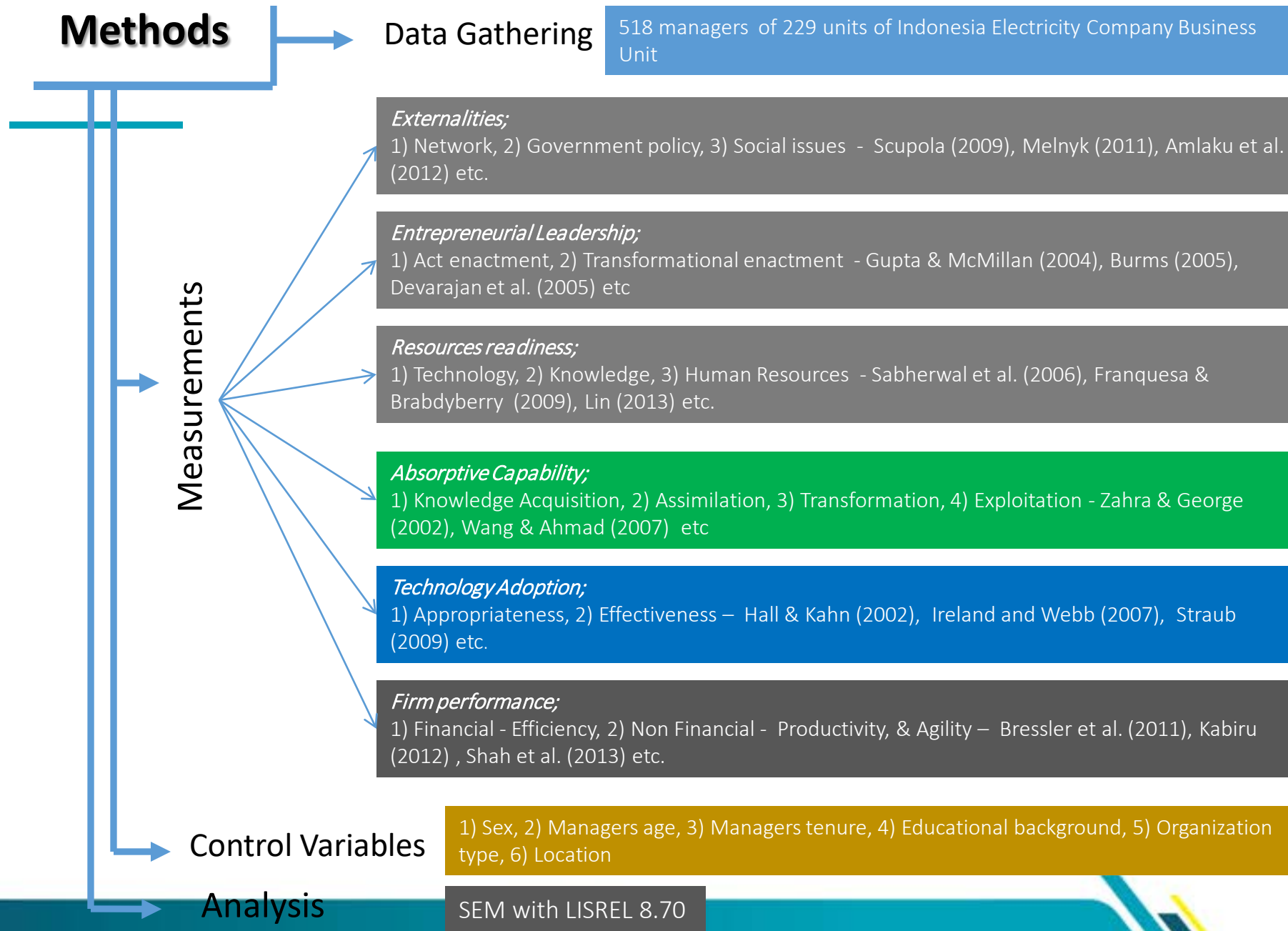
“What are environmental factors affecting the successful adoption of technology to improve the company’s performance?” → H1, H2, H3

“What are the DCs factors affecting the successful adoption of technology to improve the company’s performance?” → H7, H9

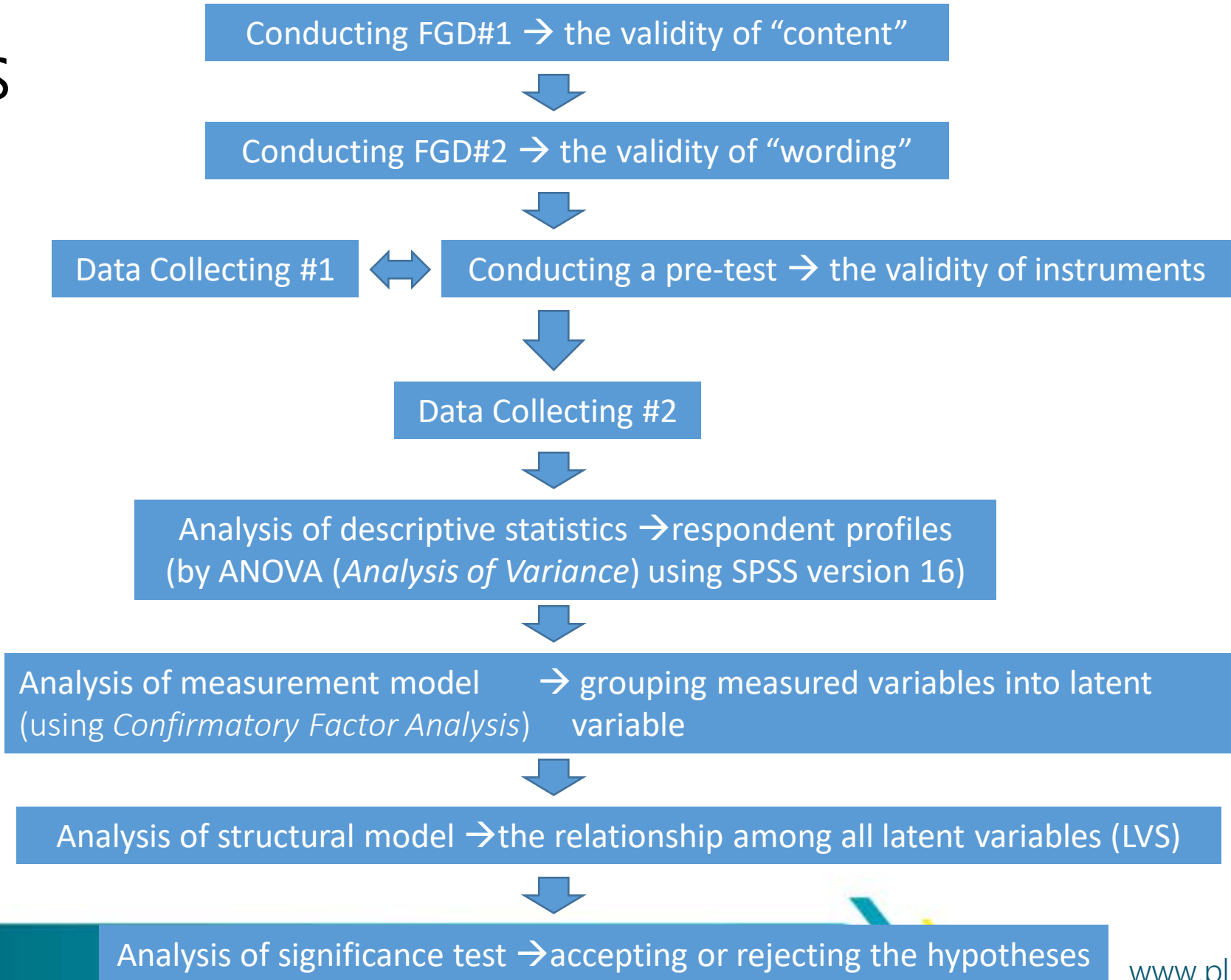
“Are the TA factors effecting to “the Dynamic Capability” is further correlated to the technology adoption, which in turn correlates with the company's performance? → H2, H4, H5

EMPIRICAL MODEL



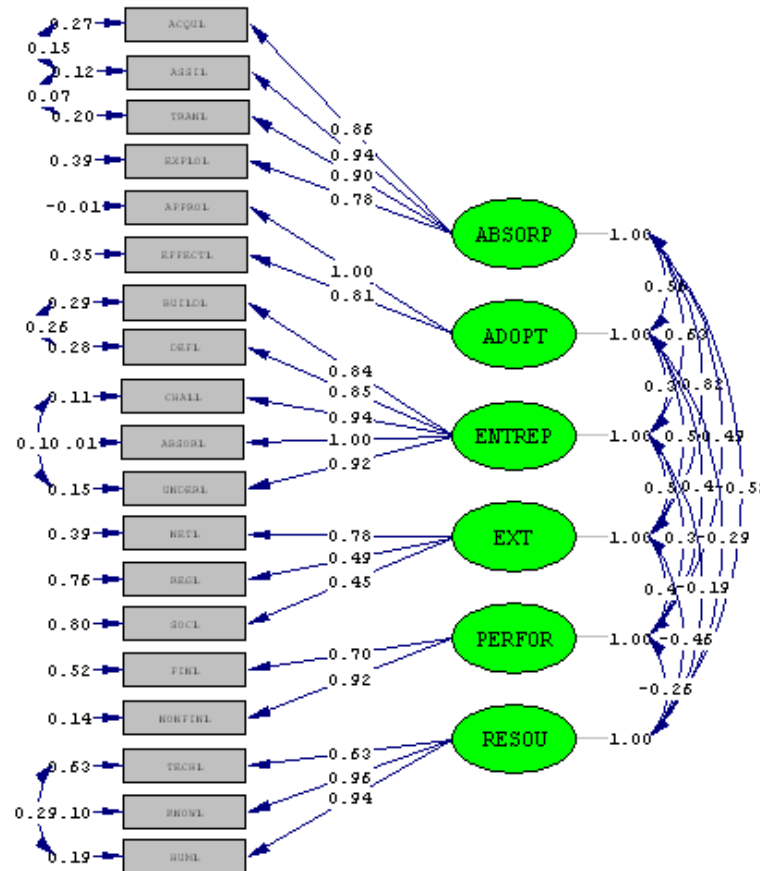


PROCESSES



RESULT - 1

Analysis of measurement model (using *Confirmatory Factor Analysis*) → grouping measured variables into latent variable



GOFI	Calculated Value	Standard Value	Conclusion
RMSEA	0.059	≤ 0.08	Fit is good
NFI	0.97	≥ 0.90	Fit is good
NNFI	0.98	≥ 0.90	Fit is good
CFI	0.98	≥ 0.90	Fit is good
IFI	0.98	≥ 0.90	Fit is good
RFI	0.96	≥ 0.90	Fit is good
Std. RMR	0.051	≤ 0.05	Fit is good
GFI	0.90	≥ 0.90	Fit is good
AGFI	0.87	≥ 0.90	Fit is marginal

Chi-Square=232.04, df=132, P-value=0.00000, RMSEA=0.059

RESULT - 2

Analysis of structural model → the relationship among all latent variables

GOFI	Calculated Values	Standard Value	Conclusion
RSMEA	0.052	≤ 0.08	Fit is good
NFI	0.96	≥ 0.90	Fit is good
NNFI	0.98	≥ 0.90	Fit is good
CFI	0.99	≥ 0.90	Fit is good
IFI	0.99	≥ 0.90	Fit is good
RFI	0.95	≥ 0.90	Fit is good
Std. RMR	0.045	≤ 0.05	Fit is good
GFI	0.93	≥ 0.90	Fit is good
AGFI	0.89	≥ 0.90	Fit is marginal

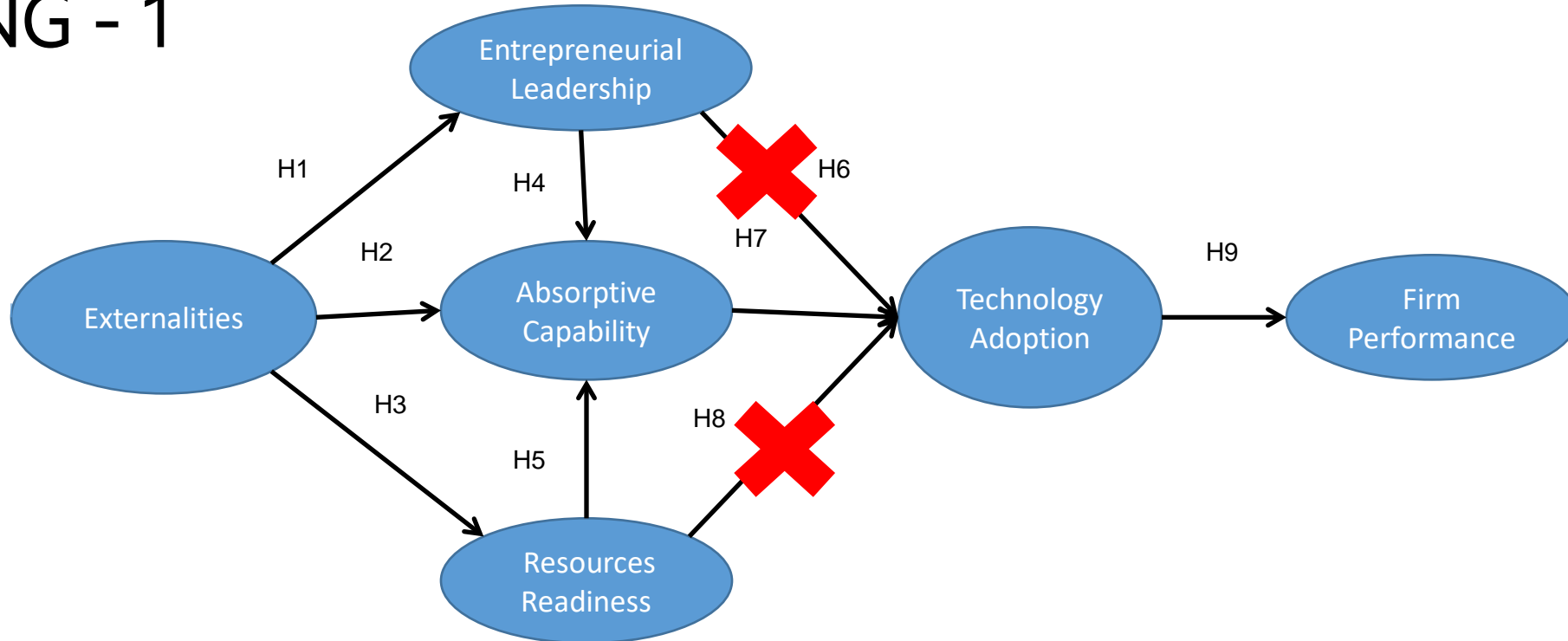
RESULT - 3

Analysis of significance test → accepting or rejecting the hypotheses

Hypotheses	Latent Variable's Relationship	Calculated t-value	Structural Coefficient	Conclusion
H1	Externalities → Entrepreneurial leadership	3.26	0.29	There is significant positive effect, hypothesis 1 is accepted.
H2	Externalities → Absorptive capability	7.01	0.60	There is significant positive effect, hypothesis 2 is accepted.
H3	Externalities → Resource readiness	4.51	8.89	There is significant positive effect, hypothesis 3 is accepted.
H4	Entrepreneurial leadership → Absorptive capability	2.23	0.35	There is significant positive effect, hypothesis 4 is accepted.
H5	Resource readiness → Absorptive capability	5.21	0.27	There is significant positive effect, hypothesis 5 is accepted
H6	Entrepreneurial leadership → Technology adoption	1.67	0.27	There is insignificant positive effect, hypothesis 6 is rejected
H7	Absorptive capability → Technology adoption	3.77	0.49	There is significant positive effect, hypothesis 7 is accepted
H8	Resources readiness → Technology adoption	0.14	0.01	There is insignificant positive effect, hypothesis 8 is rejected.
H9	Technology adoption → Firm performance	3.00	0.29	There is significant positive effect, hypothesis 9 is accepted



FINDING - 1



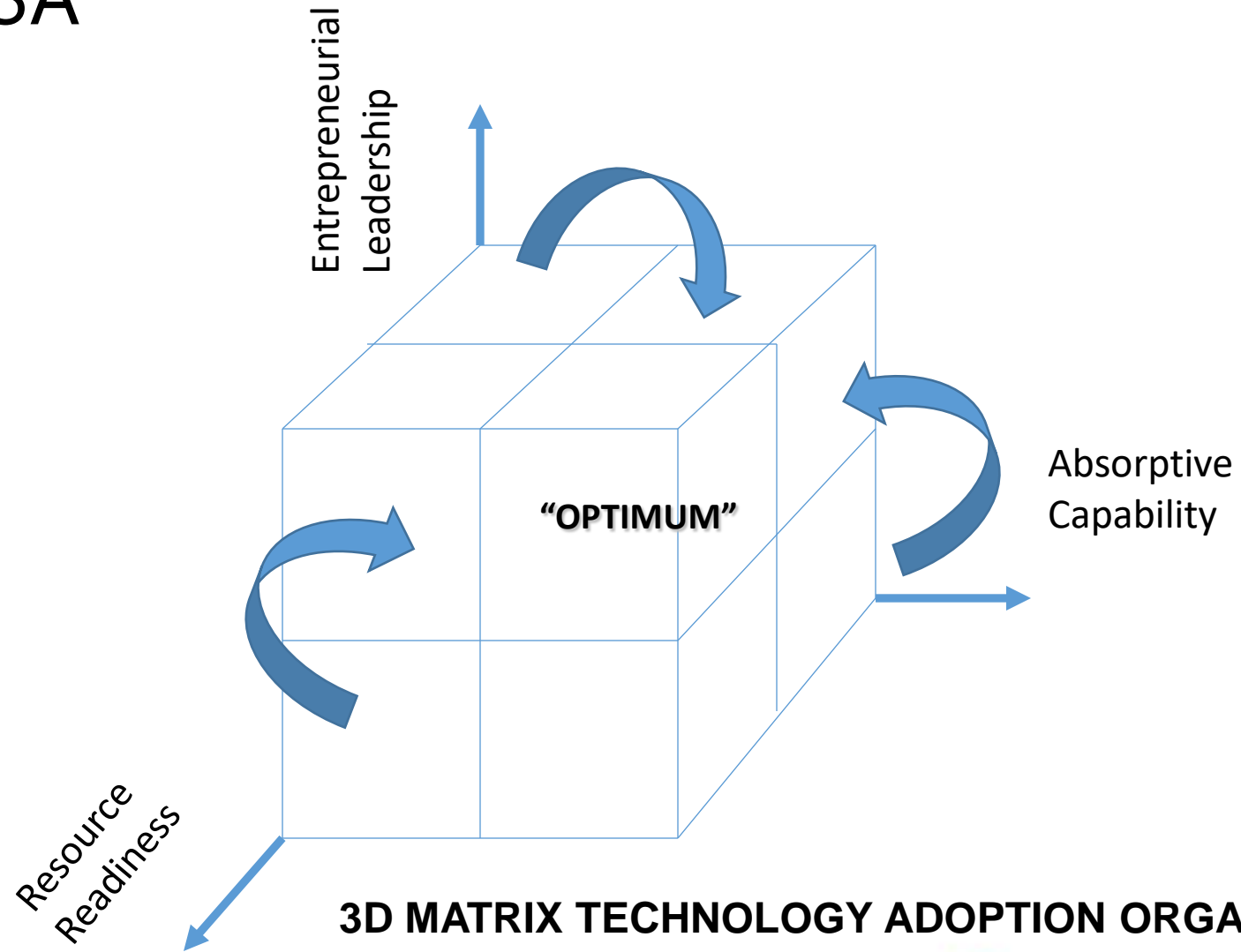
~~3~~ **TECHNOLOGY ADOPTION'S PATHWAYS:**

- ~~1. Entrep → Adopt = H6~~
- 2. Ext. → Entrep → Absorp → Adop = H1, H4, H7
- 3. Ext. → Absorp → Adop = H2, H7
- 4. Ext. → Resour → Absorp → Adop = H3, H5, H7
- ~~5. Resou → Adopt = H8~~

FINDING - 2

Research Questions	Research Results
What are the determinant factors of technology adoption to improve the business unit's performance?	This study has identified and investigated four determinant factors of technology adoption; externalities, resources readiness, entrepreneurial leadership and absorptive capability which externalities as antecedent.
What are technological factors affecting the successful adoption of technology to improve the company's performance?	This study found that the maturity level of technology and the compability of new technology with the existing technology in organization play significant role to achieve highly appropriate technology adoption.
What are organizational factors affecting the successful adoption of technology to improve the company's performance?	This study found that enthusiastic and ambitious manager plays strategic role for mediating external factors with internal organization.
What are environmental factors affecting the successful adoption of technology to improve the company's performance?	This study found that external network is the most significant factors of environmental factors affecting the successful adoption of technology to improve the company's performance.
Are the technological, organizational and environment factors affect to "Dynamic Capability"?	This study empirically shows that resource readiness, entrepreneurial leadership and externalities affect significantly to the absorptive capability of business unit.

FINDING – 3A



FINDING – 3B

No	Organization status	No of unit	Absorp	Entrep	Resou	Firm performance	
						Scale	Score
1	Optimum	6	HIGH	HIGH	HIGH	VERY HIGH	4.57
2	Innovative	202	HIGH	HIGH	LOW	VERY HIGH	4.21
3	Transactional	0	HIGH	LOW	HIGH	HIGH	-
4	Organizational	10	HIGH	LOW	LOW	LOW	2.39
5	Transformational	0	LOW	HIGH	HIGH	HIGH	-
6	Entrepreneurial	3	LOW	HIGH	LOW	LOW	2.08
7	Slack	1	LOW	LOW	HIGH	VERY LOW	1.31
8	Passive	0	LOW	LOW	LOW	VERY LOW	-

KNOWLEDGE MANAGEMENT STRENGTHENING

FIELDS IN FOCUS		
Initiatives based on external sources	Initiatives based on internal sources	Utilizing new competencies
Utilizing knowledge acquired from customers	Enhancing knowledge-sharing	Creating knowledge management duties
	Developing and integrating new values	Instituting the knowledge transfer between individuals
Comparing external knowledge with customers' experience	Systematical recycling of individual knowledge	
	Assessing and evaluating knowledge possessions	Collecting knowledge through simulations and experiments
COMPANIES		
Benetton GE Ritz - Charlton Hotels Frito - Lay Skandia	3M Boeing Ford Motor Co. Hewlett Packard McKinsey BP	IBM Honda Xerox Matsushita

TECHNOLOGY STAKEHOLDERS MANAGEMENT

Stakeholder Name	Contact Person Phone, Email, Website, Address	Impact How much does the project impact them?	Influence How much influence do they have over the project?	What is important to the stakeholder?	How could the stakeholder contribute to the project?	How could the stakeholder block the project?	Strategy for engaging the stakeholder
National Research Agency	Dr. Setya Hadi shadi@bppt.org 0878 765 287	High	High	Technology provider	Supports and provides the best technology needed by the firm	Can't provide sufficient support for the technology adoption processes	Monthly round-table discussions
Finance Division	Yurika Chan yurika@pln.co.id 0852 67 587 101	High	Medium	Budgeting allocation	Approve to financial budgeting for technology adoption	Not approval or the financial budget	Information and feedback meetings every month
Techno Magazine	Budi Satrio budis@tempo.com 0811 888 587 101	Low	High	Technology adoption publication	Publish good news about the technology adoption	Negative publication	Quarterly press meetings
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..... etc.							

ENTREPRENEURIAL LEADERSHIP

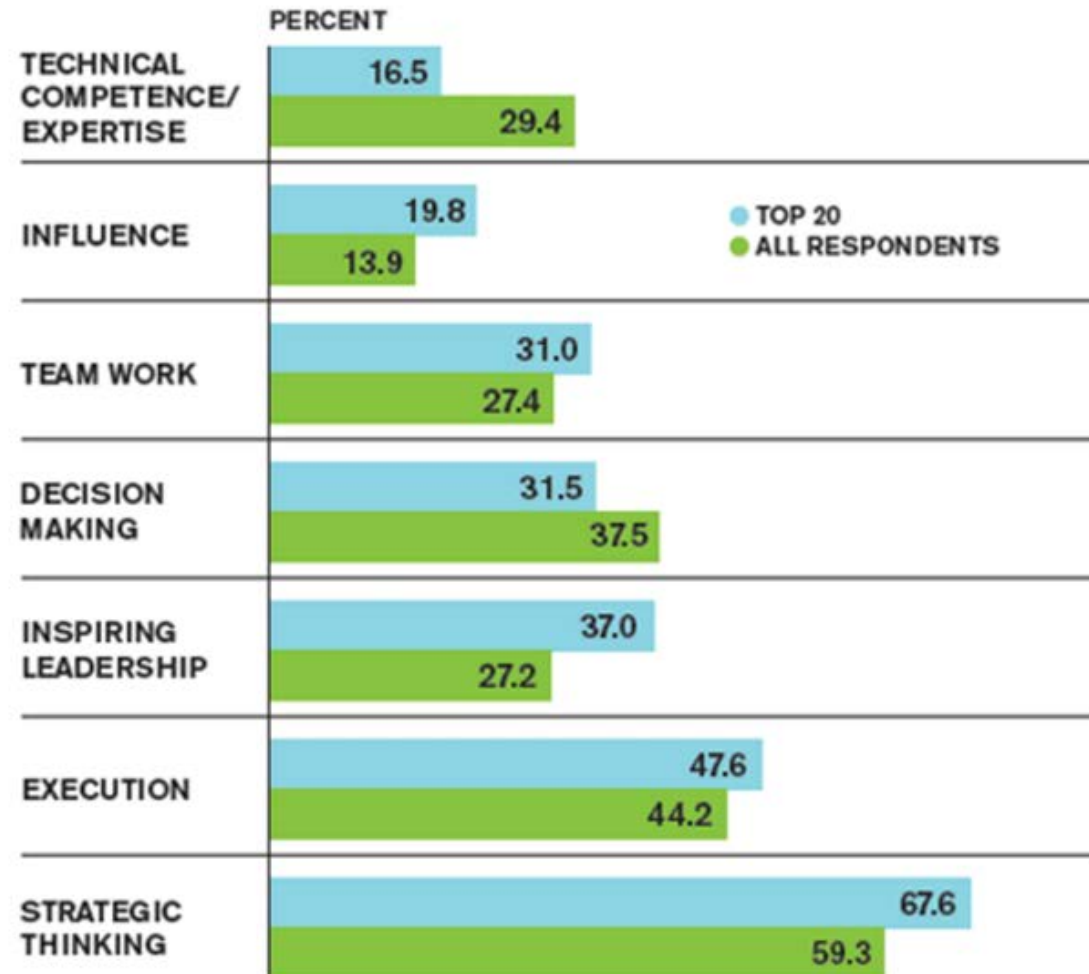
“Cast enactment” (leadership challenge);

- 1.1. Building commitment
 - 1.1.1. Inspirational
 - 1.1.2. Enthusiastic
 - 1.1.3. Team builder

- 1.2. Defining “gravity”
 - 1.2.1. Positive thinking
 - 1.2.1. Decisive
 - 1.2.3. Integrator
 - 1.2.4. Intellectually stimulating

“Transformational enactment” (entrepreneurial challenge);

- 2.1. Absorbing uncertainty
 - 2.1.1. Visionary
 - 2.1.2. Foresight
 - 2.1.3. Confident builder
- 2.2. Framing the challenge
 - 2.2.1. Improvement,
 - 2.2.2. Ambitious
 - 2.2.3. Informed
 - 2.2.4. Performance oriented
- 2.3. Underwriting/path-clearing
 - 2.3.1. Diplomatic
 - 2.3.2. Negotiator
 - 2.3.3. Convincing
 - 2.3.4. Encouraging



Source: Bloomberg BusinessWeek/Hay Group 2009 Best Companies for Leadership Survey

CONCLUSION

1. Executive / management should realize that technology adoption is not static process. It is not only about relationship between some resources both inside and outside organization but also the **ability of the organization** to recognize the **values of novelty** in the external form then **assimilate** and **apply it** for **commercial purposes**.
2. Manager should provide some supporting “hard” content such as resources and improve firm’s “software” ability such as **absorptive capability** for adopting technology successfully in their organization.
3. To achieve a successful technology adoption managers also must be acknowledge that the influence of partners commonly as “**network effects**” are likely to significantly impact technology adoption. In addition, managers should utilize “**vicarious learning**” or learning from the actions of external like other firms because technology adoption dynamic processes can be emerged by inter-related organization responds.



PLN

THANK YOU

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