Relating Shared Leadership to Team Attributes

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PURPOSE

To examine how team member attributes relate to sharing the ME Capstone version of the Full Range of Leadership Model within capstone teams.

Research Question:

How do team-level member attributes relate to the degree of shared leadership in undergraduate mechanical engineering capstone design teams?

ENGINEERING LEADERSHIP?

"By 2020 we aspire to engineers who will assume leadership positions from which they can serve as positive influences in the making of public policy and in the administration of government and industry."
(NAE, 2004 p. 50)

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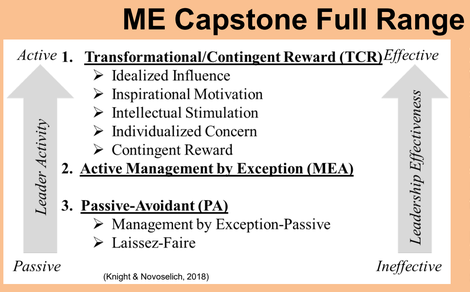
"Engineers must lead in their communities, in local, state and federal governments, and help lead society to a sustainable world. There are probably no second chances, now is the time for action, and we have to get it right. Now is the time for engineering leadership, our country needs it and our planet needs it."
(ASME, 2011,p. 3)

ME Capstone Full Range of Leadership Model

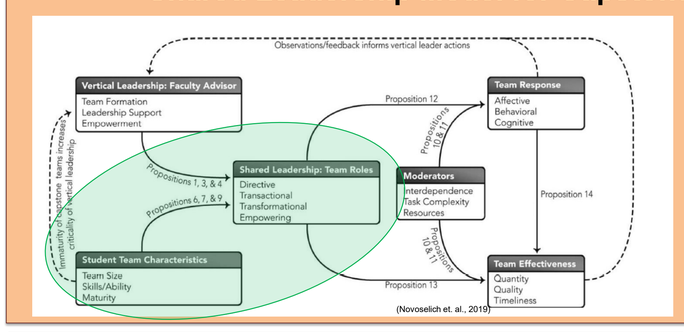


Transformational/Contingent Reward (TCR): developing team member strengths, maintaining a **compelling vision**, showing **strong sense of purpose**, and **instilling pride** in team members for being associated with her/him (Novoselich & Knight, 2015).

Active Management by Exception (MEA): a consistent focus on **maintaining standards**, identifying, and **tracking mistakes** among team members (Avolio, 2011).

Passive-Avoidant (PA): either a **delay in action** until serious issues arise or a **total absence of involvement**, especially when needed (Avolio et al. 2011).

Shared Leadership Model for Capstone Design Teams



Proposition 6: Team size is negatively associated with the development and display of shared leadership in the team.

Proposition 7: The greater the abilities of the team members, particularly interpersonal but also technical, the greater the development and display of shared leadership in the team.

Proposition 8: Greater diversity among the members of the team is negatively associated with the development and display of shared leadership in the team.

Proposition 9: Team maturity is positively associated with the development and display of shared leadership in the team.

METHODS

Data Collection:

- ME capstone teams, 2014-2015 AY
- Online Survey
- Round robin and individual survey items
- 45 Complete Teams = 209 Students

Analysis:

- **Hierarchical Linear Modeling**
- **Single Variable Models**
  - Fixed Effects
  - Random Effects
- **Follow-on Multivariate Models**
  - Backward Elimination
  - Parsimonious Model Identified

Only TCR Leadership Reported for Brevity

Team (Independent) Variables:

Team Attribute	Measure	Description
Team Size	Team Size	# Students assigned
Team Academic and Leadership Ability	Team Eng. GPA	Team-mean Eng. Course GPA
	Eng. GPA Diversity	Diversity Index of Eng. GPA
	Team Leadership Skills	Mean self-reported leadership skills score

Dependent Variables:

RESULTS

TCR Decentralization

	HLM Baseline	Model 1	Model 2	Model 3+	Model 4	Model 5	Model 6	Model 7	Model 8
Random Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Random Slope	No	No	No	No	No	No	No	No	Yes
Intercept	0.68***	0.68***	0.67***	0.68***	0.67***	0.67***	0.68***	0.68***	0.67***
Team Size		0.00							
Discp. Diversity			0.08						
Eng. GPA Diversity				-0.29*					-0.26
Team Sex					0.15				
Team Eng. GPA						0.03			
Team Leadership Skills							0.04		
Team Effort								0.02	
AIC	-17.74	-16.41	-15.93	-19.62	-16.17	-18.05	-17.52	-15.87	-15.74
BIC	-12.32	-9.19	-8.70	-12.39	-8.95	-10.82	-10.29	-8.65	-4.90
DF	3	4	4	4	4	4	4	4	4
σ^2	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.0281
Pseudo R^2		-0.01	0.01	0.12	0.01	0.07	0.05	0.01	0.12

†Note: all independent variables are grand mean centered. (Standardized Coefficients)
+Parsimonious Model
*=p≤0.05; **=p≤0.01; ***=p≤0.001

TCR Density

	HLM Baseline	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14+	Model 15
Random Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Random Slope	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	No	No	No	Yes††
Intercept	0.62***	0.62***	0.62***	0.62***	0.63***	0.62***	0.63***	0.62***	0.62***	0.62***	0.61***	0.62***	0.62***	0.62***	0.62***	0.62***
Team Leadership Skills		0.045**							0.04**				0.02	0.03	0.03*	0.03*
Eng. GPA Diversity			-0.23***							-0.22**			-0.13	-0.14	-0.18*	-0.17*
Team Eng. GPA				0.03**							0.03*		0.01	0.02		
Team Effort					0.05*							0.05*	0.01			
Team Size						0.00										
Discp. Diversity							-0.17									
Team Sex								-0.04								
AIC	-45.93	-53.88	-54.86	-53.30	-48.99	-44.60	-47.34	-44.02	-50.17	-51.06	-52.46	-45.03	-56.49	-58.28	-57.74	-47.82
BIC	-40.51	-46.65	-47.64	-46.07	-41.76	-37.37	-40.11	-36.79	-39.33	-40.22	-41.62	-34.19	-43.84	-47.44	-48.7	-29.76
DF	3	4	4	4	4	4	4	4	6	6	6	6	7	6	5	10
σ^2	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
Pseudo R^2		0.20	0.25	0.22	0.10	0.04	0.05	-0.01	0.21	0.25	0.29	0.10	0.37	0.37	0.33	0.33

†Note: all independent variables are grand mean centered. (Standardized Coefficients)
††Random Slope for Eng. GPA Diversity Only
+Parsimonious Model
*=p≤0.05; **=p≤0.01; ***=p≤0.001

Implications:

- **Diversity of engineering course** performance has the strongest relationship with the degree of shared leadership in capstone design teams.
  - Greater GPA diversity **decreases leadership decentralization**
  - Greater GPA diversity **decreases leadership density**
- The level of **perceived leadership skills** is related to the degree of shared leadership within capstone design teams.
  - Teams that believe they have more leadership skills have more dense leadership networks
  - **Teams that believe they have more leadership skills enact more leadership.**

Takeaways

- **Team formation matters…**
  - Consider how **engineering expertise** is spread across teams, it may affect the leadership experience of all members.
  - **Engineering skills** may be a source of **power** within capstone teams.
  - **Preparing students to lead** may be important to their leadership experiences… those who think they have skills may exercise those skills more.

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