

COMMUNITY CONTEXT AND ELECTRIC VEHICLE ADOPTION

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EV ADOPTION MODELS

$$y = f(x_i), \quad i = 1, \dots, n$$

y = dependent variable

x_i = independent variables

EV adoption in a community = f(average income, local inflation, median age)

y = # of EVs in a community

x₁ = average income

x₂ = local inflation

x₃ = median age

INDUCTIVE vs DEDUCTIVE APPROACH

<i>Deductive Approach</i>	<i>Inductive Approach</i>
Well-grounded in and used to test <i>theoretical propositions</i>	Built on a researcher's communication and <i>interactions with society</i>
Validate <i>objectively</i> constructed and reliably measured reality using established scientific principles	Rely on <i>subjective</i> interpretations of multiple, context-specific realities
Characterized by searching for evidence that <i>proves or disproves a general theory</i> and is not intended to search for real-world relationships that are not identified by the existing literature	Overwhelmingly based on <i>repetitive iterations of on-the-ground observations in a natural setting</i> , and findings from the existing literature and theory merely serve as one tool in the researcher's toolkit that subjectively may or may not be utilized

A disregard of context

SOCIETAL EV ADOPTION: LITERATURE REVIEW

<i>Reference</i>	<i>Model</i>	<i>Data</i>	<i>Approach</i>
Javid & Nejat, 2017	Multinomial Logit Model	California Household Travel Survey	Deductive
Bitencourt & Abud, 2014	Bass Diffusion Model	Publicly Available (Multiple Sources)	Deductive
Simsekoglu & Nayum, 2019	Hierarchical Multiple Regression	Web-survey	Deductive
Graham-Rowe, et al., 2012	Thematic Analysis	Semi-structured interviews of EV users	Inductive

A disregard of context

References:

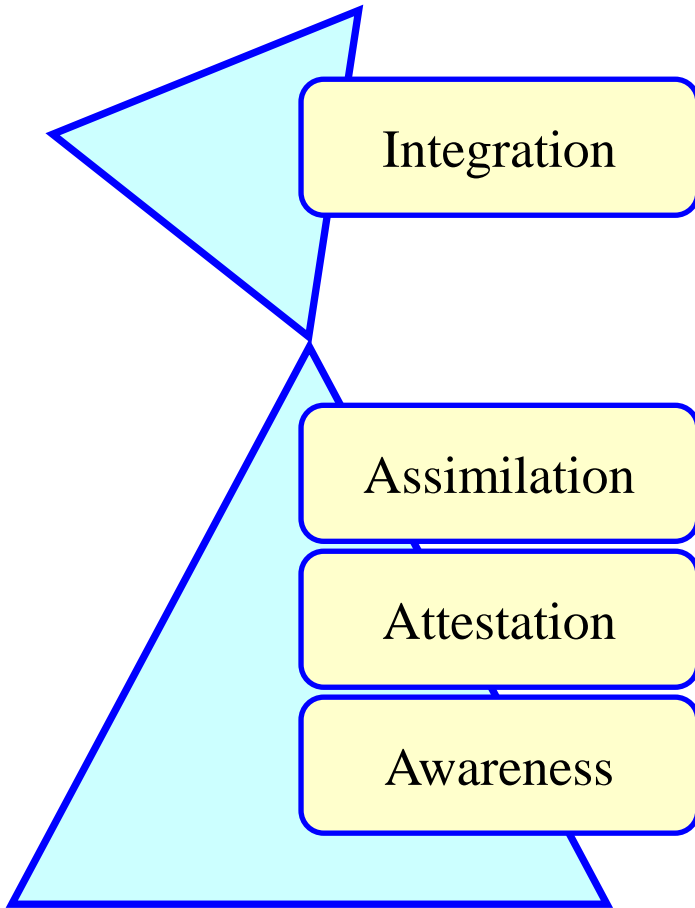
1. Javid, R., & Nejat, A. (2017). A comprehensive model of regional electric vehicle adoption and penetration. *Transport Policy*, 30-42.
2. Bitencourt, L., & Abud, T. (2014). Bass diffusion model adaptation considering public policies to improve electric vehicle sales- A Brazilian case study. *Energies*.
3. Simsekoglu, O., & Nayum, A. (2019). Predictors of intention to buy a battery electric vehicle among conventional car drivers. *Transportation Research Part F: Traffic Psychology and Behavior*, 1-10.
4. Graham-Rowe, E., Gardner, B., Abraham, C., Skippon, S., Dittmar, H., Hutchins, R., & Stannard, J. (2012). Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: A qualitative analysis of responses and evaluations. *Transportation Research Part A*, 46, 140-153.

CONTEXTUAL ENGINEERING (CE)

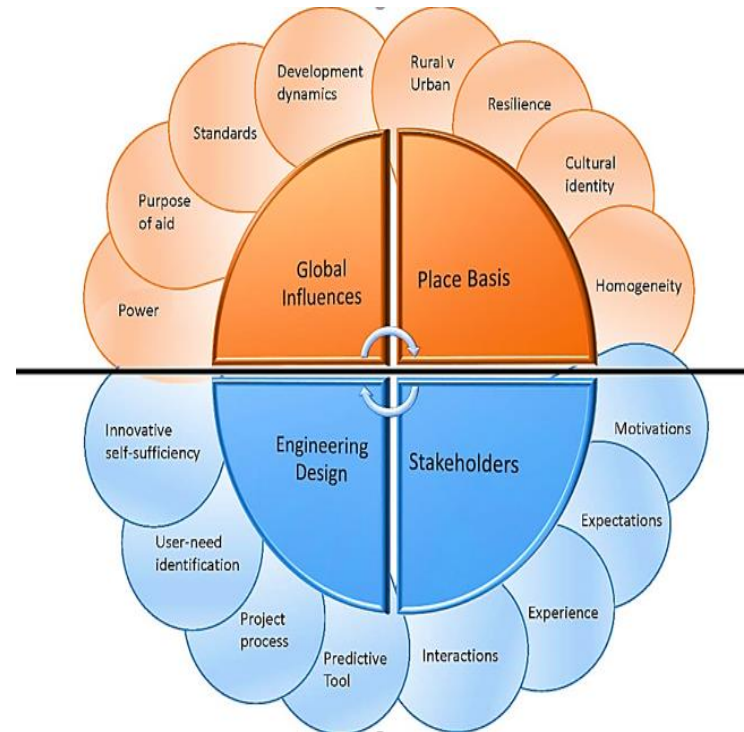
- “The creative *application of science, mathematical methods, societal understanding, and place-based knowledge* to address a physical need that serves the user of the innovation while *recognizing the influence of stakeholder motivations, capabilities, and values.*”
- In the CE approach, user education and development are secondary to design implementation, because *context determines the existing capabilities as well as the propensity for evolving those capabilities* and internalizing information exchanges before an infrastructure is deployed.

CE FRAMEWORK

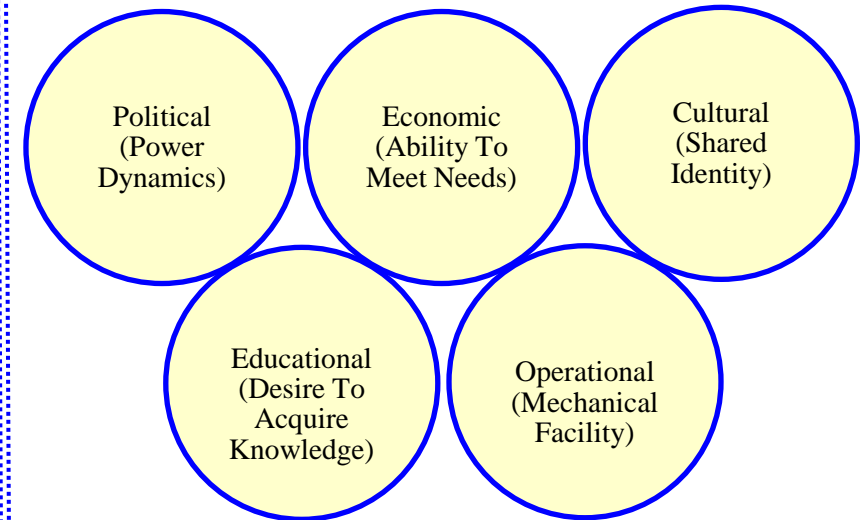
3-levels of evaluator's perception:



4-underlying contextual conditions:



5-critical contextual influences:



CE QUESTIONNAIRE / TOOL

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Location:		1 = no, not present, never occurs	
Date:		3 = sometimes, present but not prevalent, occurs occasionally	
Assessor:		5 = yes, prevalent, occurs often	
			SCORE
Have you observed at least 25% of the community's residents visibly manifesting a common identity (ethnicity, religious practice, common non-English language, or behavior)?			
Do community members who manifest a cultural identification live and work fully integrated with segments of community population that do not share cultural identification? (5 if no cultural diversity)			
Do residents practice behaviors, social habits, politics, etc. that they overtly attribute to spiritual beliefs?			
Do residents use technology or technical practices that they say are unique to their cultural identification or history?			
Is there a primary religion practiced in the community?			
Do community members overtly express discrimination against anyone based on physical characteristics, cultural practices, or religious beliefs?			
Do the majority of younger adults adhere to beliefs, language and/or behaviors associated with the cultural traditions of their elders?			
Does the community strictly adhere to democratic principles in nominating and electing its leadership?			
Can residents accurately describe how their local government is organized and managed?			
Do attendees in community public meetings disagree with leaders and express personal opinions, even if they differ from the majority opinion?			
Do the majority of residents clearly understand the process whereby residents may effectively air grievances and/or seek redress from their community's leadership?			
Does the community have sub-groups of residents, such as neighborhoods, family pods, or coalitions?			
Does any resident have the equal right to participate in a governing board?			
Is there a sense that authority resides within local governance (eg, are decisions made by local governance regularly maintained despite disagreement from a higher level of government)?			
Are the community's governance procedures and documents easily available to all residents? (website or social media page, for example?)+A21			
Have you witnessed any violent disagreements or threat of violence, either during community meetings or in public conversations outside of meetings?			
What is the average apparent age of community leaders? >90% NLE=1, >80% NLE=2, >70% NLE=3, >60%=4, >50%=5			
Is there evidence that non-government intervention contributed to completion of past infrastructure projects? (eg., social programs, agricultural extension, rural development)			
Do community leaders appear to benefit from leadership through status, social control, or living comfort?			
Is the community's population self-employed >80%=5, >60%=4,>40%=3,>20%=2, <20%=1			
Do self-supporting residents in the community sell their goods and services outside the community >70%=1, >60%=2, >50%=3, >40%=4, <=40%=5			
Are there stores, banks, gas stations, and/or other service outlets located within community boundaries?			
Are homes built to size, material and method stands typically seen in suburban/urban settings? >70%=5, >55%=4, >40%=3, >25%=2, <=10%=1			
Does the community government offer reliable municipal services (street lighting, street maintenance, garbage pick-up, fire protection, etc.) >90%=5, >70% = 4, >50%=3, >30%=2, <=30%=1			
Is there a health clinic or hospital located within the community or immediately adjacent and easily accessible			
What is the apparent average age of the community? >=70% NLE=1, <70% NLE=2, <60% NLE=3, <50% NLE=4, <40% NLE=5			
Do residents have access to and regularly use networked computers (laptops with wifi, desktops with internet access)? Always=5, Usually=4, Sometimes=3, Rarely=2, Never=1			
Does the community provide sanitary sewer service to homes (versus home septic)? Always=5, Usually=4, Sometimes=3, Rarely=2, Never=1			
Do you see evidence of heavy alcohol use in the community (ie alcohol consumption at workplace, discarded liquor bottles) Always=5, Often=4, Sometimes=3, Rarely=2, Never=1			
Do homes in the community have newer appliances and electrical devices (ie Alexa) Always=5, Usually=4, Sometimes=3, Rarely=2, Never=1			
Do most residents own a smart phone Always=5, Usually=4, Sometimes=3, Rarely=2, Never=1			
Are the homes you see in the community well maintained and updated? Always=5, Usually=4, Sometimes=3, Rarely=2, Never=1			
Do residents demonstrate an interest in understanding or obtaining technology they're not familiar with? Always=5, Usually=4, Sometimes=3, Rarely=2, Never=1			
Do residents own newer-model vehicles in good condition? Always=5, Usually=4, Sometimes=3, Rarely=2, Never=1			
Do residents describe experiencing illnesses that they attribute to environmental conditions? Always=5, Usually=4, Sometimes=3, Rarely=2, Never=1			
Is there a high school in or near town that children from the community may easily attend?			
Is there a college or university in or near town that children from the community may easily attend?			
Do community children attend secondary school for general education >90%=5, >70% = 4, >50%=3, >30%=2, <=30%=1			
Do community children attend post-secondary school or vocational training programs? >90%=5, >70% = 4, >50%=3, >30%=2, <=30%=1			
Do children from the community attend university >40%=5, >30%=4, >20%=3, >10%=2, <=10%=1			
Are community leaders well educated? Often through university=5, Often through post-secondary=4, sometimes through post-secondary=3, often through secondary=2, sometimes through secondary=1			

Influence	Assessor				Avg.
	1	2	3	4	
Cultural	19.7%	20.5%	19.9%	19.9%	20.0%
Political	19.9%	20.6%	20.5%	21.6%	20.6%
Educational	21.4%	22.3%	22.1%	22.1%	22.0%
Mechanical	20.4%	16.8%	16.6%	16.6%	17.6%
Economic	18.7%	19.8%	20.9%	19.9%	19.8%

FACTORS IMPACTING SOCIETAL EV ADOPTION

<i>Analyzed 19 journal articles in this work</i>	
Multidimensional aspects of EVs	<ul style="list-style-type: none"> • Government policy • Consumer demographics • Social dynamics • Public perception
Client community	<ul style="list-style-type: none"> • Interest groups • Regions • States • Nations

<i>Factor</i>	<i>Freq.</i>
EV Charging Service Price	13
Availability Of Public EV Charging Stations	13
EV Purchase Price	11
Educational Status Of The Potential Buyer	10
Yearly Income Of The Potential Buyer	10
EV's Driving Range	9
Time Required To Fully Charge The EV's Battery	9
Tax Incentives Available To The Potential Buyer	9
Environmental Benefits Of EVs	9
Age Of The Potential Buyer	8
Gender Of Potential Buyer	8
Annual EV Maintenance Cost	7
Number Of Cars Owned By Potential Buyer	6
Access To Garage / Private Parking For The Potential EV Buyer	5
Miles Driven Per Day By The Potential Buyer	4

CERG MEETING - MARCH 2023

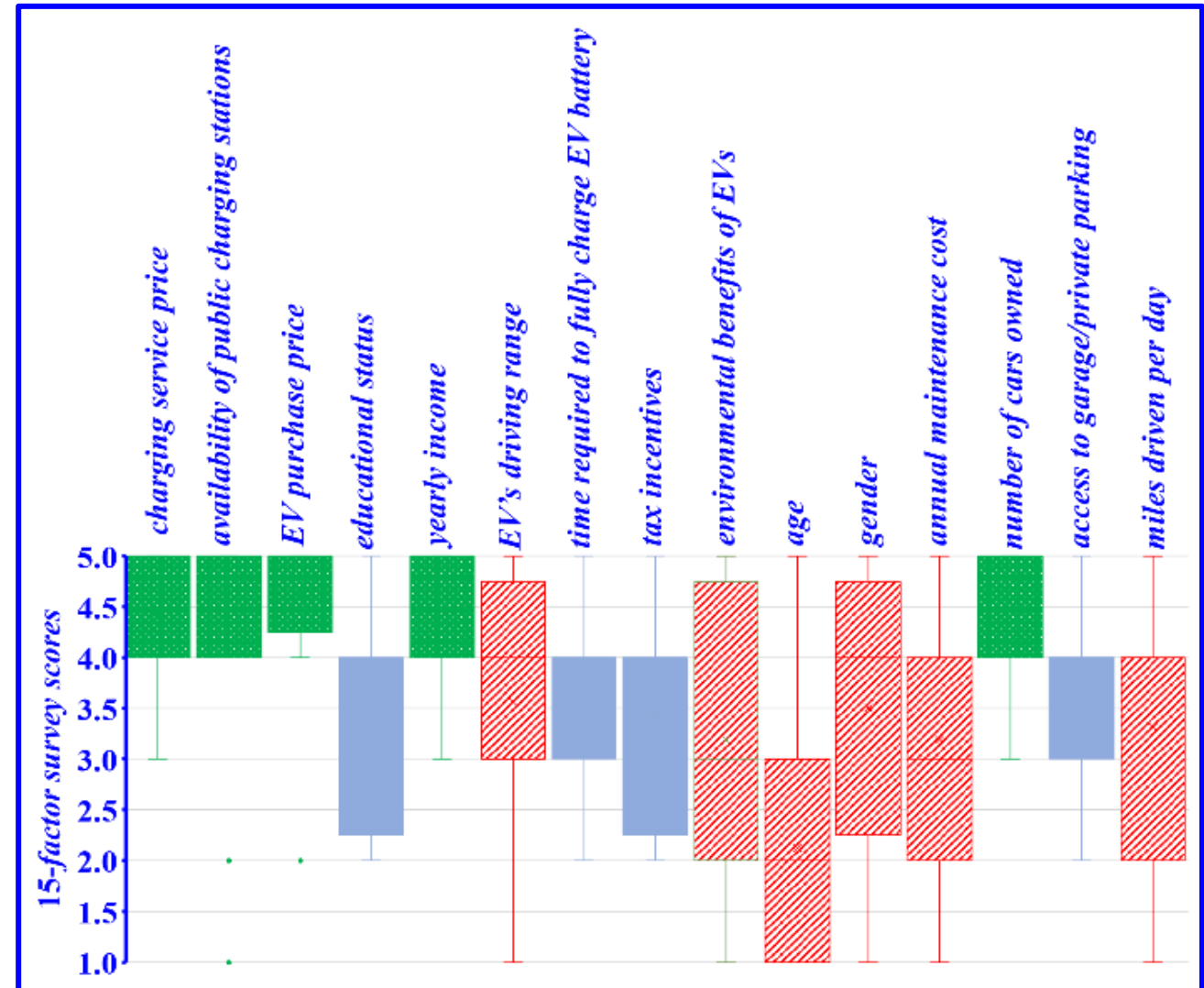
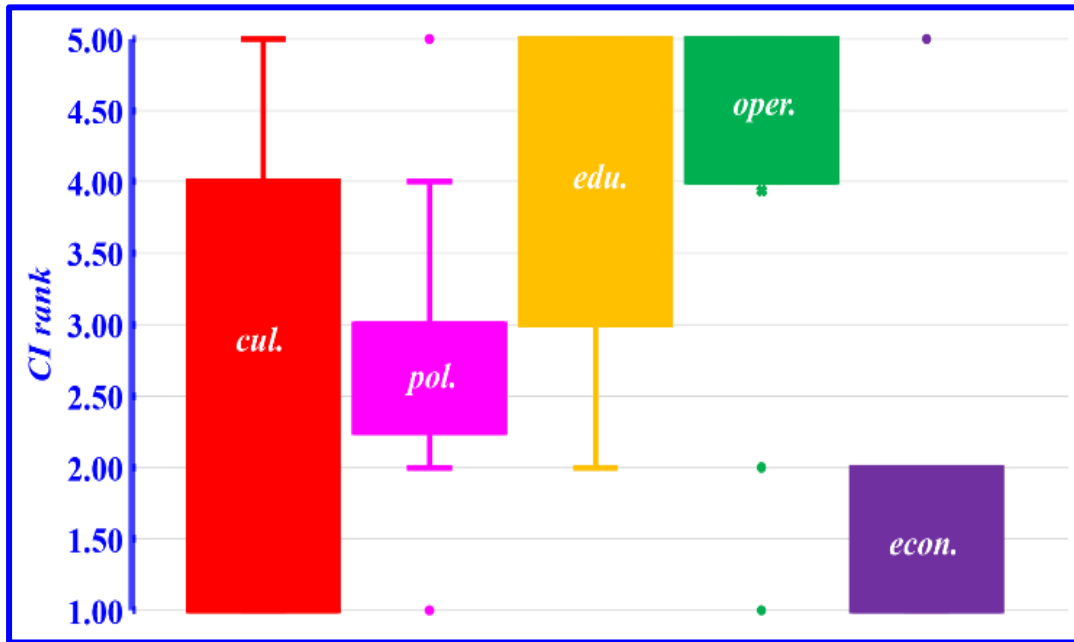
Respondent	Cultural					Political	Educational		Operational	Economic					
	EV's driving range	Age of the potential EV buyer	Gender of the potential EV buyer	Access to garage / private parking for the potential EV buyer	Miles driven per day by the potential EV buyer	Tax incentives available to the potential EV buyer	Educational status of the potential EV buyer	Environmental benefits of EVs	Time required to fully charge the EV battery	EV charging service price	Availability of public EV charging stations	EV purchase price	Yearly income of the potential EV buyer	Annual maintenance cost of the EV	Number of cars owned by the potential EV buyer
A	2	1	4	4	2	3	4	1	3	5	5	5	5	5	4
B	5	4	1	4	4	2	5	5	5	4	5	5	5	2	4
C	5	3	2	3	4	2	2	1	4	4	5	5	3	3	1
D	4	2	1	5	5	4	3	5	4	5	2	4	5	4	2
E	5	2	3	5	5	3	3	3	4	4	2	4	4	2	4
F	4	3	2	4	4	3	3	4	4	5	4	5	5	4	2
G	2	5	2	4	3	2	4	4	4	3	4	5	5	5	4
H	3	4	1	4	2	4	2	4	3	4	4	5	5	4	3
I	3	2	4	5	4	4	4	4	2	4	4	5	4	5	4
J	4	4	2	5	5	5	4	4	4	5	1	5	5	4	5
K	3	2	1	5	3	5	2	2	4	5	4	2	4	3	5
L	4	2	1	5	4	4	4	2	4	5	5	5	4	4	3
M	5	5	3	5	4	4	4	5	3	5	5	5	5	5	3
N	3	5	1	5	4	4	2	4	3	4	5	5	5	1	3
O	1	5	5	5	2	2	3	1	4	4	5	4	3	1	2
P	4	2	1	4	4	4	4	4	4	5	5	5	5	4	2

1 = strongly disagree, 2 = slightly disagree, 3 = neutral, 4 = slightly agree, 5 = strongly agree.

CONTEXTUAL FINGERPRINT

<i>Respondent</i>	<i>Cultural</i>	<i>Political</i>	<i>Educational</i>	<i>Operational</i>	<i>Economic</i>
<i>A</i>	21.6% (4)	19.0% (2)	20.1% (3)	23.2% (5)	16.0% (1)
<i>B</i>	20.6% (3)	20.1% (2)	21.3% (4)	21.9% (5)	16.0% (1)
<i>C</i>	18.2% (1)	19.7% (4)	19.4% (3)	23.5% (5)	19.1% (2)
<i>D</i>	21.6% (4)	22.3% (5)	20.1% (3)	16.5% (1)	19.4% (2)
<i>E</i>	16.7% (1)	21.0% (4)	20.7% (3)	23.7% (5)	17.9% (2)
<i>F</i>	13.7% (1)	21.1% (3)	22.7% (4)	23.5% (5)	19.0% (2)
<i>G</i>	15.0% (1)	19.1% (3)	24.7% (5)	23.1% (4)	18.1% (2)
<i>H</i>	18.3% (2)	19.2% (3)	21.6% (4)	23.5% (5)	17.5% (1)
<i>I</i>	21.9% (4)	21.1% (3)	22.7% (5)	18.6% (2)	15.6% (1)
<i>J</i>	13.2% (1)	20.5% (3)	22.7% (4)	23.6% (5)	19.9% (2)
<i>K</i>	21.7% (2)	16.8% (1)	19.1% (3)	23.3% (5)	19.0% (2)
<i>L</i>	16.7% (1)	19.4% (3)	22.7% (2)	23.5% (5)	17.7% (2)
<i>M</i>	24.4% (5)	20.4% (3)	17.9% (2)	21.1% (4)	16.2% (1)
<i>N</i>	21.0% (3)	17.9% (2)	21.7% (4)	22.6% (5)	16.8% (1)
<i>O</i>	20.3% (3)	18.3% (1)	20.2% (2)	20.9% (5)	20.5% (4)
<i>P</i>	21.5% (4)	20.5% (3)	21.8% (5)	19.7% (2)	16.6% (1)

THE IMPORTANCE OF CONTEXT



CONCLUSIONS

- Recognition of unique conditions, constraints, identities, and capabilities, a.k.a. *context of the community*, plays a significant role in determining its members (possible) *interaction with a technology*.
- Contextual understanding will equip EV researchers to identify and focus on *community-specific enablers of technology adoption*.
- *Targeted and community-centric policies* can thus be generated to improve realism of EV adoption models and reduce policy failures.
- CE provides *one framework that can be used by researchers to enhance their contextual understanding*.