

Creativity in RE and Its Measurement

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Assistant Professor

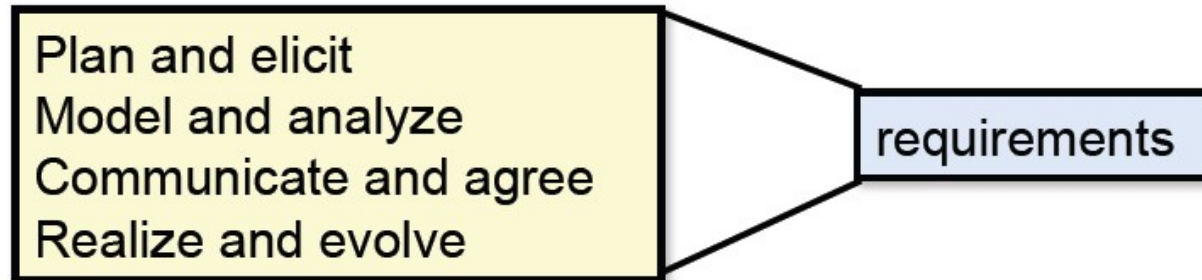
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Requirements engineering (RE)

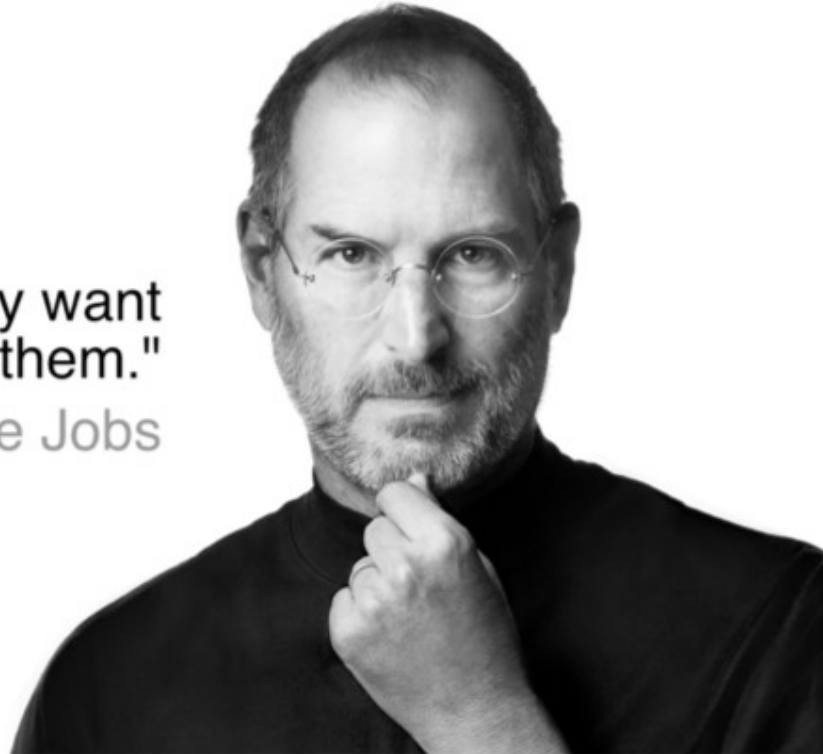
- Requirements engineering (RE)



- Involves interaction among multiple stakeholders
- Traditional RE
 - Requirements exist in the stakeholders' minds in an implicit manner [Lemos *et al.*, 2012]
 - Customer driven

Requirements engineering (RE)

"People don't know what they want
until you show it to them."
- Steve Jobs



Picture source: Internet

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Requirements engineering (RE)



Picture source: Internet

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Creativity in RE



Picture source: Internet



Creativity in RE

- More critical in modern software industry
 - Competition in the industry
 - Multiple system in the same application domain
- Modern RE
 - Creative requirements
 - Improve sustainability



Creativity in RE

- Creativity [Sternberg, 1999]
 - Ability to produce work that is both
 - Novel
 - original and unexpected
 - Appropriate
 - useful and adaptive to task constraints



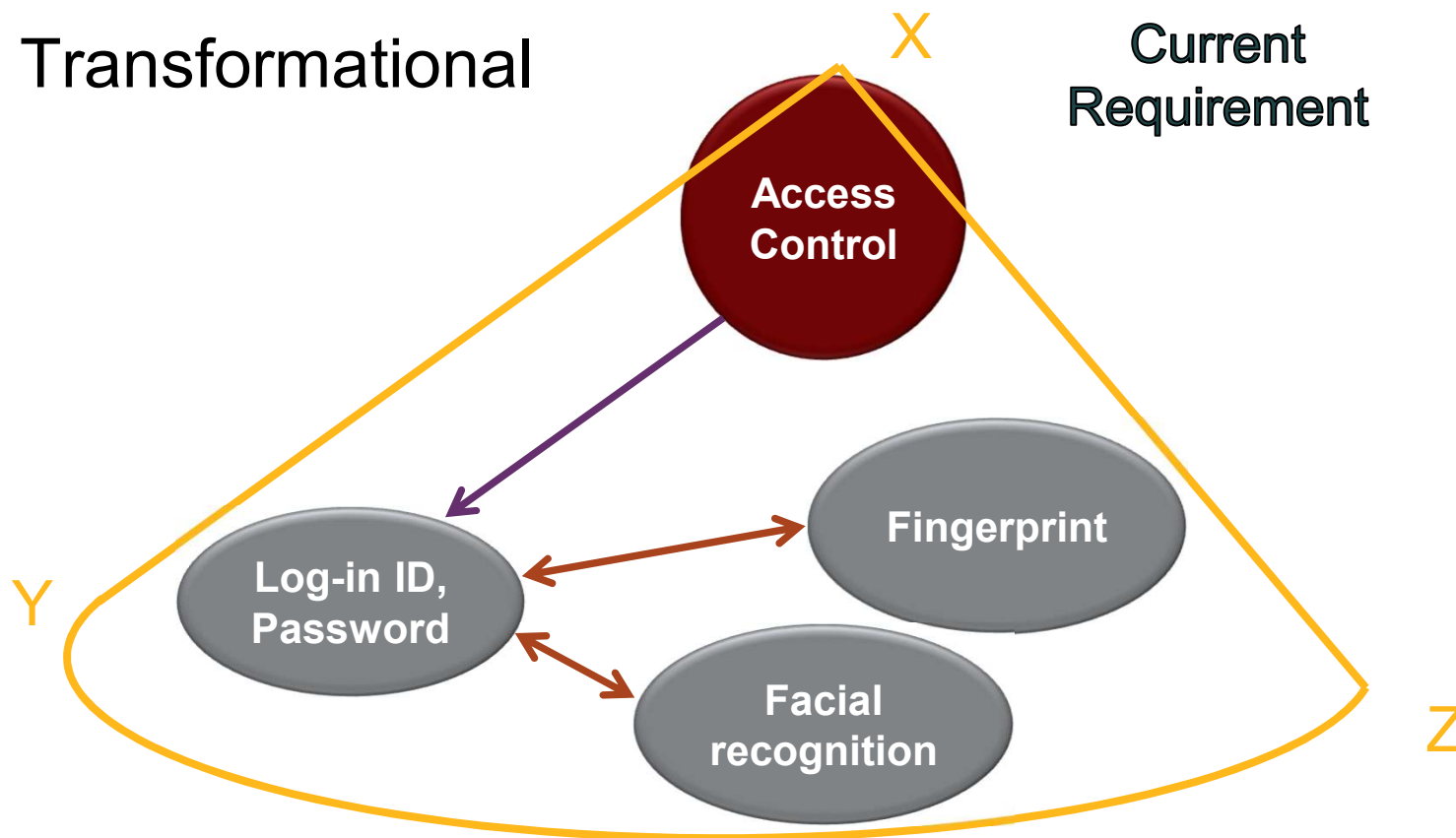
Creativity in RE

- Creativity [Sternberg, 1999]
 - Ability to produce work that is both
 - Novel
 - original and unexpected
 - Appropriate
 - useful and adaptive to task constraints
- In RE [Maiden *et al.*, 2010]
 - Capture of requirements
 - New to the stakeholders
 - May not be historically new to humankind



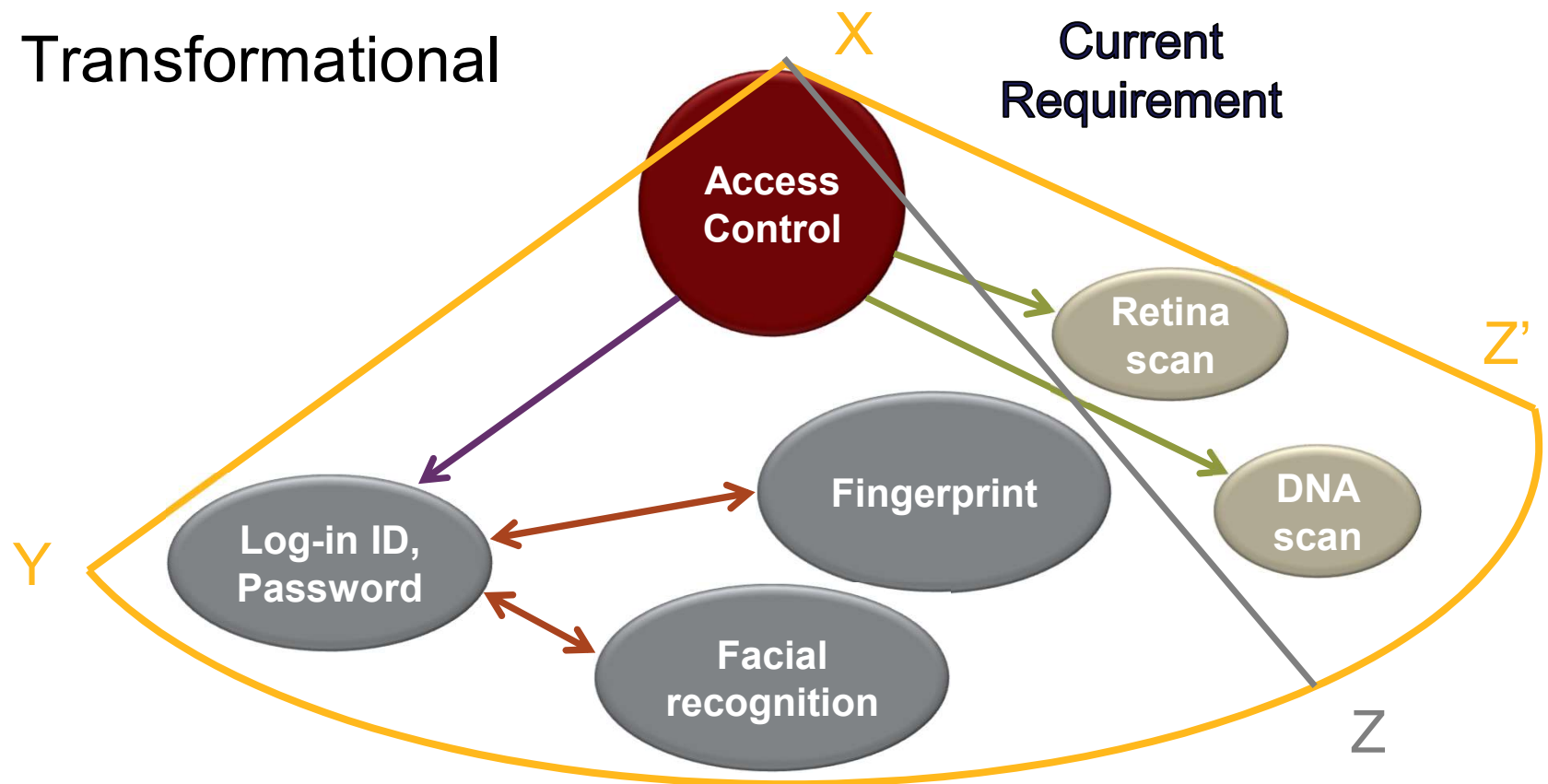
Creativity in RE

- Categories of Creativity [Boden, 2003]
 - Exploratory
 - Combinational
 - Transformational



Creativity in RE

- Categories of Creativity [Boden, 2003]
 - Exploratory
 - Combinational
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Creativity in RE

System	New Requirement
Firefox	F1: Firefox should provide floating tab-view
	F2: Firefox should provide button for saving all tabs
	F3: Firefox should inform users the count of open tabs
	F4: Firefox user can select text saving directly into files
	F5: Firefox should provide arrow to browse tabs
	F6: Firefox users can zoom in/out by a dragging slider
	F7: Firefox user can text phone number from the web page
	F8: Firefox can parallel tab-view

Source: Bhowmik et al., 2020

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Creativity in RE

Louisiana ...W Bangla...xCarnegie...Mississippi...Stanford U...Blekinge T...Sweden - ...University ...Startside - ...LU FACULTY ...Fédération...

en.wikipedia.org/wiki/Bangladesh

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Bangladesh

From Wikipedia, the free encyclopedia

This article is about the People's Republic of Bangladesh. For other uses, see *Bangladesh* (*disambiguation*).

Bangladesh /bɑːndʒəˈdeɪ/; bæŋɡlə ˈdaːtʃ) (Bengali: বাংলাদেশ, pronounced: [ˈbənladə̪t͡ʃ] (listen), lit. "The land of Bengal"), officially the **People's Republic of Bangladesh** (Bengali: গণপ্রজাতন্ত্রী বাংলাদেশ *Gônôprōjatôntri Bangladesh*), is a country in South Asia. It is bordered by India to its west, north and east; Burma to its southeast and separated from Nepal and Bhutan by the Chicken's Neck corridor. To its south, it faces the Bay of Bengal. Bangladesh is the world's eighth-most populous country, with over 160 million people, and among the most densely populated countries. It forms part of the ethno-linguistic region of Bengal, along with the neighbouring Indian states of West Bengal and Tripura.

The present-day borders of Bangladesh took shape during the Partition of Bengal and British India in 1947, when the region used to be known as East Pakistan, as a part of the newly formed state of Pakistan. It was separated from West Pakistan by 1,400 km of Indian territory. Due to political exclusion, ethnic and linguistic discrimination and economic neglect by the politically dominant western wing, nationalism, popular agitation and civil disobedience led to the Bangladesh Liberation War and independence in 1971. After independence, the new state endured poverty, famine, political turmoil and military coups. The restoration of democracy in 1991 has been followed by relative calm and economic progress. In 2014, the Bangladeshi general election was boycotted by major opposition parties, resulting in a parliament and government dominated by the Awami League and its smaller coalition partners.

Bangladesh is a unitary parliamentary republic with an elected parliament called the Jatiyo Sangshad. Bengalis form the country's largest ethnic group, along with indigenous peoples in northern and southeastern districts. Geographically, the country is dominated by the fertile Bengal delta, the world's largest delta. The four largest and constitutionally recognized religions in the country are Islam (89%), Hinduism (8%), Buddhism (1%) and Christianity (0.5%).

Bangladesh is identified as a Next Eleven economy. It has achieved significant strides in human and social development since independence, including in progress in gender equity, universal primary education, food production, health and population control.^{[c][7][8]} However, Bangladesh continues to face numerous political, economic, social and environmental challenges,

People's Republic of Bangladesh
গণপ্রজাতন্ত্রী বাংলাদেশ
Gônôprōjatôntri Bangladesh

FlagEmblem

Anthem:
Amar Sonar Bangla
আমার সোনার বাংলা

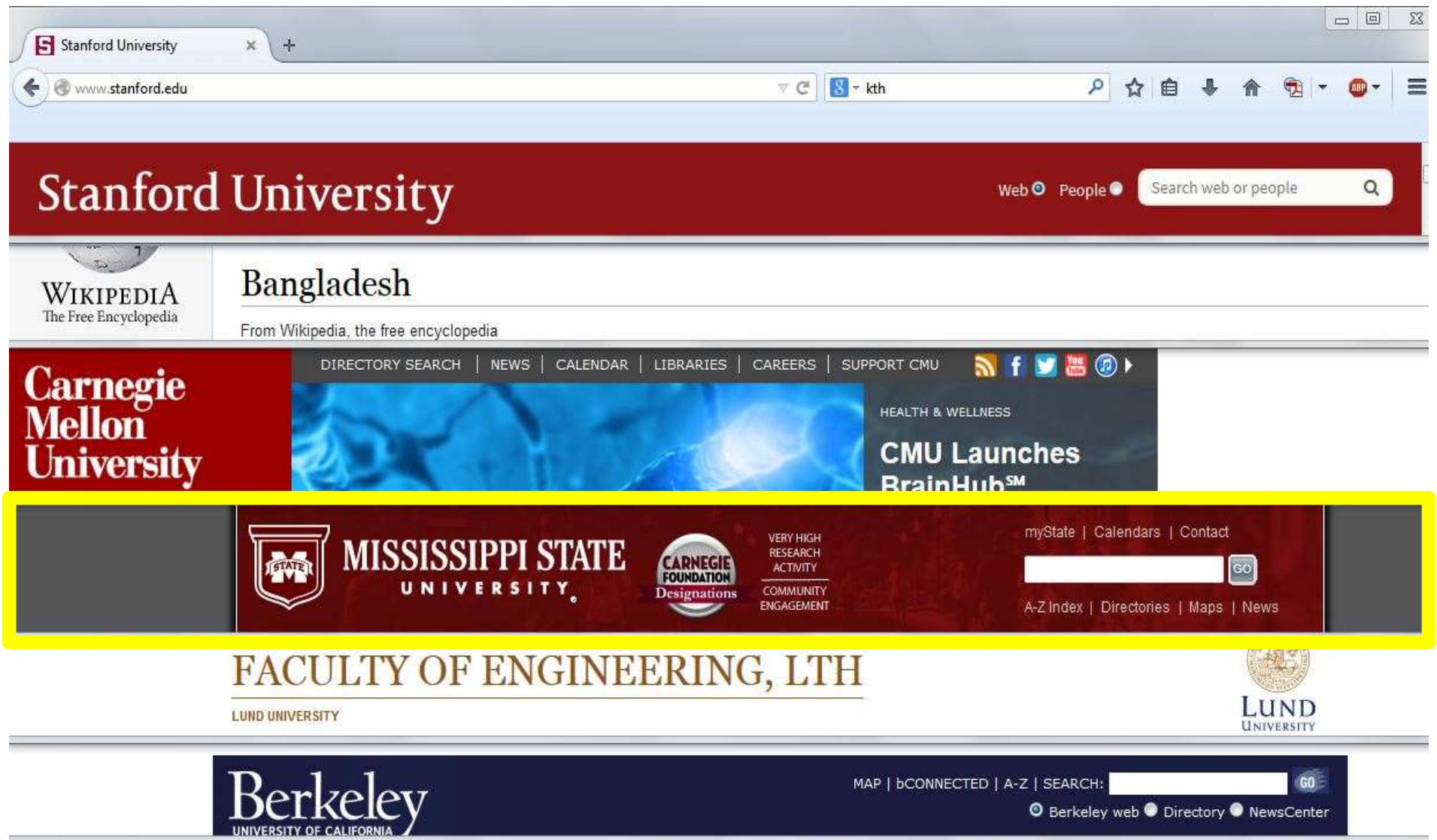
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MENU

Government Seal of Bangladesh
বাংলাদেশ সরকার সীলমোহর



Creativity in RE



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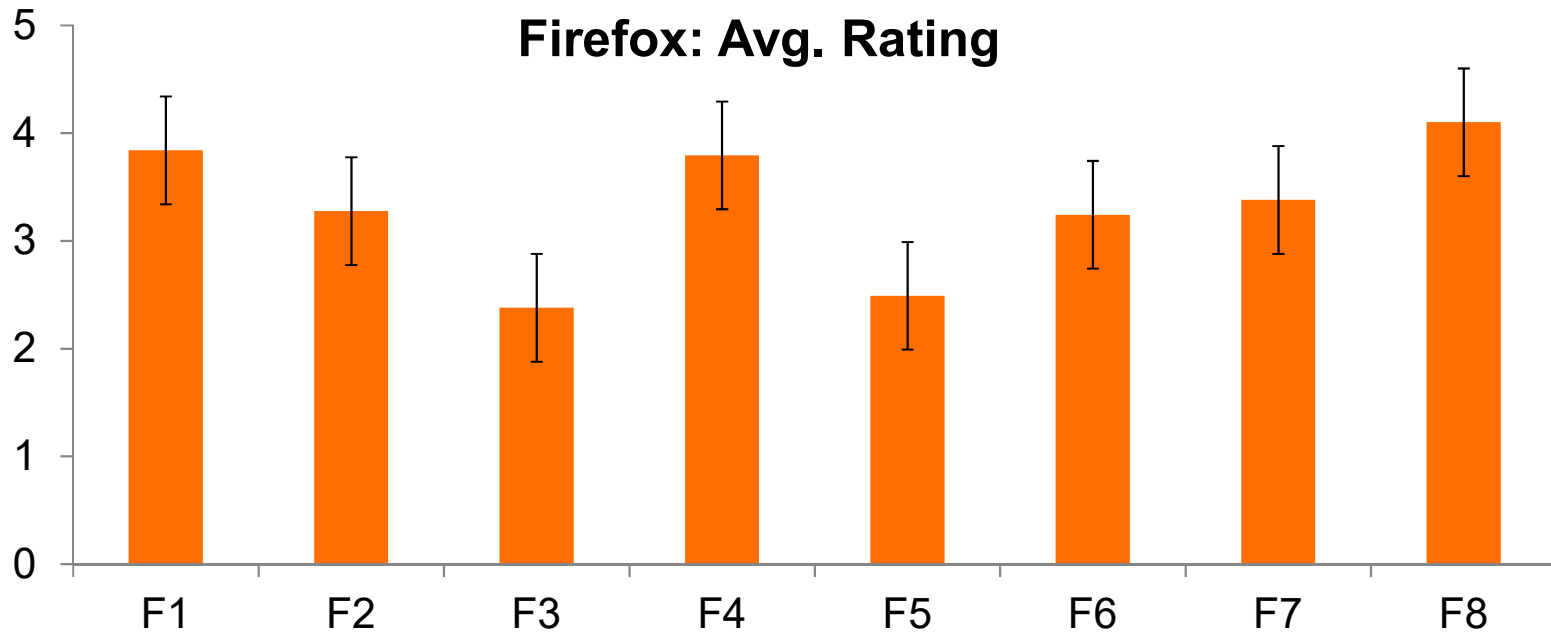
How to measure creativity in RE?

- Creativity [Sternberg, 1999]
 - Ability to produce work that is both
 - Novel
 - original and unexpected
 - Appropriate
 - useful and adaptive to task constraints
- Rate the requirements at a 5-point Likert Scale
 - 1 = least innovative
 - 2 = not innovative
 - 3 = neutral
 - 4 = innovative
 - 5 = most innovative



How to measure creativity in RE?

- Kappa statistic is used to show the level of agreement among participants [Manning *et al.* 2008]
 - Firefox: 0.79



Source: Bhowmik et al., 2020

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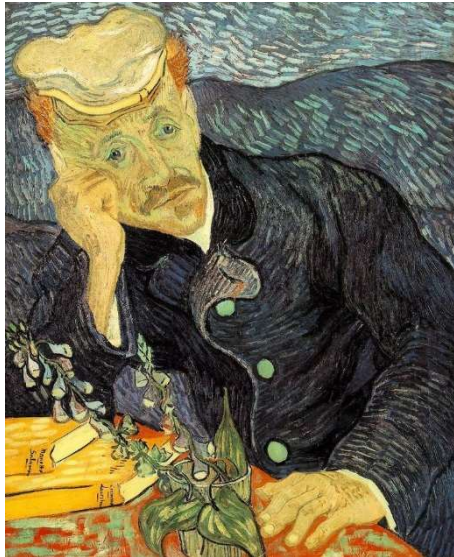
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Is such a single rating sufficient?



How to measure creativity?



\$149.7 M

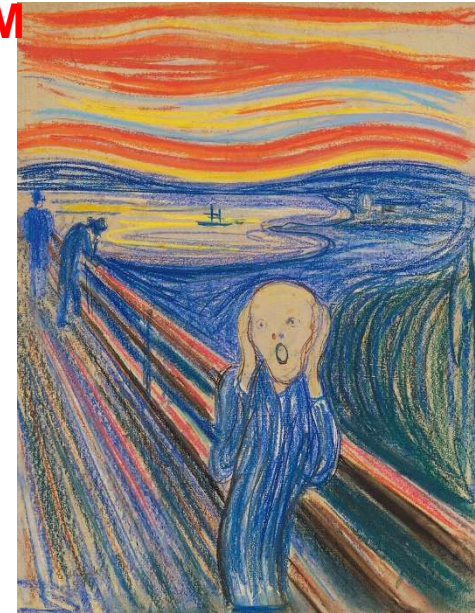


\$103.4 M



\$300 M

\$119.9 M



\$112.5 M

Picture source: Internet

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How to measure creativity in RE?

- In Recent Years
- Clarity
 - Unambiguous, provides an appropriate level of detail
- Novelty
 - Users find it original and unexpected
 - something that is not common place, mundane, or conventional
- Usefulness
 - Useful & implementable
 - Provides value or utility to the users

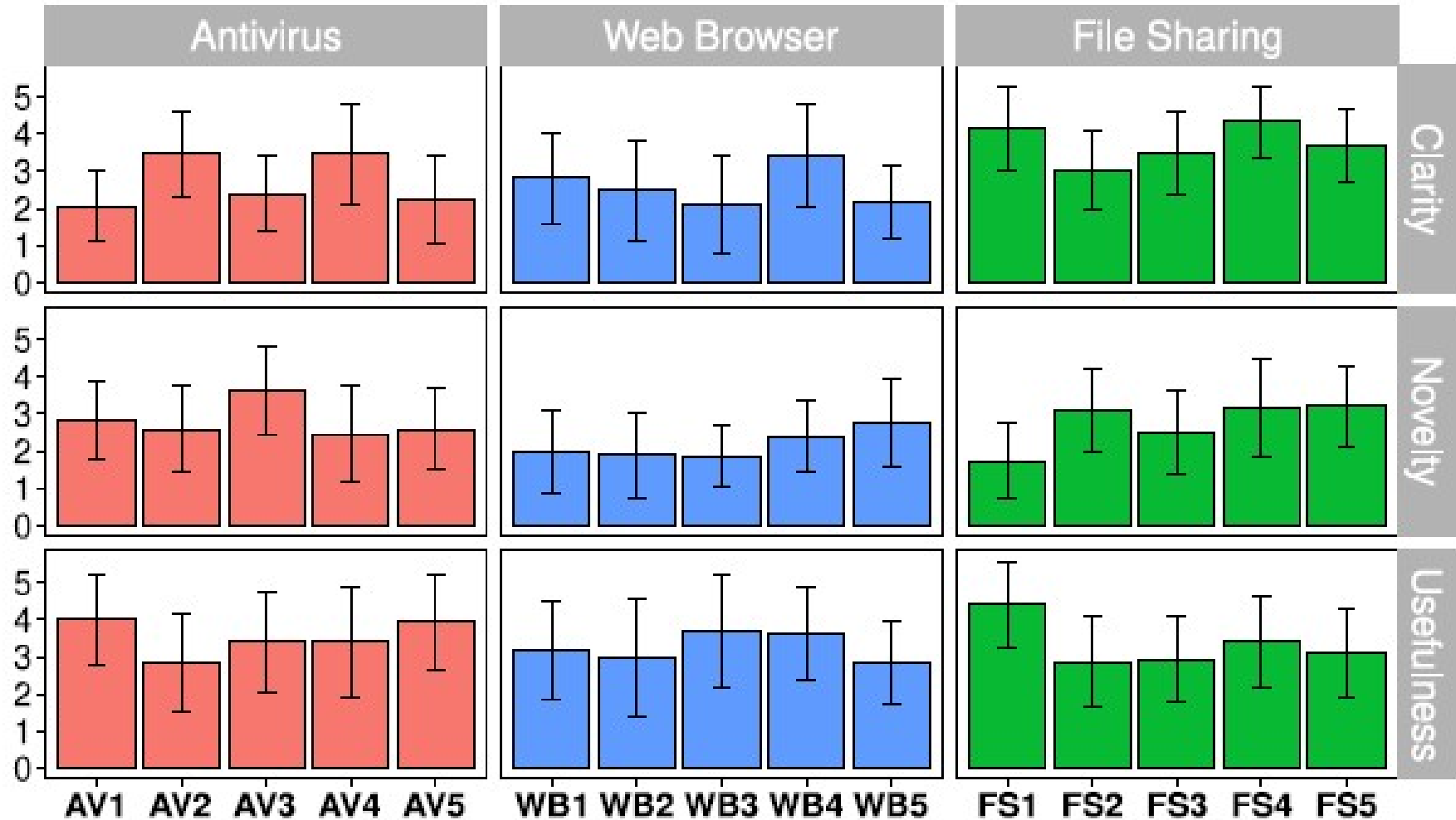


How to measure creativity in RE?

- Clarity
- Novelty
- Usefulness
- Rate the requirements at a 5-point Likert Scale
 - 1 = very low
 - 2 = low
 - 3 = medium
 - 4 = high
 - 5 = very high



How to measure creativity in RE?



Picture source: Do et al., 2020

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How to measure creativity?

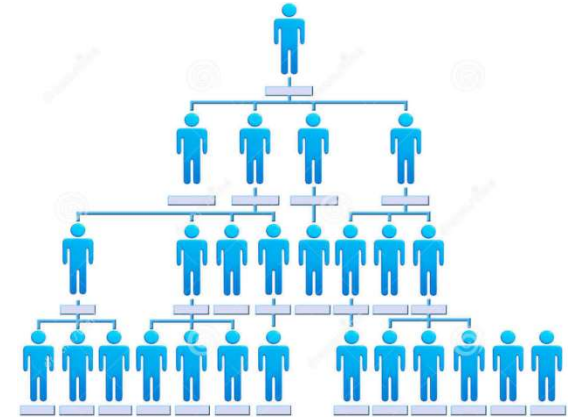
- Facet-Level-Measurement Approach [Batey, 2012]
- Facet: What is being measured?
 - The 4 Ps
 - Person (trait)
 - Process
 - Press (environment)
 - Product

Person X Process X Press = Product



How to measure creativity?

- Level: We are measuring the facet at what level?
 - The 4 levels
 - Culture
 - Organization
 - Team
 - Individual



Picture source: Internet

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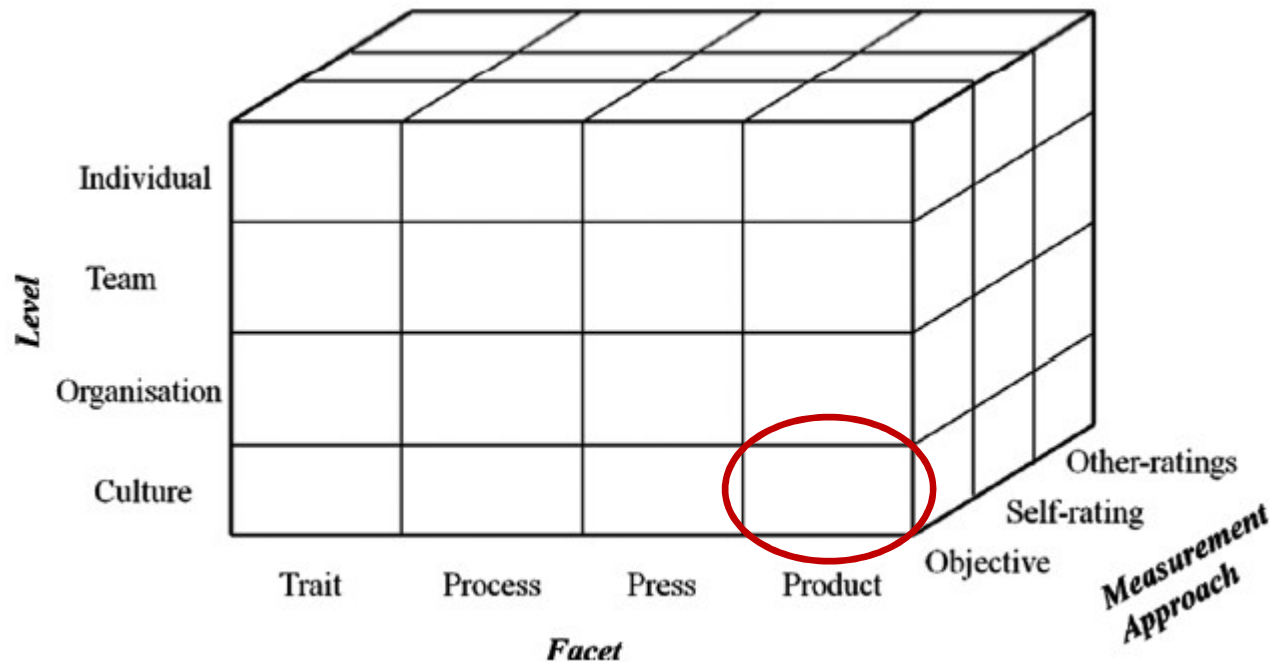
How to measure creativity?

- Measurement Approach: How to measure a facet at a specific level?
 - Objective measure
 - # of patents for an inventor, # of exhibitions for an artist
 - Subjective measure
 - From the focal point of analysis, done internally
 - E.g., self-rating, rating from the team members about the product they built
 - Other-ratings
 - Rating provided by an external subject matter expert



How to measure creativity in RE?

- A three dimensional heuristic framework by Mark Batey [Batey, 2012]



Product = Requirement
Ratings: Objective, Expert

How to measure creativity in RE?

- Levels and kind of creativity in products
[Cropley & Cropley, 2005]

Criterion	Kind of Product				
	Routine	Original	Elegant	Innovative	Aesthetic
Effectiveness	+	+	+	+	-
Novelty	-	+	+	+	+
Elegance	-	-	+	+	?
Genesis	-	-	-	+	?



How to measure creativity in RE?

- The Creative Solution Diagnosis Scale (CSDS) with 30 attributes [adapted from Cropley et al., 2011]

Relevance & Effectiveness	Novelty			Elegance		Genesis
	Problematization	Existing Knowledge	New Knowledge	External	Internal	
Correctness	Diagnosis	Replication	Redirection	Recognition	Completeness	Foundationality
Performance	Prescription	Combination	Reconstruction	Convincingness	Gracefulness	Transferability
Appropriateness	Prognosis	Incrementation	Reinitiation	Pleasingness	Harmoniousness	Germinality
Operability			Redefinition		Sustainability	Seminality
Safety			Generation			Vision
Durability						Pathfinding

27 different attributes



How to measure creativity in RE?

- The question we would like to ask

Can we adapt CSDS to measure creativity in RE?



Defining the attributes in RE

Attribute	General Definition	Redefine in RE
Correctness	The solution accurately reflect conventional knowledge and/or technique	The requirement accurately reflects conventional knowledge and/or technique about the application domain
Appropriateness	The solution fits within task constraints	The requirement fits within the task constraints. That is, given the constraints/limitations of resources (e.g., time, money, technology, etc.) in hand, a successfully implementation of the requirement is possible.

adapted from Cropley et al., 2011
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How to evaluate creativity in RE?

- **27 creativity attributes** that should be used to assess creativity merit of a requirement
 - **Correctness:** The requirement accurately reflects conventional knowledge and/or technique about the application domain
 - **Operability:** The requirement is easy to use. That is, the requirement does not have any negative effect on the usability of the software system (it can be implemented in such a way)
 - **Prognosis:** The requirement helps the requirements engineer (or stakeholder) anticipate likely effects of changes that will take place in the software
 -



Exercise

Firefox can parallel tab-view

Attribute	Rate 5-Strongly Agree 4-Agree 3-Neutral 2-Disagree 1-Strongly disagree
1. Correctness: The requirement accurately reflects conventional knowledge and/or technique about the application domain.	
2. Performance: The requirement does what it is supposed to do. That is, the requirement has a positive impact on the overall functionality of the software system. Or, the requirement improves the overall functionality (or, performance) of the software system. In other words, the requirement makes the software more attractive to the users.	
3. Appropriateness: The requirement fits within the task constraints. That is, given the constraints/limitations of resources (e.g., time, money, technology, etc.) in hand, a successfully implementation of the requirement is possible.	



Summary

- Creativity in RE
 - Why it is important?
- How to measure creativity?
- How to measure creativity in RE?
 - Do we need a more sophisticated measurement approach?
- Next
 - Requirements-Based Testing



THANK YOU



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