International Council on Systems Engineering
A better world through a systems approach

Analysing Systems Engineering Vision 2035 Through a Cultural Lens

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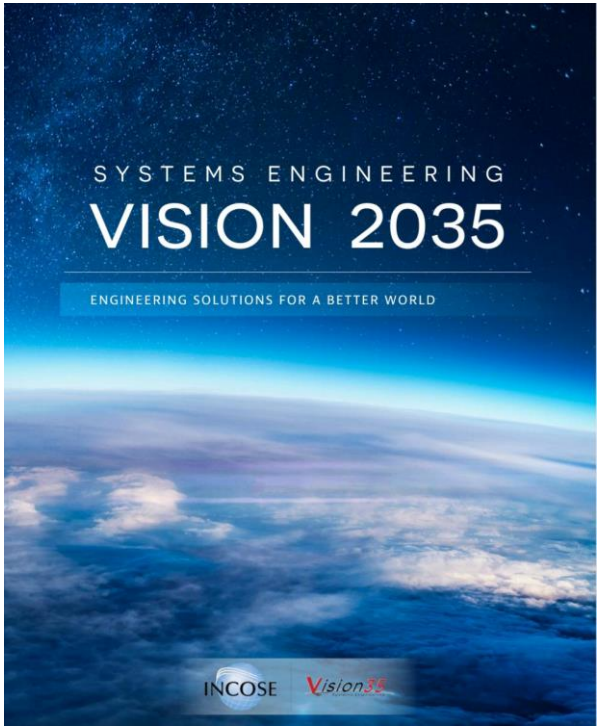
Analysing Systems Engineering Vision 2035 Through a Cultural Lens



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- Conclusion

Methodology

Methodology

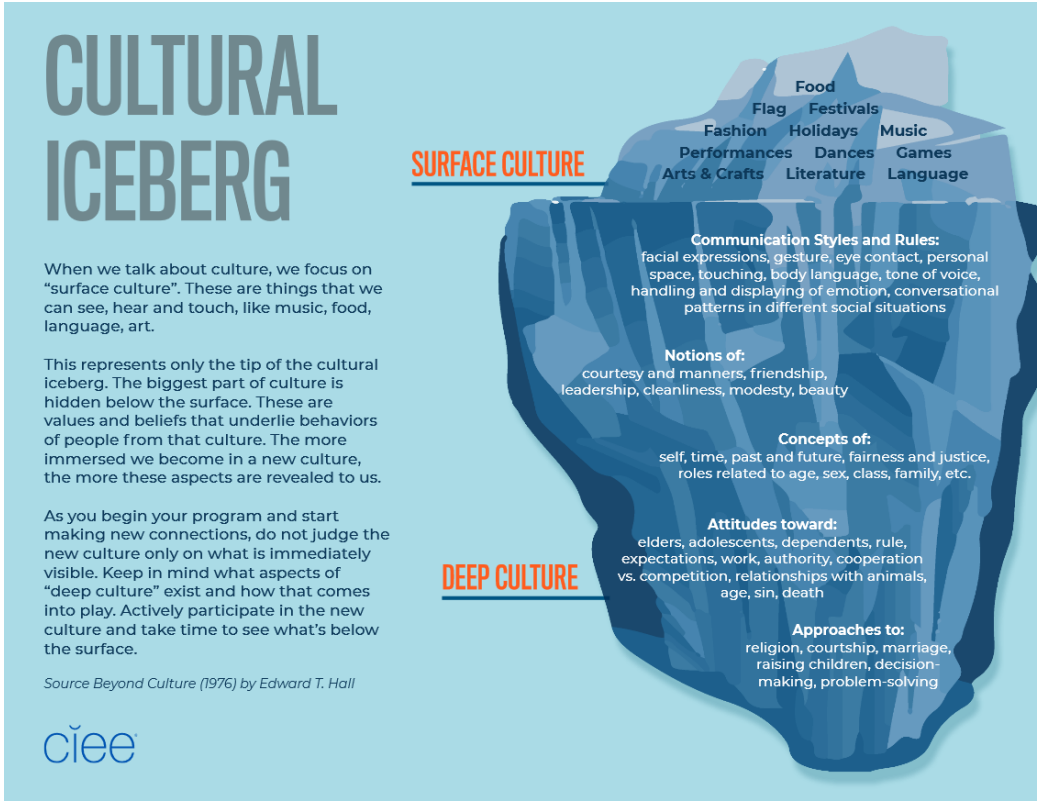
- Comparative Review of Cultural Differences in SE Between Eastern and Western Paradigms
- Cultural Analysis of SE Vision 2035

Eastern Vs. Western Approaches to Systems Engineering

Culture

Definition of Culture

Culture is an umbrella term which encompasses the social behavior and norms found in human societies, as well as the knowledge, beliefs, arts, laws, customs, capabilities, and habits of the individuals in these groups. (Tylor,1871)



Key Studies for SE Practices Addressing Cultural Dimensions

Side	References
China & Japan / Eastern	(Dai, 1997; Jingyuan, 1990; Lin et al., 2012; Lu et al., 2018; L. L. Lynn, 2019; Okada et al., 2009; Sanders & Jackie, 2016; Wakasugi, 1992; N. Wang, 2011; Z. Wang, 2000; Xuesen, 1986, 1991; Xuesen et al., 1993, 2011; Yuejie 跃杰, 2018)
Comparative Studies	(Collins & Callahan, 2009; Ferris, 2006b, 2006a; Hofstede, 2008; Khoo Hsien H. & Tan Kay C., 2003; Li & Li, 2009; L. H. Lynn, 2002, 2003; Ogawa & Rhodes, 2009; Pan et al., 2013; Pandikow et al., 2007; Qian, 2013; Warner, 1994)
USA / Western	(Braun, 1962; Castellani, 2018; Copley, 1923; Ferris, 2004; Hieronymi, 2013; INCOSE, 2023; Maurer, 2017; Ramage & Shipp, 2020)

Cultural Influence in Space Programs Study By MIT

China × Malaysia × Saudi Arabia* × United States ×

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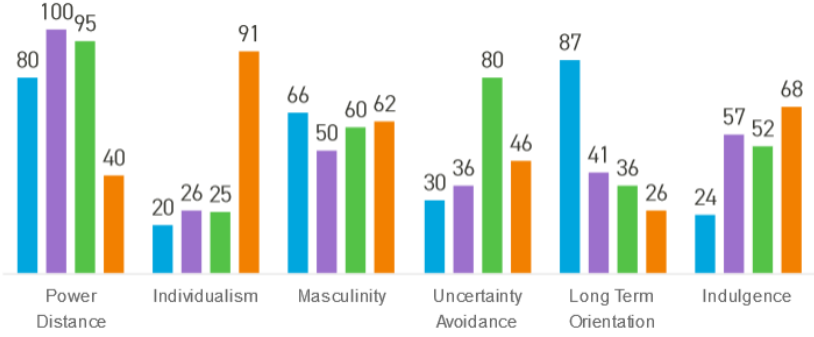


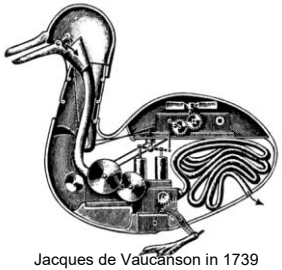
* estimated

"Investigating the Impact of Cultural Differences on Systems Engineering: A Case Study of Manned Space Flight Programs in the United States and China" (Qian, 2013)

Eastern Vs. Western Cultural Factors in SE

Cultural Factor	West	East
Quality [11], [14]	Build the system fast. Then, improve it by testing	Consume more time in design and verification, before building the system
Decision-Making [11]	Could be handled by individual	Should be consulted by a group
Management Discussion [16]	Very easy to negotiate with the manager	Very difficult to discuss with the manager
Thinking [10]	Reductionism, goal-oriented	Holism, process-oriented
Design changes [13]	Accept changes easily	Accept changes hardly
Interfaces between engineers [13]	Like to have clear interfaces and inputs/outputs between engineers	Like to have more overlapping roles
Hierarchy [17]	Less hierarchy	More hierarchy
Number of engineers per population [14]	Less	More
Technological obsolescence of engineers [14]	Fast	Delayed
Engineers in higher management roles [14]	Less	More
Engineers' rotation training [14]	Less	More
Teamwork [14]	Less, defined roles	More, organic forms
Language		More ambiguity and imprecision
Engineers' organization [14]		More flexible
Engineers' confidence [14]	Higher	Lower
Engineers' Loyalty [11], [17]	Lower	Higher

The Role of Philosophical Paradigms In Modern SE



Jacques de Vaucanson in 1739

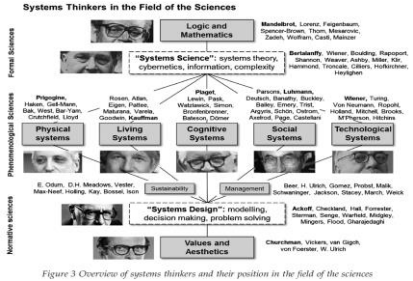
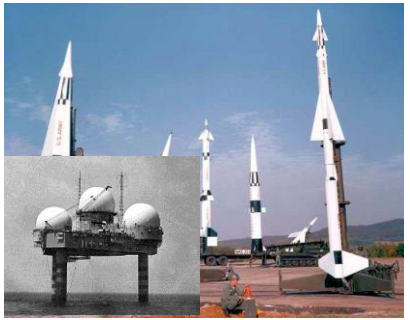


Figure 3 Overview of systems thinkers and their position in the field of the sciences

(Hieronymi, 2013)



Western SE

Greek Philosophy Theology

Scientific Revolution

Mechanical Philosophy / Modernity

Systems Science

Post WWII Industry

Chinese SE

Ancient Chinees

Marxism

Qian Xuesen

Modern Chinese Systems

Confucius (479 BC)

Dujiangyan Irrigation System (256 BC)

(Sanders and Jackie, 2016)

Analysing SE Vision 2035 from a Cultural Lens

Consumption, Over Population, Japan Society 5.0, Human-Centered SE, Ethics & Values, History of SE, Visualization, Theoretical Foundation, Major Societal Challenges, Heuristics

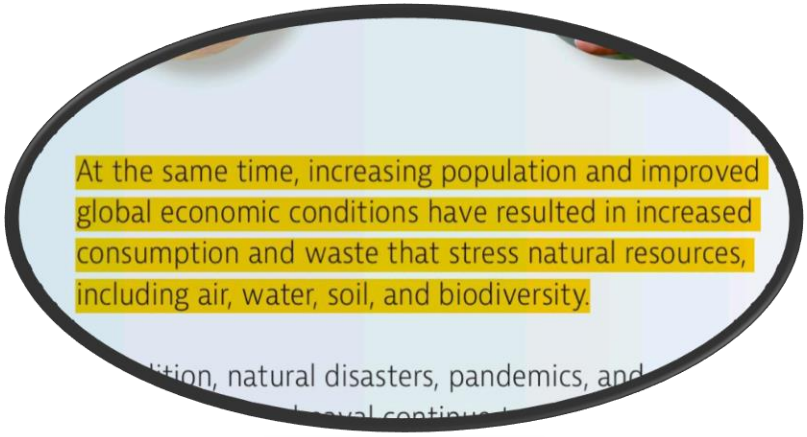
1. Consumption

INCOSE SE Vision 2035 **page iv**

- Consumption Behavior
  - 18th Century, West Europe
  - 1920s: Mass Production → Mass Consumption
  - 1950s: Need Based → Desire Based
- Eastern Approaches to Consumption:
  - Conficusism & Taoism: Balance with nature
  - Motannini: Ethical use of resources
- Polojarvi :(2022) Envisioning INCOSE & UNSDGs: socio-anthropological model of macro-level change.
- **Key Takeaway:** Support movements in INCOSE related to wise consumption:

2. Over-Population

INCOSE SE Vision 2035 **page iv**



(Dyett & Thomas, 2019; Mason, 1995; Scudellari, 2015; Thomas & Gosink, 2021):

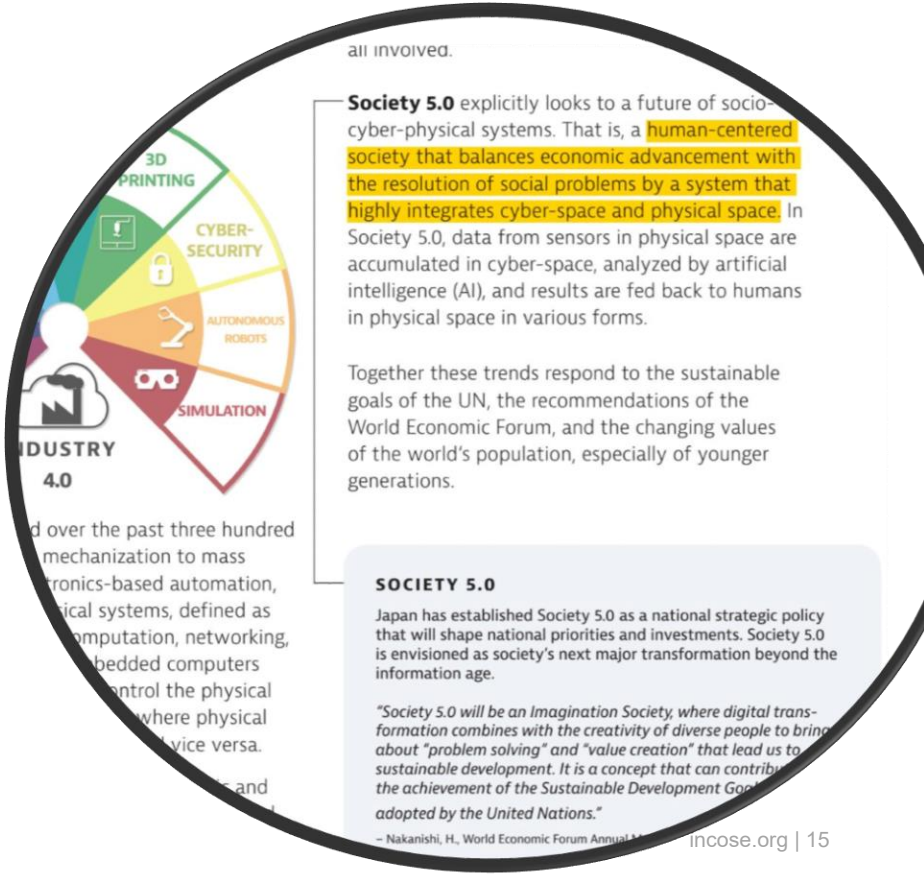
- Over-Population as a source of environmental issues is hotly debated.
- Ethical concerns arise over human population planning strategies associated with overpopulation arguments, such as forced sterilization and coercive birth control measures.
- The total carbon emissions from Bezos' yacht, private jets, mansions, and other luxury purchases are equivalent to the emissions from 2.1 million homes (Barros and Wilk, 2021).
- **Key Takeaway:** More balanced approach that focus on the consumption patterns is suggested.

3. Japan Society 5.0

INCOSE SE Vision 2035 **page 7**

Masayoshi Ari (at INCOSE IS2021):

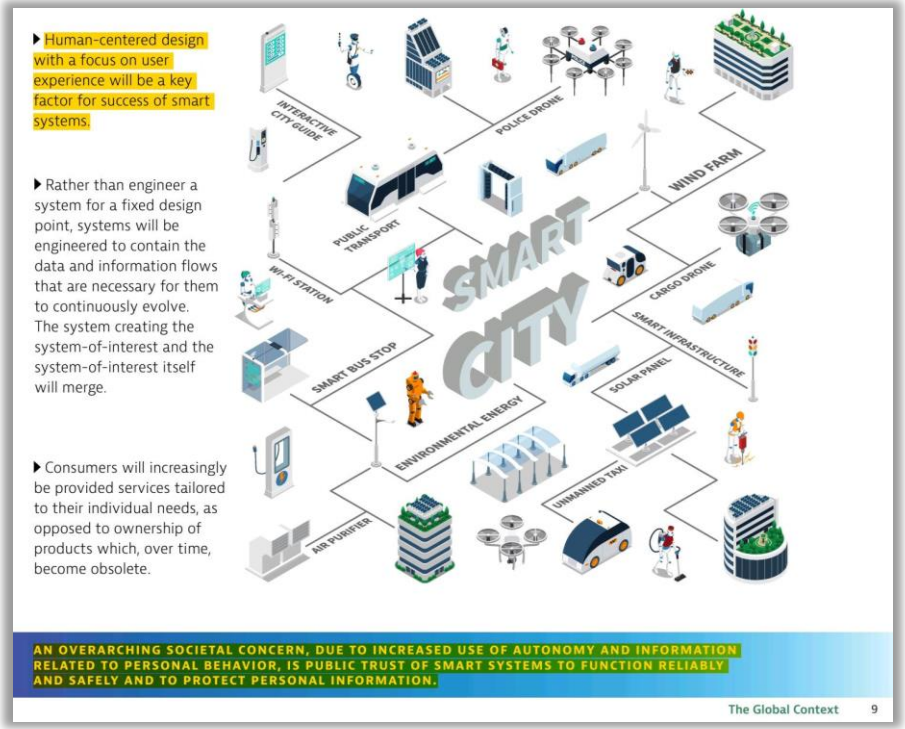
- Traditional Japanese manufacturing →Perfect "reasoning of the state," with homogeneous citizens, and a "vertical" relationship between the state and its citizens
- Modern industrialization → Horizontal hierarchy.
- Covid-19 → Sectionalism negative effects appeared.
- Japan Society 5.0 → Challenges in specifying roles; complex relationship design needed.
- **Key Takeaway:** To account for cultural adaption for new approaches.



4. Human-Centered SE

INCOSE SE Vision 2035 **page 9**

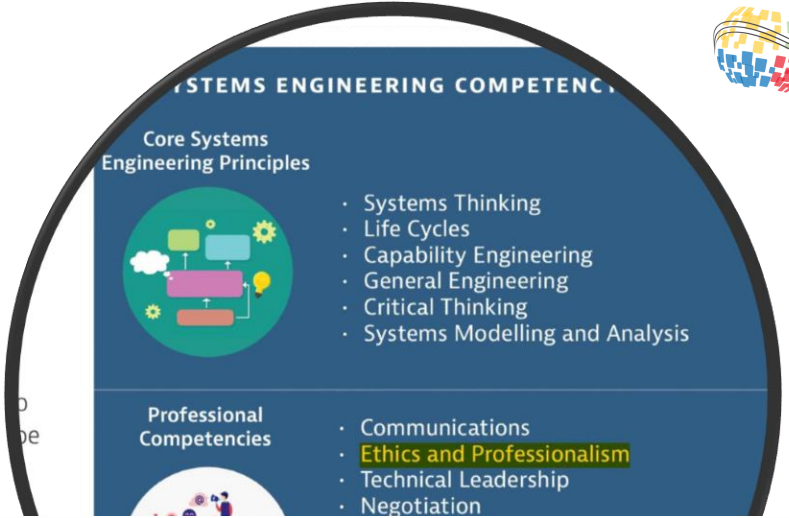
- Western Philosophy (Renaissance, Modernity, and Post-Modernity) → Human centrality changes, individualism
- Eastern Philosophy (Confisusim, Taoism, and Buddhism) → Collective action, interconnectedness, and harmony
- Example: Science Fiction
- **Key Takeaway:** To consider elements that is more collective, and harmony.

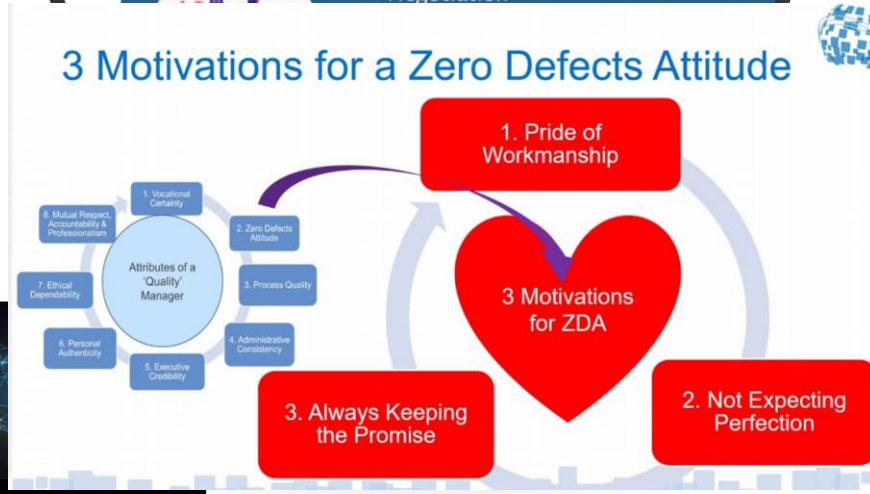


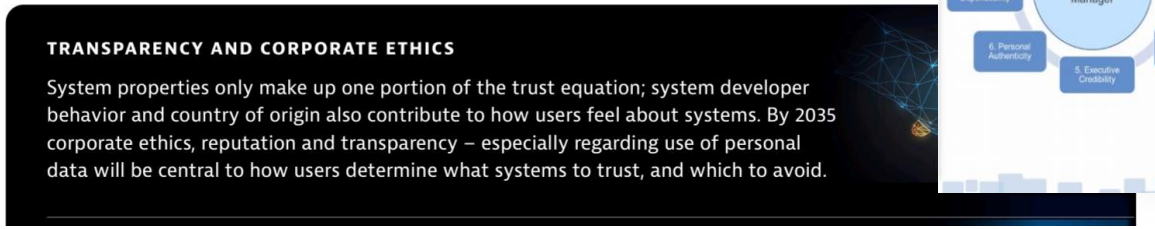
5. Ethics & Values

INCOSE SE Vision 2035 **page 19, 37**

- INCOSE QM WG, Brown et al, 2021
- Are values from nature, from nurture, chosen, unconscious, fixed or changeable?
- To better understand ZDA, we could investigate the differences between Western and Japanese cultures.
- Spirituality influence
- **Key Takeaway:** to utilize multi-cultural holistic perspective of ethics and values.







6. History of SE

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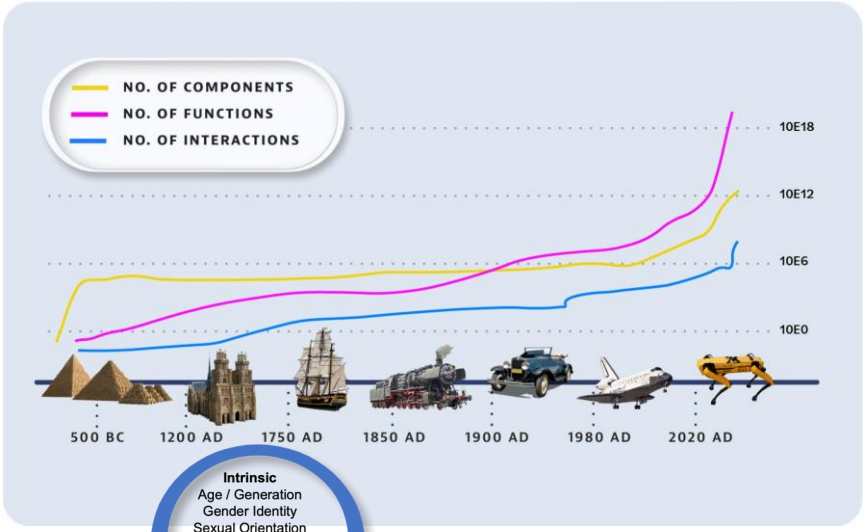
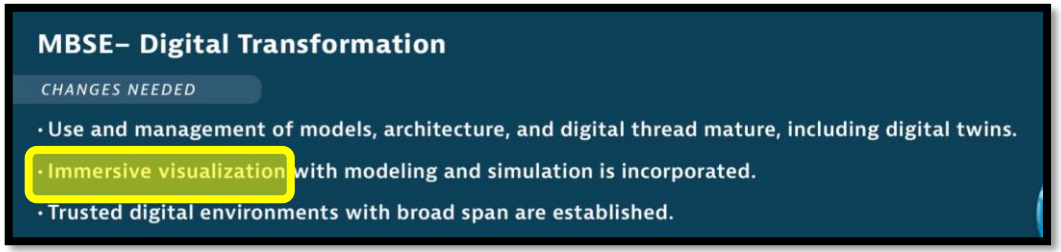
- Western SE history → Bertalanffy, Forrester
- Eastern SE history → Qian Xuesen
- *"For systems thinking to become a historical must and a trend of thoughts, Bertalanffy (1968) has made great contributions. However, as a matter of fact, this trend of thoughts* ***has been explored and developed either before or after Bertalanffy independently by various scholars in many different fields or research topics****. Some of these works were even more specific, more systematic, and more in-depth than what Bertalanffy proposed"* (Lin et al., 2012, p. 38)
- **Key Takeaway:** to include diversity in SE contribution from global perspective. (Harding and Pickard, 2019)

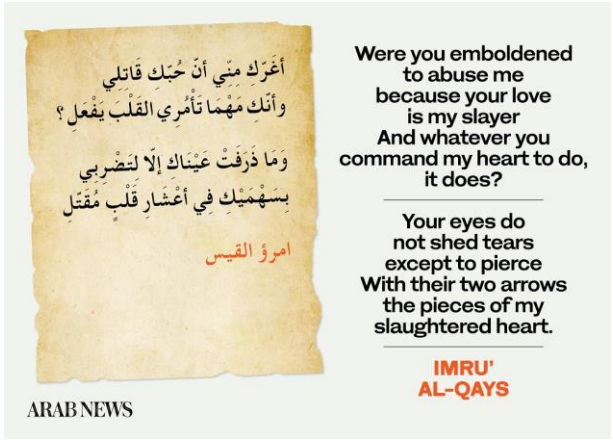


7. Visualization

INCOSE SE Vision 2035 **page 18**

- Western → explicit representations
- Eastern → implicit understanding
- (Brown, 2022): If a picture is worth 1000 words, what is a story worth?
- Islamic / Arabic → Words can carry more weight
- **Key Takeaway:** incorporating rational, process oriented, and narrative-based approaches from other cultures.





8. Theoretical Foundations

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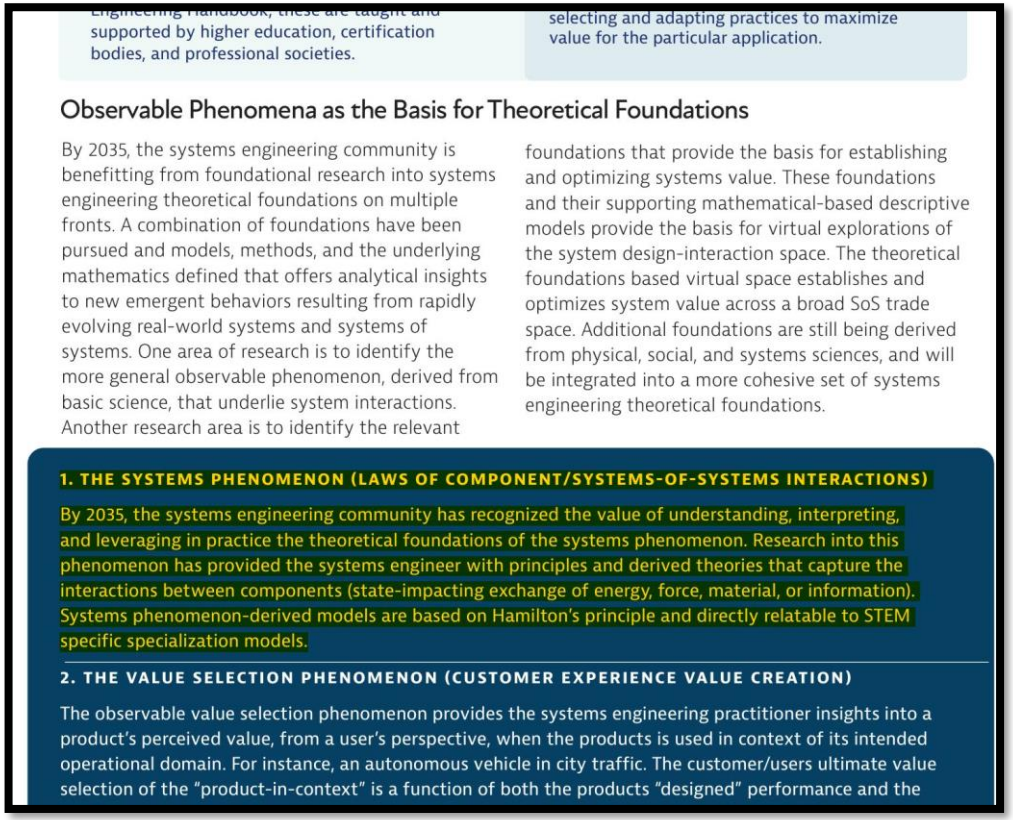
- Western Philosophies → Casualty
  - (Ferris, 2004) The Interplay of Modernism, Postmodernism and Systems Engineering.
- Eastern Philosophies → Complex web of relationship
  - (Xuesen, 1986) On Thinking Science
  - (Xuesen, 1991) Open Complex Giant Systems
- **Key Takeaway:** Integrating Eastern systems thinking perspectives in theoretical foundations of SE.



supported by higher education, certification bodies, and professional societies.

selecting and adapting practices to maximize value for the particular application.

Observable Phenomena as the Basis for Theoretical Foundations

By 2035, the systems engineering community is benefitting from foundational research into systems engineering theoretical foundations on multiple fronts. A combination of foundations have been pursued and models, methods, and the underlying mathematics defined that offers analytical insights to new emergent behaviors resulting from rapidly evolving real-world systems and systems of systems. One area of research is to identify the more general observable phenomenon, derived from basic science, that underlie system interactions. Another research area is to identify the relevant foundations that provide the basis for establishing and optimizing systems value. These foundations and their supporting mathematical-based descriptive models provide the basis for virtual explorations of the system design-interaction space. The theoretical foundations based virtual space establishes and optimizes system value across a broad SoS trade space. Additional foundations are still being derived from physical, social, and systems sciences, and will be integrated into a more cohesive set of systems engineering theoretical foundations.

1. THE SYSTEMS PHENOMENON (LAWS OF COMPONENT/SYSTEMS-OF-SYSTEMS INTERACTIONS)

By 2035, the systems engineering community has recognized the value of understanding, interpreting, and leveraging in practice the theoretical foundations of the systems phenomenon. Research into this phenomenon has provided the systems engineer with principles and derived theories that capture the interactions between components (state-impacting exchange of energy, force, material, or information). Systems phenomenon-derived models are based on Hamilton's principle and directly relatable to STEM specific specialization models.

2. THE VALUE SELECTION PHENOMENON (CUSTOMER EXPERIENCE VALUE CREATION)

The observable value selection phenomenon provides the systems engineering practitioner insights into a product's perceived value, from a user's perspective, when the products is used in context of its intended operational domain. For instance, an autonomous vehicle in city traffic. The customer/users ultimate value selection of the "product-in-context" is a function of both the products "designed" performance and the

9. Major Societal Challenges

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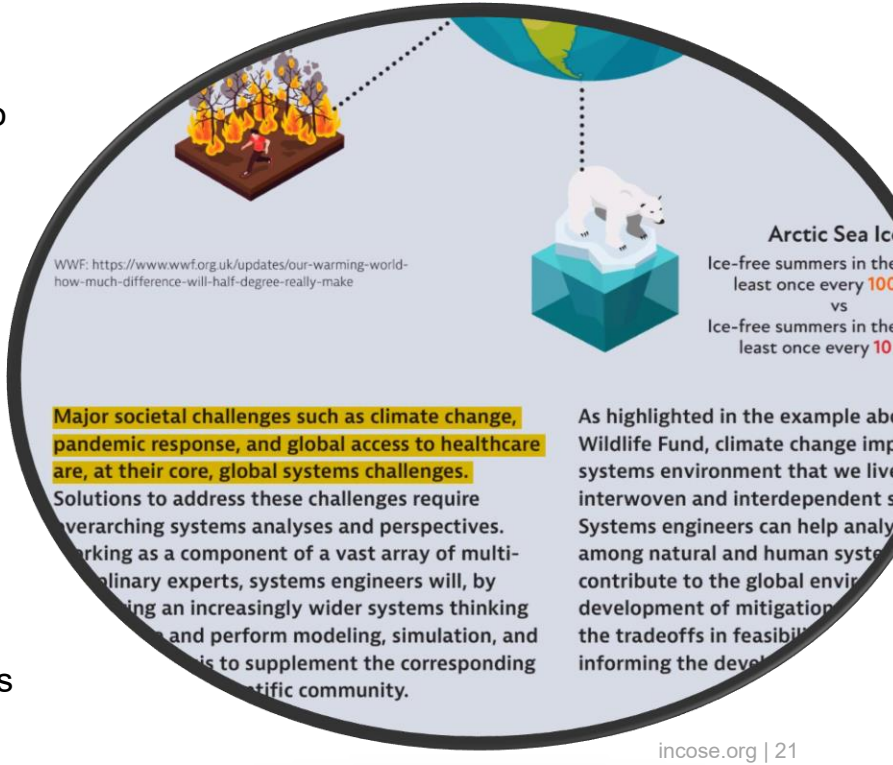
- (Jackson, 2022; Mazzucato, 2021) SE successes in Apollo Program → challenges in other social disciplines.
- UN SDGs
  - World wide acceptance
  - Debates on the details, e.g. Abortion (Daby & Mosely 2022; Ginsburg, 1998)
- (El Messiri, 1996) Example from newspaper:
  - Cover page: Causalities from bus accident in India.
  - Back small news: Sharp rise in children born outside marriage In another region.
- **Key Takeaway:** Incorporating diverse cultural perspectives in framing major societal Challenges.



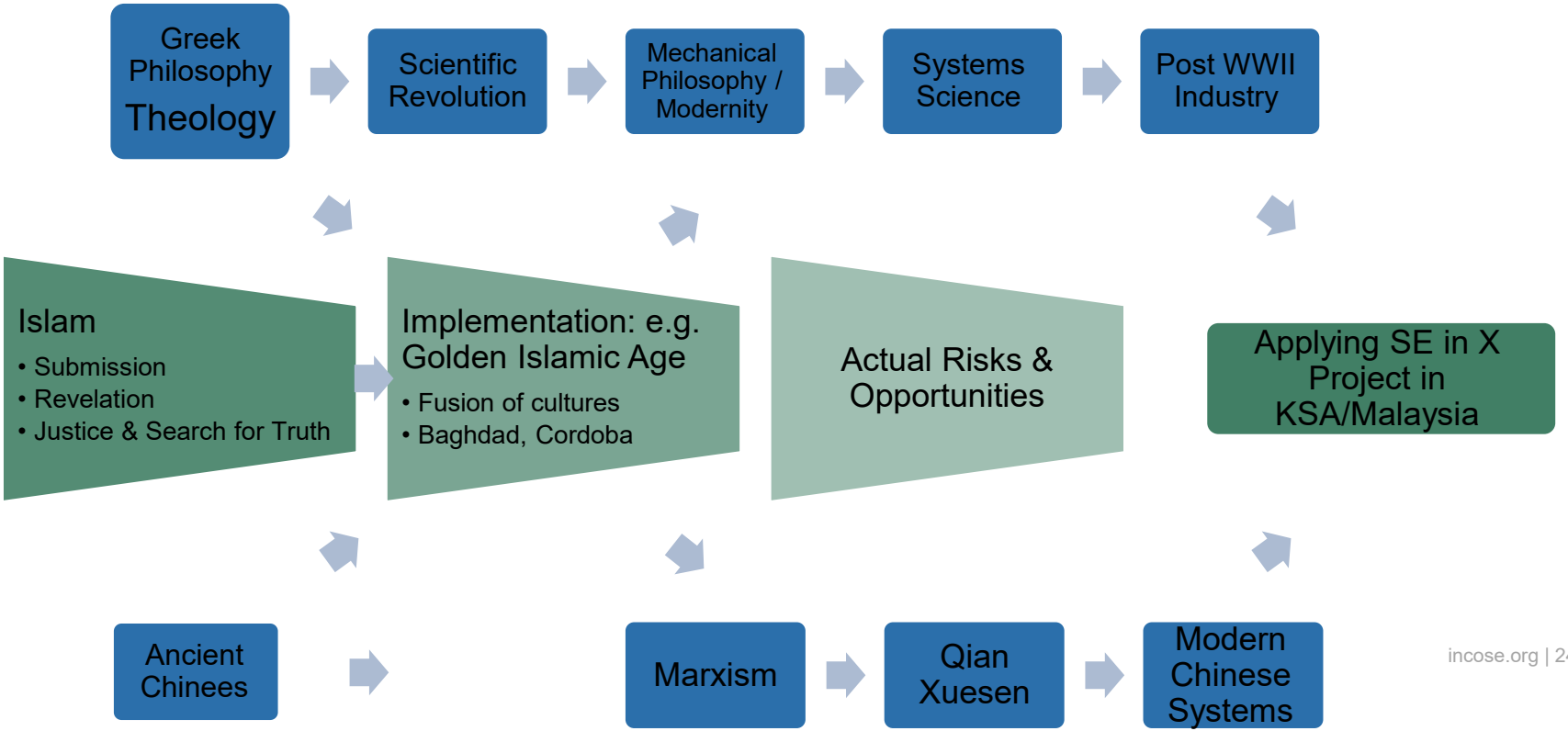
10. Heuristics

INCOSE SE Vision 2035 **page 70**

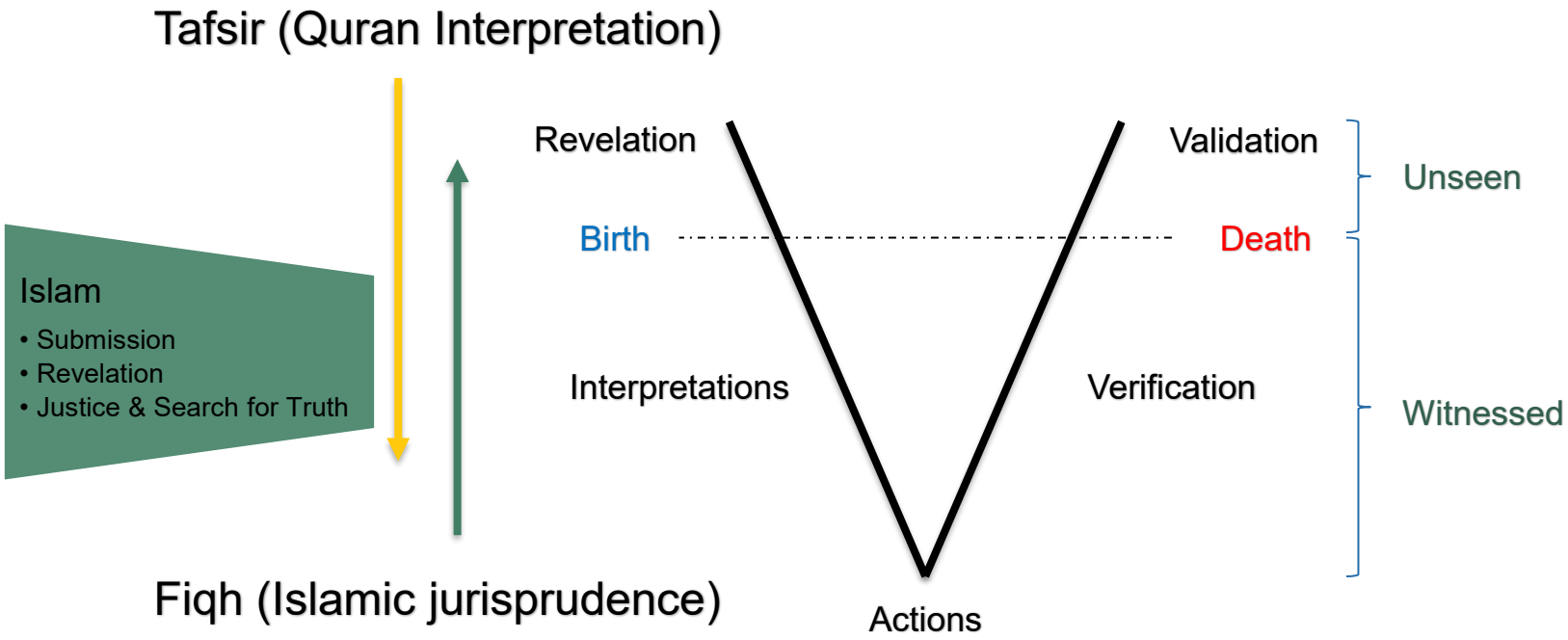
- Western → Structured problem solving
  - (SE Handbook, 2023, p.20) “Don’t assume that the original statement of the problem is necessarily the best, or even the right one”
  - (Stockman et. al., 2010) International collaboration in ISS
- Eastern → Collective wisdom
- (INCOSE Heuristics WG, Wang, 2021) Chinese Proverbs
  - “Proverb/Idiom: A skillful wife cannot cook a meal without rice. (Song Dynasty, 960–1279), SE Application: It is imperative to plan for all necessary resources to execute a successful project, and to avoid the predicament of lacking basic means to accomplish the job.” (McKinney et al., 2021, p. 49)
- **Key Takeaway:** Integrating diverse cultural perspectives in heuristics.

Work in Progress: Cultural Tailoring of Systems Engineering

Cultural Analysis as a Tool for Tailoring Systems Engineering

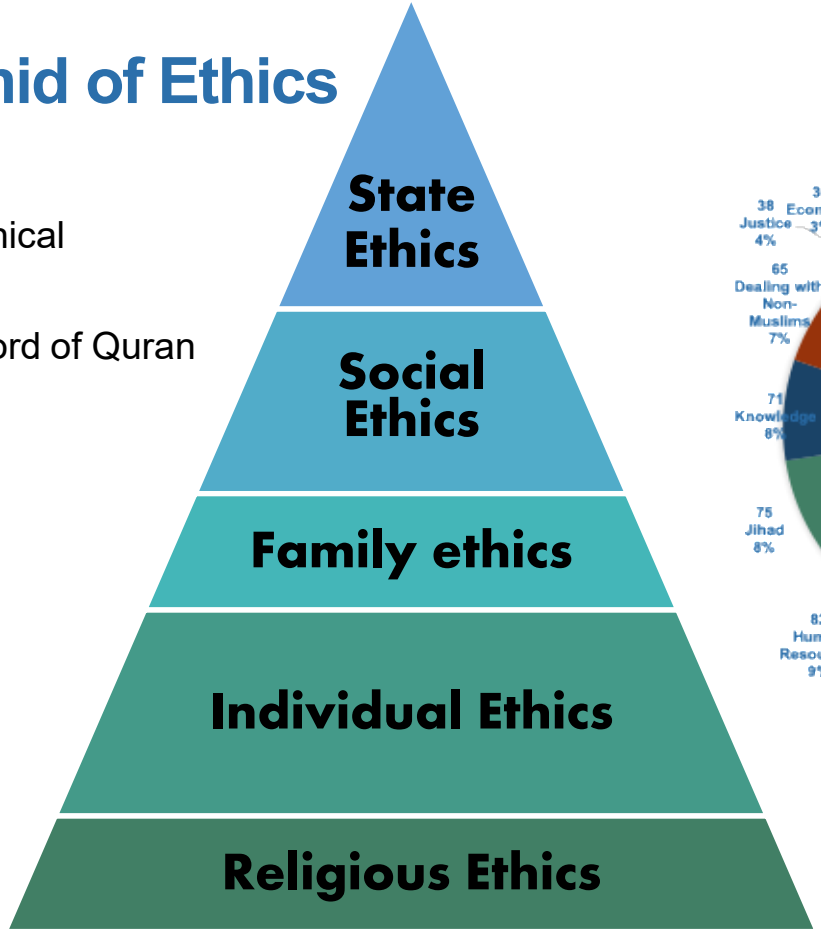


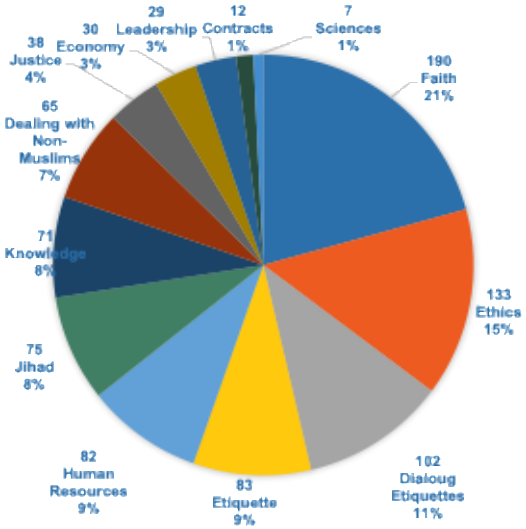
Real Life-Cycle Model

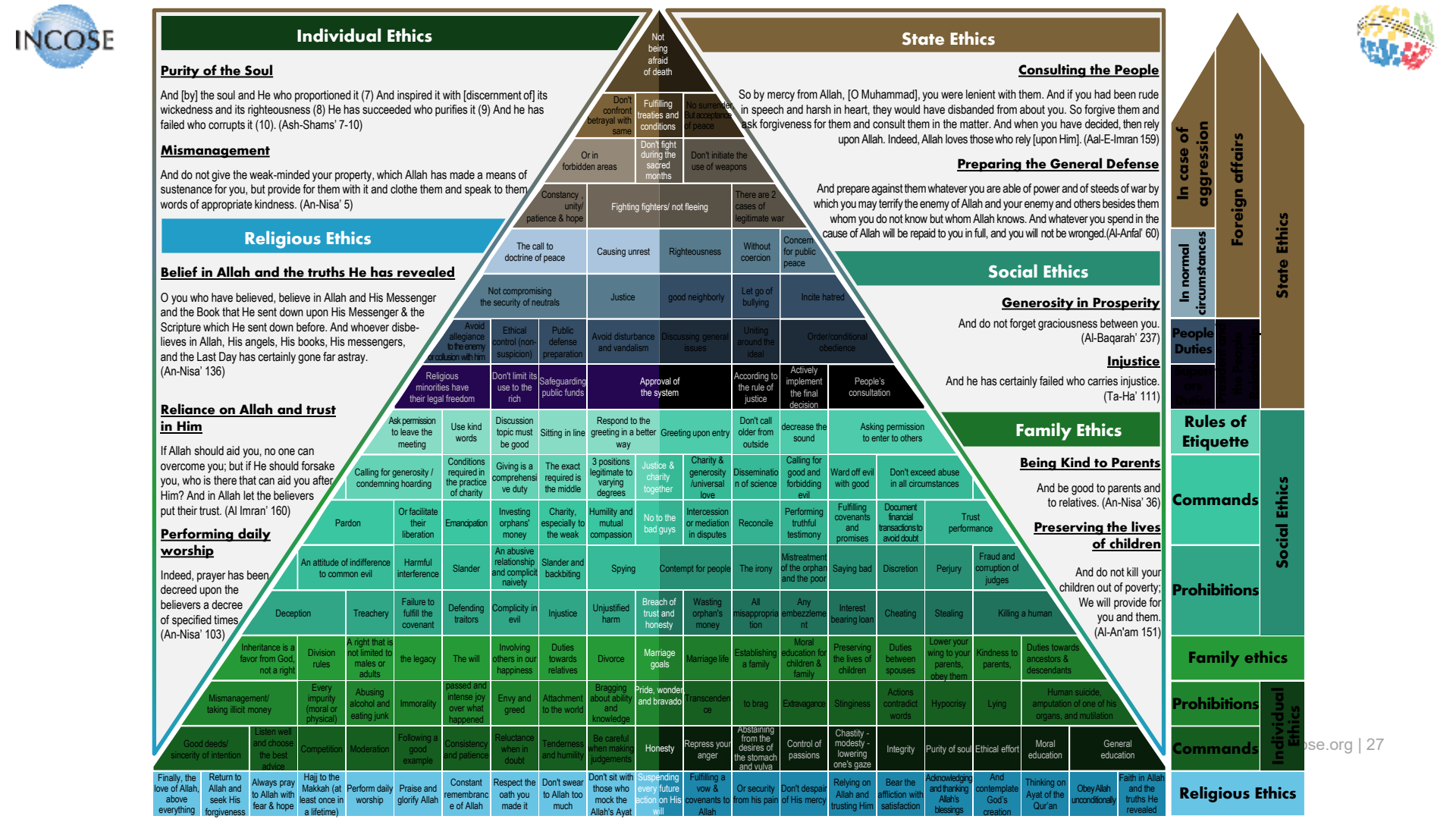


Examples: Pyramid of Ethics

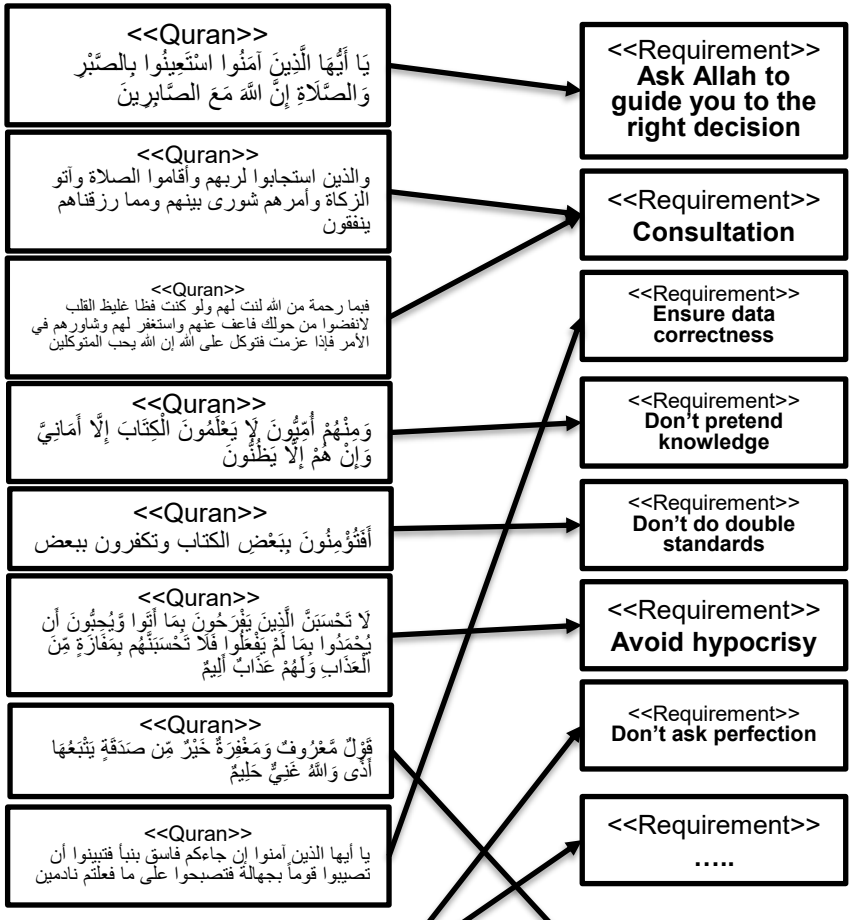
- 500 Ayah to address SE ethical dimensions captured
- (Daraz,1951) The Moral Word of Quran
  - 5 Categories of Ethics
  - 180 Ethic
  - Connected to 800 Ayah

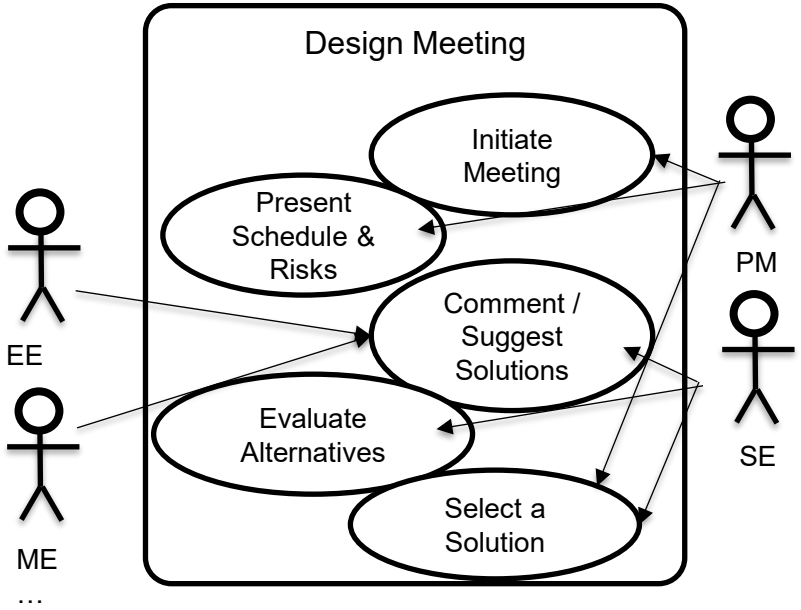





Individual Ethics
Purity of the Soul
And [by] the soul and He who proportioned it (7) And inspired it with [discernment of] its wickedness and its righteousness (8) He has succeeded who purifies it (9) And he has failed who corrupts it (10). (Ash-Shams' 7-10)
Mismanagement
And do not give the weak-minded your property, which Allah has made a means of sustenance for you, but provide for them with it and clothe them and speak to them words of appropriate kindness. (An-Nisa' 5)
Religious Ethics
Belief in Allah and the truths He has revealed
O you who have believed, believe in Allah and His Messenger and the Book that He sent down upon His Messenger & the Scripture which He sent down before. And whoever disbelieves in Allah, His angels, His books, His messengers, and the Last Day has certainly gone far astray. (An-Nisa' 136)
Reliance on Allah and trust in Him
If Allah should aid you, no one can overcome you; but if He should forsake you, who is there that can aid you after Him? And in Allah let the believers put their trust. (Al Imran' 160)
Performing daily worship
Indeed, prayer has been decreed upon the believers a decree of specified times (An-Nisa' 103)
State Ethics
Consulting the People
So by mercy from Allah, [O Muhammad], you were lenient with them. And if you had been rude in speech and harsh in heart, they would have disbanded from about you. So forgive them and ask forgiveness for them and consult them in the matter. And when you have decided, then rely upon Allah. Indeed, Allah loves those who rely [upon Him]. (Aal-E-Imran 159)
Preparing the General Defense
And prepare against them whatever you are able of power and of steeds of war by which you may terrify the enemy of Allah and your enemy and others besides them whom you do not know but whom Allah knows. And whatever you spend in the cause of Allah will be repaid to you in full, and you will not be wronged.(Al-Anfal' 60)
Social Ethics
Generosity in Prosperity
And do not forget graciousness between you. (Al-Baqarah' 237)
Injustice
And he has certainly failed who carries injustice. (Ta-Ha' 111)
Family Ethics
Being Kind to Parents
And be good to parents and to relatives. (An-Nisa' 36)
Preserving the lives of children
And do not kill your children out of poverty; We will provide for you and them. (Al-An'am 151)
Not being afraid of death
Don't confront betrayal with same
Fulfilling treaties and conditions
No surrender but acceptance of peace
Or in forbidden areas
Don't fight during the sacred months
Don't initiate the use of weapons
Constancy , unity/ patience & hope
Fighting fighters/ not fleeing
There are 2 cases of legitimate war
The call to doctrine of peace
Causing unrest
Righteousness
Without coercion
Concern for public peace
Not compromising the security of neutrals
Justice
good neighborly
Let go of bullying
Incite hatred
Avoid allegiance to the enemy or collusion with him
Ethical control (non-suspicion)
Public defense preparation
Avoid disturbance and vandalism
Discussing general issues
Uniting around the ideal
Order/conditional obedience
Religious minorities have their legal freedom
Don't limit its use to the rich
Safeguarding public funds
Approval of the system
According to the rule of justice
Actively implement the final decision
People's consultation
Ask permission to leave the meeting
Use kind words
Discussion topic must be good
Sitting in line
Respond to the greeting in a better way
Greeting upon entry
Don't call older from outside
decrease the sound
Asking permission to enter to others
Calling for generosity / condemning hoarding
Conditions required in the practice of charity
Giving is a comprehensive duty
The exact required is the middle
3 positions legitimate to varying degrees
Justice & charity together
Charity & generosity /universal love
Dissemination of science
Calling for good and forbidding evil
Ward off evil with good
Don't exceed abuse in all circumstances
Pardon
Or facilitate their liberation
Emancipation
Investing orphans' money
Charity, especially to the weak
Humility and mutual compassion
No to the bad guys
Intercession or mediation in disputes
Reconcile
Performing truthful testimony
Fulfilling covenants and promises
Document financial transactions to avoid doubt
Trust performance
An attitude of indifference to common evil
Harmful interference
Slander
An abusive relationship and complicit naivety
Slander and backbiting
Spying
Contempt for people
The irony
Mistreatment of the orphan and the poor
Saying bad
Discretion
Perjury
Fraud and corruption of judges
Deception
Treachery
Failure to fulfill the covenant
Defending traitors
Complicity in evil
Injustice
Unjustified harm
Breach of trust and honesty
Wasting orphan's money
All misappropriation
Any embezzlement
Interest bearing loan
Cheating
Stealing
Killing a human
Inheritance is a favor from God, not a right
Division rules
A right that is not limited to males or adults
the legacy
The will
Involving others in our happiness
Duties towards relatives
Divorce
Marriage goals
Marriage life
Establishing a family
Moral education for children & family
Preserving the lives of children
Duties between spouses
Lower your wing to your parents, obey them
Kindness to parents,
Duties towards ancestors & descendants
Mismanagement/ taking illicit money
Every impurity (moral or physical)
Abusing alcohol and eating junk
Immorality
passed and intense joy over what happened
Envy and greed
Attachment to the world
Bragging about ability and knowledge
Pride, wonder and bravado
Transcendence
to brag
Extravagance
Stinginess
Actions contradict words
Hypocrisy
Lying
Human suicide, amputation of one of his organs, and mutilation
Good deeds/ sincerity of intention
Listen well and choose the best advice
Competition
Moderation
Following a good example
Consistency and patience
Reluctance when in doubt
Tenderness and humility
Be careful when making judgements
Honesty
Repress your anger
Abstaining from the desires of the stomach and vulva
Control of passions
Chastity - modesty - lowering one's gaze
Integrity
Purity of soul
Ethical effort
Moral education
General education
Finally, the love of Allah, above everything
Return to Allah and seek His forgiveness
Always pray to Allah with fear & hope
Hajj to the Makkah (at least once in a lifetime)
Perform daily worship
Praise and glorify Allah
Constant remembrance of Allah
Respect the oath you made it
Don't swear to Allah too much
Don't sit with those who mock the Allah's Ayat
Suspending every future action on His will
Fulfilling a vow & covenants to Allah
Or security from his pain
Don't despair of His mercy
Relying on Allah and trusting Him
Bear the affliction with satisfaction
Acknowledging and thanking Allah's blessings
And contemplate God's creation
Thinking on Ayat of the Qur'an
Obey Allah unconditionally
Faith in Allah and the truths He revealed
In case of aggression
In normal circumstances
Foreign affairs
State Ethics
People Duties
Rules of Etiquette
Commands
Prohibitions
Social Ethics
Family ethics
Prohibitions
Commands
Individual Ethics
Religious Ethics

Examples: Pyramid of Ethics Needs-Requirements-Use Case





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Conclusion

1) **FUSE Enhancement**: Deep integration of cultural and societal dimensions is key to advancing the next phase of FUSE.
2) **Comparative Insight**: Western SE favors reductionism and rapid iteration; Eastern SE emphasizes holistic planning and collective responsibility.
3) **Cultural Integration**: Understanding these paradigms enables a more inclusive and adaptive SE framework.
4) **Saudi Context**: Nations like Saudi Arabia can tailor SE using Islamic principles of justice, balance, and collective well-being.
5) **Call to Action**: Embed diverse ethical frameworks and localized approaches to make SE Vision globally relevant and impactful to address Global / Major Societal Challenges.

Thank You

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