

The influence of organization alignment on the effectiveness of systems engineers

Dr. Pamela Burke

Stevens Institute of Technology





The influence of organization alignment on the effectiveness of systems engineers

Helix Project Members

Dr. Nicole Hutchison, Principal Investigator

Dr. Dinesh Verma, Co-Principal Investigator

Dr. Pamela Burke

Mr. Ralph Giffin

Dr. Hoong Yan See Tao

Mr. Sergio Luna

Ms. Suchita Kothari

Ms. Shikha Soneji

Mr. Deep Makwana

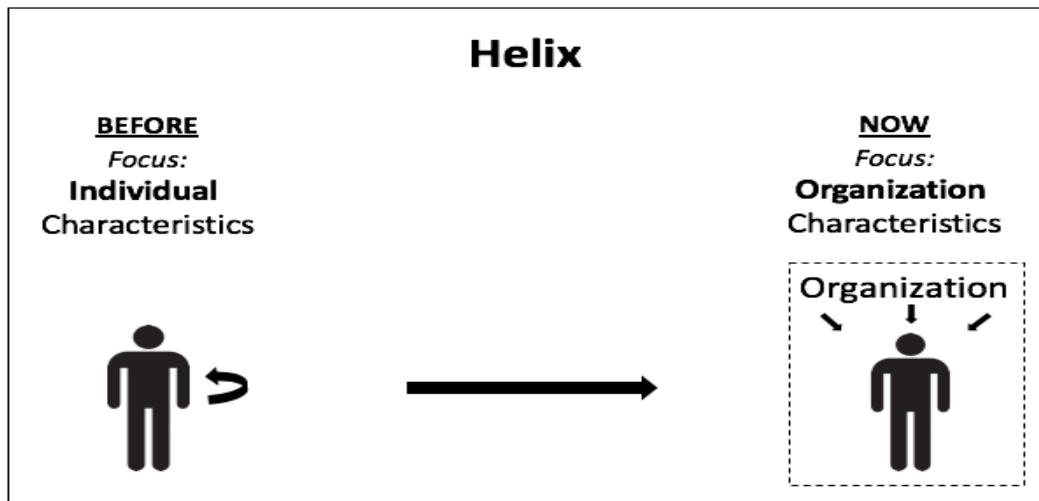
Stevens Institute of Technology



- Introduction
- Research Methodology
- Interpreting culture types and alignment using the Competing Values Framework “CVF” and the Quality of Interaction Index “Qi” surveys
- Other measures of alignment: Interpreting survey data with interview data
- Value of ongoing research to participating organizations and systems engineering community
- Next Steps



- Helix is a multi-year longitudinal study designed to build an understanding of the systems engineering workforce in the DoD and Defense Industry Businesses.
- Since 2012, the Helix project has investigated what makes systems engineers effective; this work culminated in *Atlas: The Theory of Effective Systems Engineers*.
- Current work builds on the understanding of individual systems engineers defined in *Atlas* by exploring how organizational culture, governance, structure, and workforce composition contribute to the effectiveness of the systems engineering workforce.





In 2018, the Helix team has created a new methodology to delve into the culture, governance, and structure of the organizations using:

Group interviews with systems engineers, peers, VPs and Human Resource executives

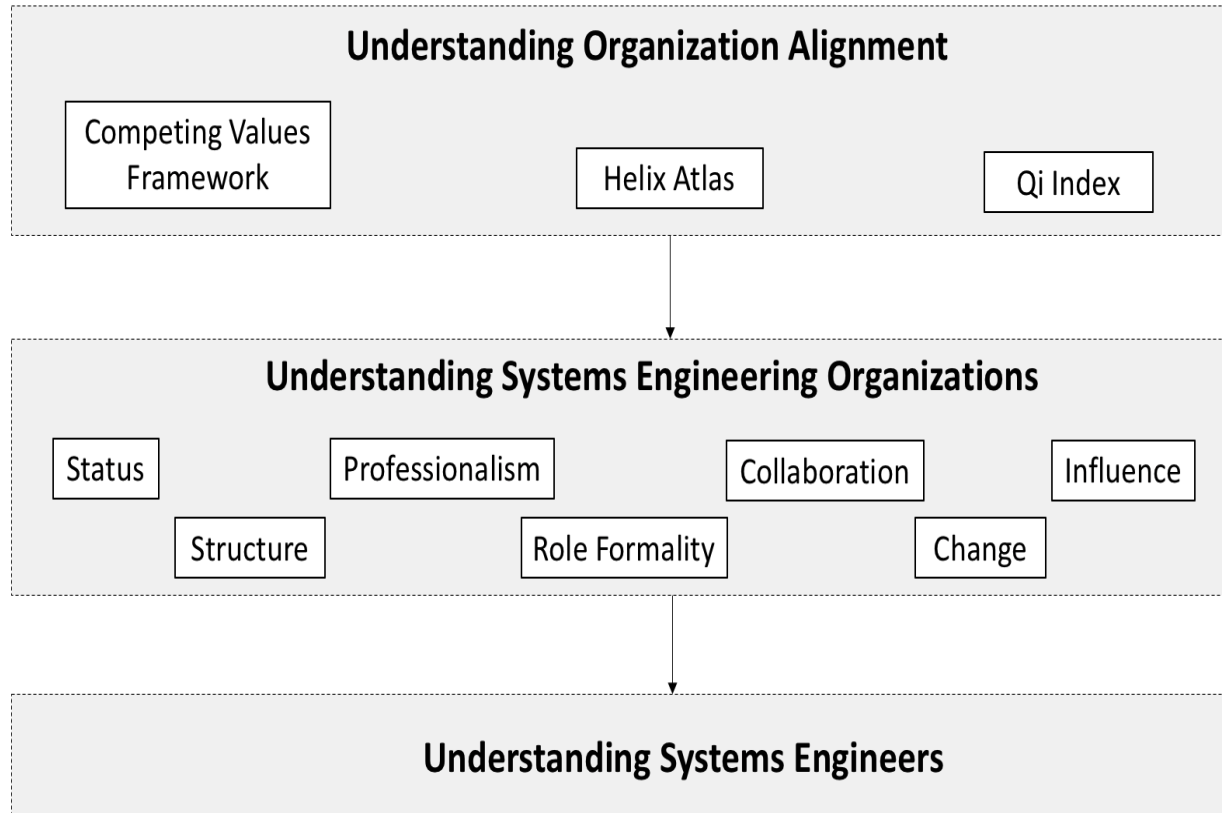
Online questionnaire for systems engineers, peers, and management

Group discussions and workshops about the results



Methodology: Web-Based Survey Approach

Today we are reporting findings from two parts of the survey including the *Competing Values Framework (CVF)* and the *Quality of Interaction Index (Qi)* specifically related to organization culture and team behavior.



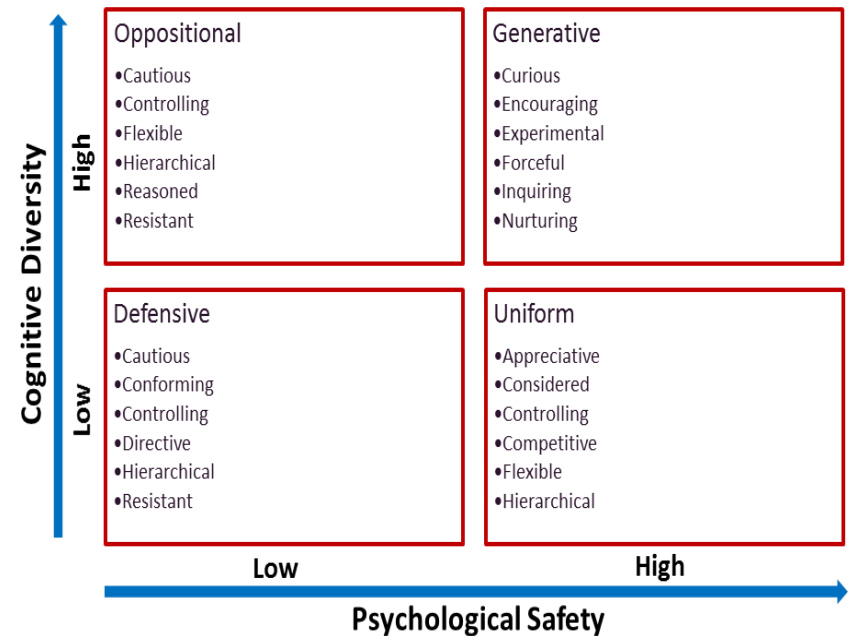


Exploring Organization Culture and Climate

- **CULTURE:** The Competing Values Framework highlights beliefs and assumptions about what drives value and effectiveness.
- **CLIMATE:** The Qi Index reveals perceptions about how people work together and what it feels like to work there.



Competing Values Framework

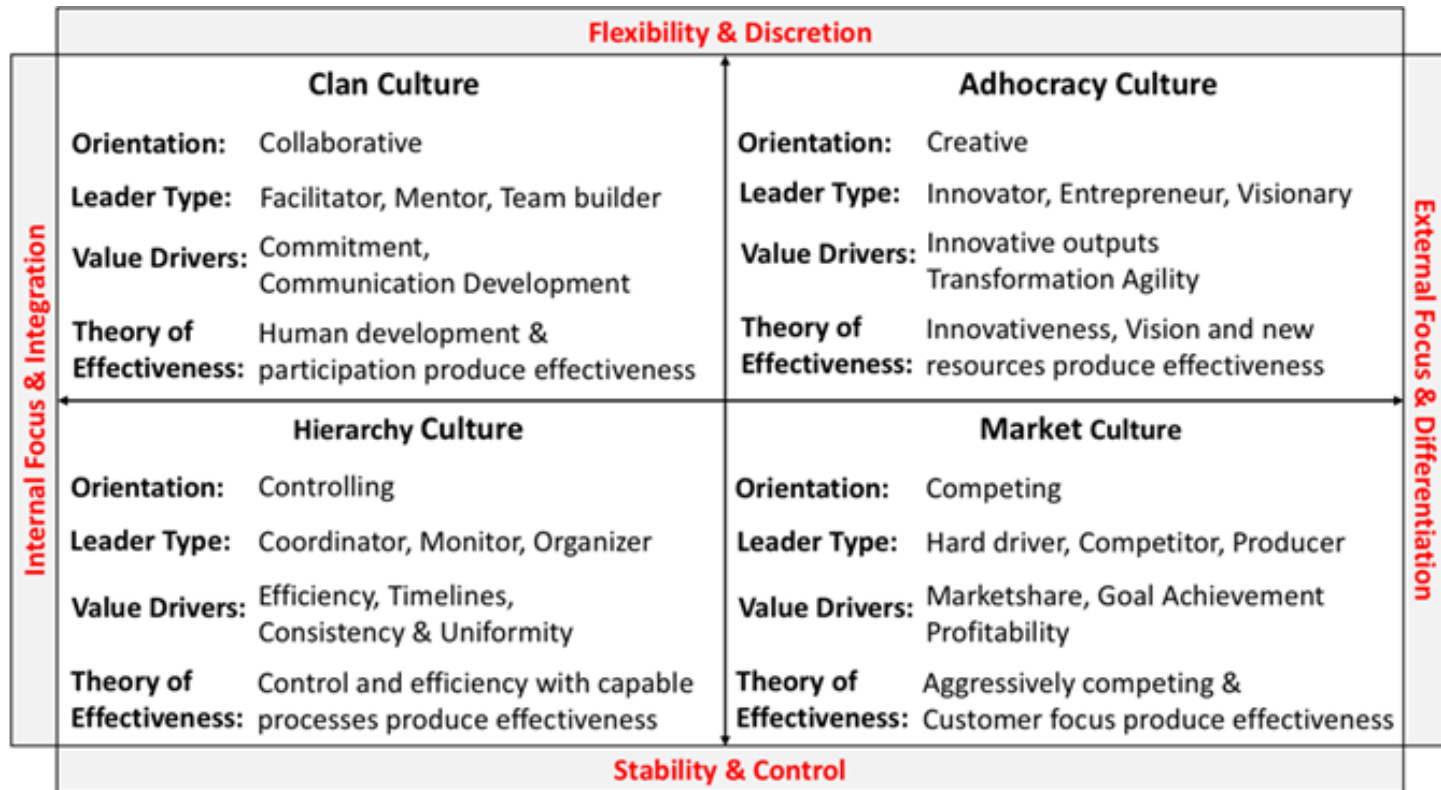


Qi Index



The Competing Values Framework

- The Competing Values Framework (CVF) developed by Kim S. Cameron and Robert E. Quinn (2011) as measured by the “Organizational Culture Assessment Instrument” (OCAI), has been used by hundreds of organizations over 25 years to understand and describe main cultural attributes that relate to organizational success.





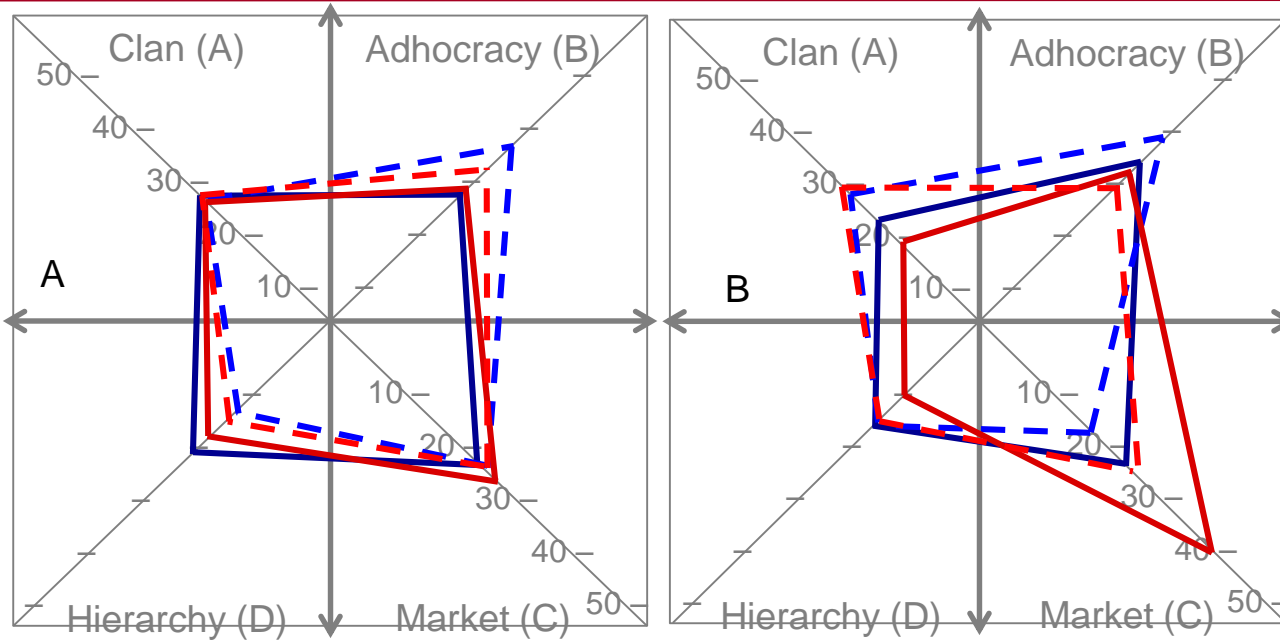
The Competing Values Framework

- The four culture types are measure by a six-item survey (the OCAI), where each participant divides 100 points among four alternative descriptions for the six items, depending on how similar the description is to their organization.
- The six items include dominant characteristics, leadership, management for employees, organization “glue,” strategic emphasis, and criteria of success.

Dominant Characteristics	Now	Future
A. The organization is a very personal place. It is like an extended family. People seem to share a lot of themselves. <i>(Clan)</i>		
B. The organization is a very dynamic and entrepreneurial place. People are willing to stick their necks out and take risks. <i>(Adhocracy)</i>		
C. The organization is very results oriented. A major concern is with getting the job done. People are very competitive and achievement oriented. <i>(Market)</i>		
D. The organization is a very controlled and structured place. Formal procedures generally govern what people do. <i>(Hierarchy)</i>		
Example of questions adapted from the CVF survey (Cameron & Quinn, 2011, pp. 30)	TOTAL	

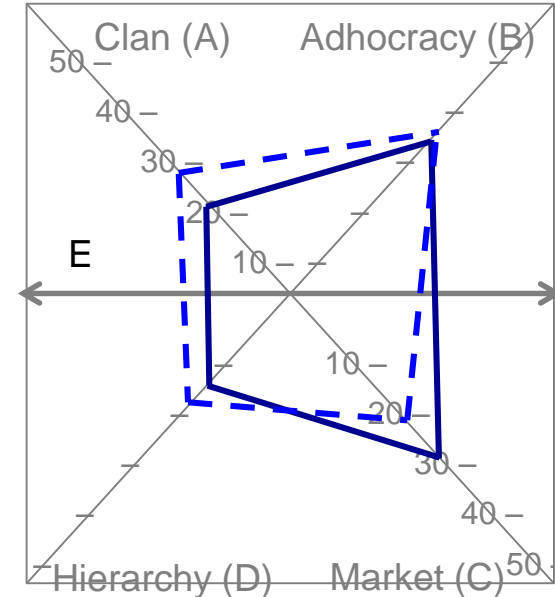
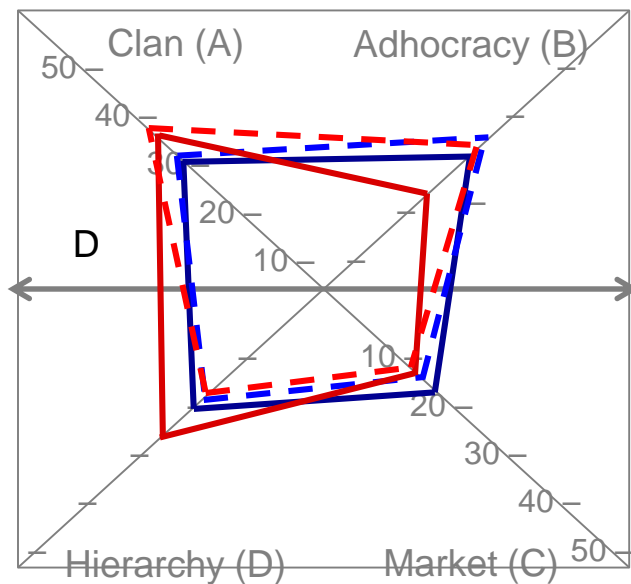
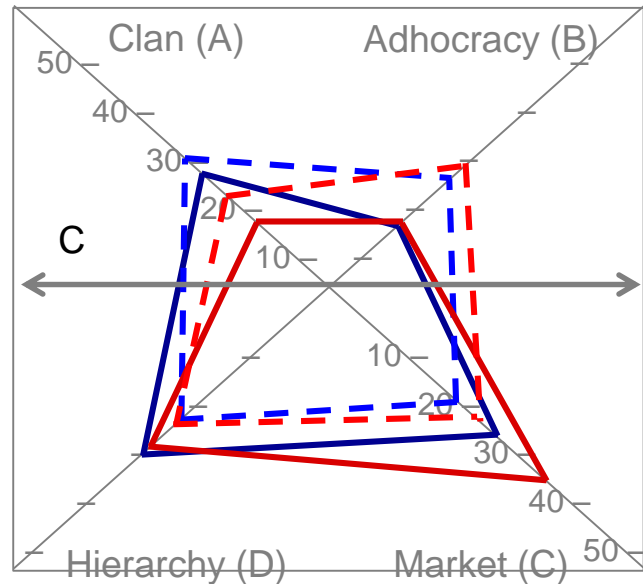


Comparing Profiles of 5 Organizations



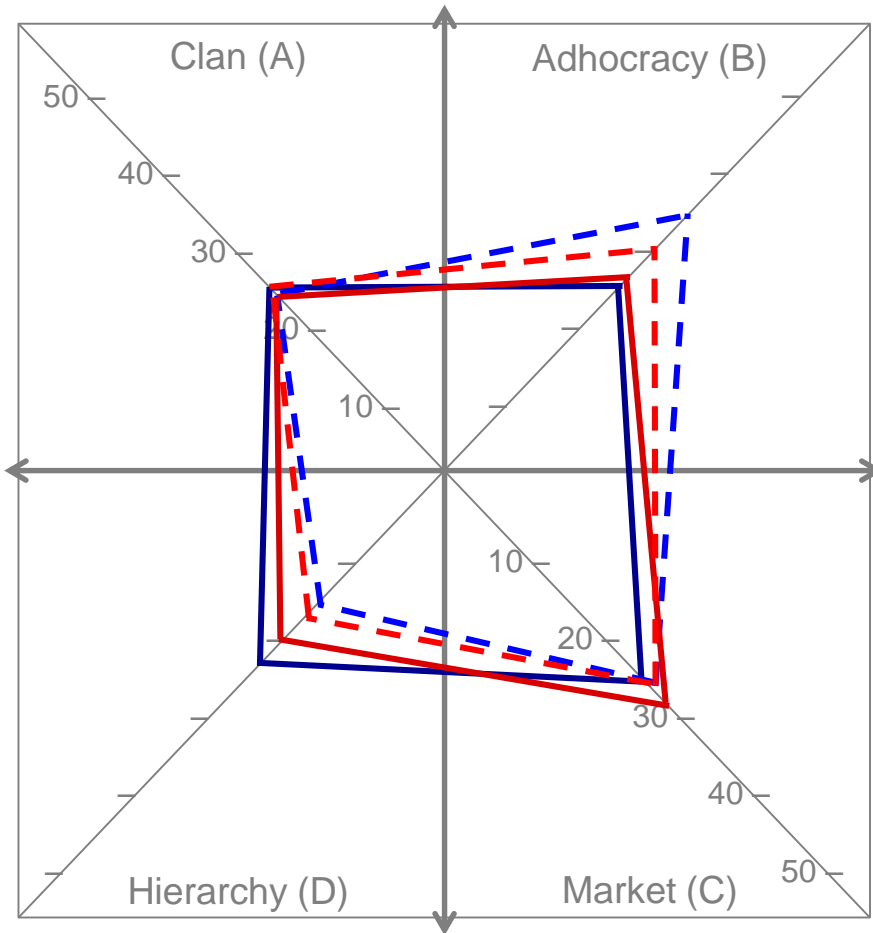
Data from 5 systems organizations in technologically sophisticated, complex product industries in the Netherlands December 2018

- SEs - Now
- - - SEs - Future
- Peers - Now
- - - Peers - Future





Org A The Competing Values Framework



- SEs - Now
- - SEs - Future
- Peers - Now
- - Peers - Future

9 SE
8 Peers

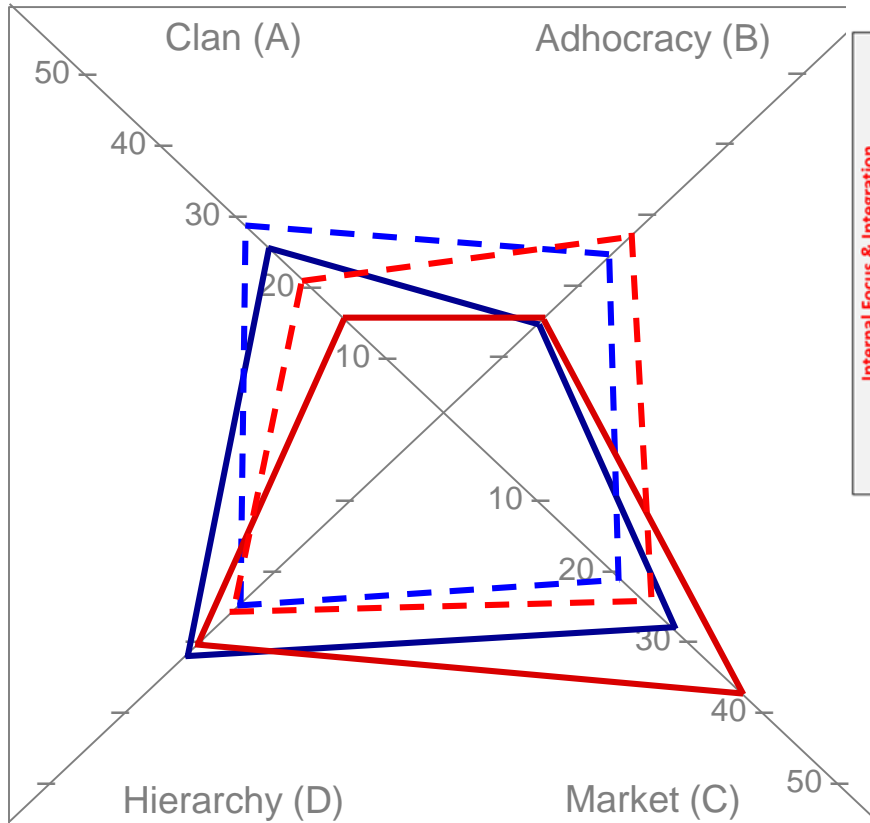
		Flexibility & Discretion		
Internal Focus & Integration	Clan Culture	Orientation: Collaborative Leader Type: Facilitator, Mentor, Team builder Value Drivers: Commitment, Communication Development Theory of Effectiveness: Human development & participation produce effectiveness	Adhocracy Culture Orientation: Creative Leader Type: Innovator, Entrepreneur, Visionary Value Drivers: Innovative outputs, Transformation Agility Theory of Effectiveness: Innovativeness, Vision and new resources produce effectiveness	
	Hierarchy Culture	Orientation: Controlling Leader Type: Coordinator, Monitor, Organizer Value Drivers: Efficiency, Timelines, Consistency & Uniformity Theory of Effectiveness: Control and efficiency with capable processes produce effectiveness	Market Culture Orientation: Competing Leader Type: Hard driver, Competitor, Producer Value Drivers: Marketshare, Goal Achievement, Profitability Theory of Effectiveness: Aggressively competing & Customer focus produce effectiveness	
			Stability & Control	
			External Focus & Differentiation	

Overall, there is a perceived need to shift the culture from hierarchical process and control towards greater innovation. They perceive their current culture to have a slightly more external than internal focus (Adhocracy and Market strengths) and wish to enhance that focus especially through developing greater Adhocracy.

Overall Scores for Org A	SE Now	SE Future	Peers Now	Peers Future
A. Clan	24	23	24	25
B. Adhocracy	26	34	27	30
C. Market	27	28	29	28
D. Hierarchy	23	15	20	17
TOTAL	100	100	100	100



Org C The Competing Values Framework



- SEs - Now
- - - SEs - Future
- Peers - Now
- - - Peers - Future

		Flexibility & Discretion			
Internal Focus & Integration	Clan Culture	Orientation: Collaborative		Adhocracy Culture	Orientation: Creative
	Leader Type: Facilitator, Mentor, Team builder			Leader Type: Innovator, Entrepreneur, Visionary	
	Value Drivers: Commitment, Communication Development			Value Drivers: Innovative outputs, Transformation Agility	
	Theory of Effectiveness: Human development & participation produce effectiveness			Theory of Effectiveness: Innovativeness, Vision and new resources produce effectiveness	
	Hierarchy Culture	Orientation: Controlling		Market Culture	Orientation: Competing
	Leader Type: Coordinator, Monitor, Organizer			Leader Type: Hard driver, Competitor, Producer	
	Value Drivers: Efficiency, Timelines, Consistency & Uniformity			Value Drivers: Marketshare, Goal Achievement, Profitability	
	Theory of Effectiveness: Control and efficiency with capable processes produce effectiveness			Theory of Effectiveness: Aggressively competing & Customer focus produce effectiveness	
		Stability & Control			
				External Focus & Differentiation	

Overall, there is a desire to shift the culture towards greater flexibility and discretion including greater attention to people and innovation.

Overall Scores for Org C	SE Now	SE Future	Peers Now	Peers Future
A. Clan	24	27	16	20
B. Adhocracy	14	24	15	26
C. Market	29	22	38	27
D. Hierarchy	33	27	31	26
TOTAL	100	100	100	100

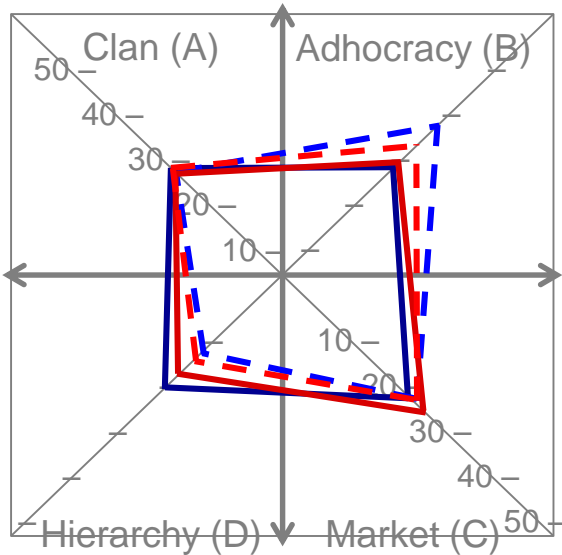


Interpreting Alignment in CVF Culture Profiles

- **Type** – match or mismatch with corporate strategy & environment
- **Discrepancies** – difference between today and desired future
- **Strength** – having a dominant culture or balanced pattern related to the nature of the challenges the organization faces
- **Congruence** – alignment between characteristics – strategy, leadership style, management style, reward system, etc.



Interpreting Alignment in CVF Culture Profiles



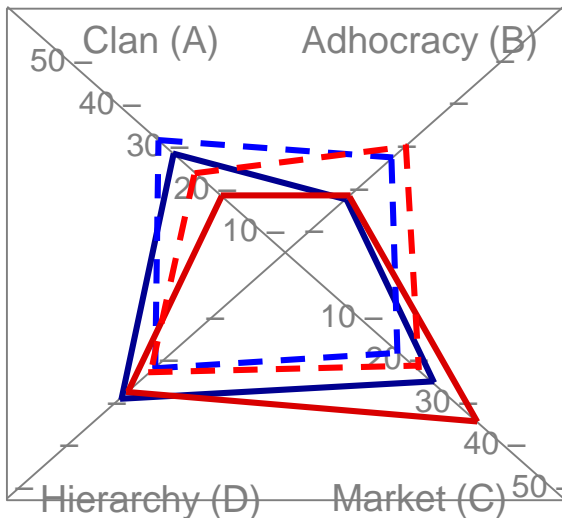
Organization A

Type: Adhocracy may clash with parent-company culture

Discrepancies: Future desire to shift to more dominant Adhocracy culture and reduce Hierarchy/Control culture

Strength: Preference for a more dominant Adhocracy culture

Congruence: High congruence across the 6 characteristics for the shift from control Hierarchy to more creative Adhocracy and mixed congruence across the characteristics for collaborative Clan and competitive Market focus.



Organization C

Type: Mixed views within the organization – how does this meet needs?

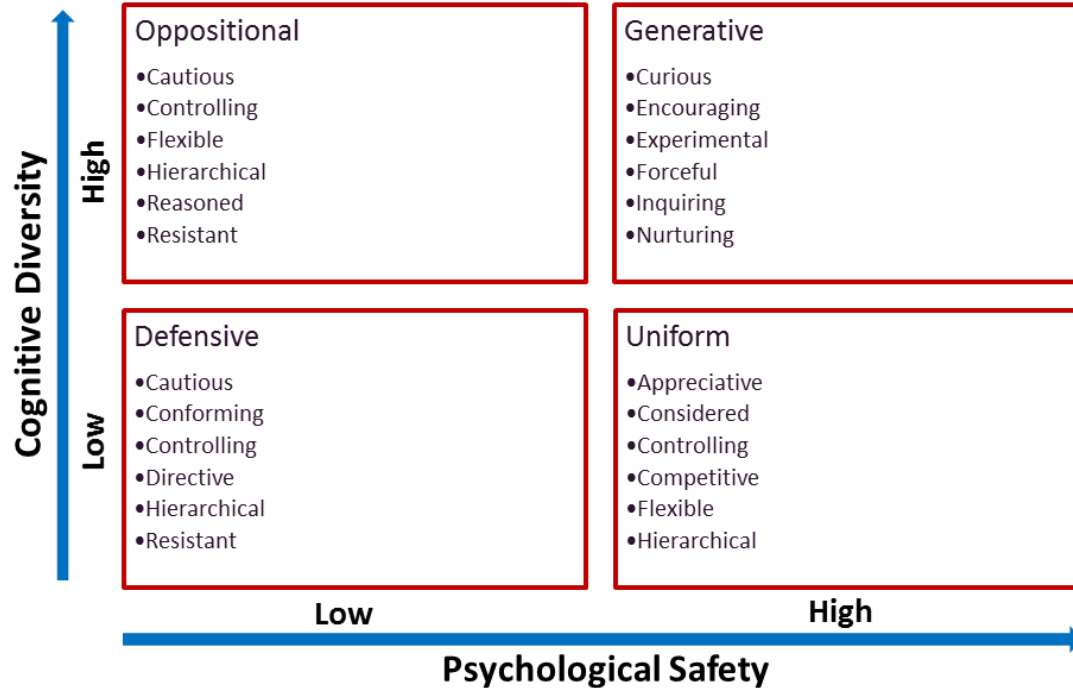
Discrepancies: Future desire to increase Adhocracy and Clan culture and reduce Hierarchy/Control and Market culture

Strength: Preference for a more balanced culture in the future

Congruence: High congruence across the 6 characteristics for the shift from Market and Hierarchy focus to more Adhocracy and Clan focus with mixed congruence in the leadership and management style dimensions.



Org A Quality of Interaction Index (Qi Index)



The Quality of Interaction Index (Qi Index) focuses on organization behaviors, emotions, and cultural traits associated with the ability to adapt and innovate.

The best problem-solving teams are psychologically safe and cognitively diverse.

These data can be used to better understand how you operate and to see areas for future development.

The instrument consists of 18 statements rated for the extent to which they describe the organization, and three questions where participants choose descriptive words about 1) how they feel about the organization, 2) the behaviors they see in their organization, and 3) the current state of the organization.

Source: Reynolds, A. & Lewis, D. (2018). *The two traits of the best problem-solving teams*. Harvard Business Review Blog, 4/2/18.

For more info, see Human Insights
<https://www.human-insight.com/>



Interpreting Alignment in Qi Profiles

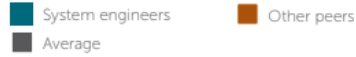
The Qi position you see below shows you where your team or organisation is situated based on all the data collected. From the Qi Spread you can see the distribution of the individual perspectives.

Qi: Average position

Generative factor: 3,21



Legend



Qi: Group spread

Generative factor: 3,21, standard deviation 2,24



Org A Qi Scatter

Strong alignment in Generative quadrant for both SEs and Peers

Systems Engineers are less aligned with each other on degree of cognitive diversity and psychological safety

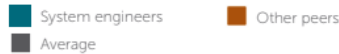
The Qi position you see below shows you where your team or organisation is situated based on all the data collected. From the Qi Spread you can see the distribution of the individual perspectives.

Qi: Average position

Generative factor: 5,34



Legend



Qi: Group spread

Generative factor: 5,34, standard deviation: 2,69



Org C Qi Scatter

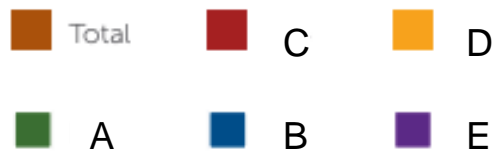
Weaker Alignment on a single quadrant

Systems engineers and peers vary on views of psychological safety



5 Company Combined Qi Results

Legend



Qi: Team average positions

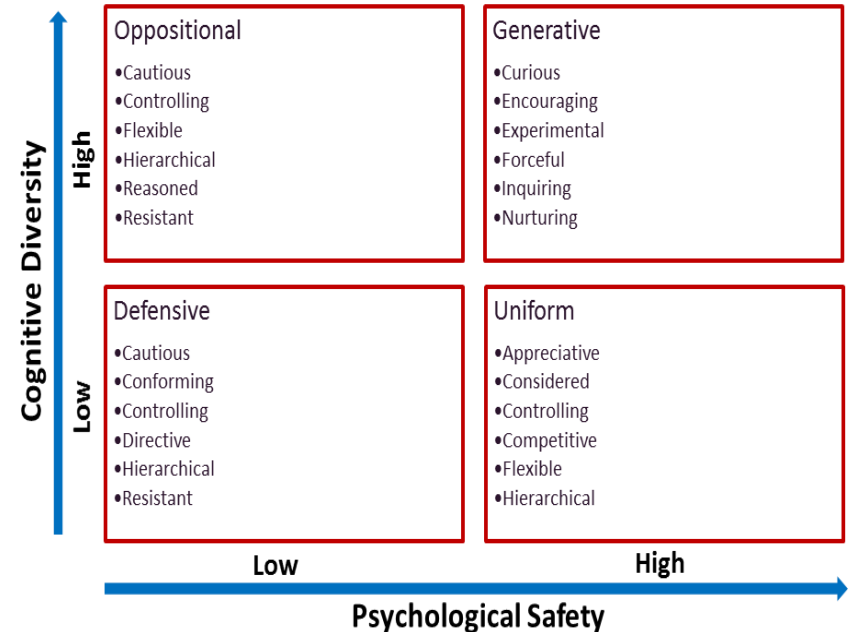


Qi: Team spread



Alignment: Organization Culture and Climate

- A Generative Climate with high psychological safety and high cognitive diversity can aid effectiveness in any culture.
- Early results make us hypothesize that generative climates may be more common in cultures that value innovation (Adhocracy), customer focus (Market), and human development (Clan).





Org A Culture As Described in Interviews

Clan (Collaborate)

Personal ownership is a governing principle.
Transparency is what gives you control.
Make sure people who make decisions and do the work are connected.
Consensus as a cultural trait – score high on femininity as a cultural skill, more than others.
We treat each other like family.
A lot can be said openly without repercussions.
We try to put a mandate as low as possible.
Get collective intelligence maximally used.
Co-located cross functional teams create a bubble.
Consensus, but we could decide what not to do better.
They're ready to invest in people.
Communication between projects is limited.

Hierarchy (Control)

Parent company cares about process repeatability, not a match with us.
We cannot even imagine getting tasks assigned.
SA is a role, not a position. No formal functional organization.
We're varied in types of tooling and processes – similar deliverables but the process we use to get these deliverables aren't the same.
Depend a lot on local heroship. You get the result by the person you put there. Needs change to move to product lines – multiple heroes in parallel. Single project approach in our genes.
We fall into pitfalls - every project invents everything itself.
We have a lot to gain in the road mapping process.

Adhocracy (Create)

We create ownership by delegating challenging goals to people who have the freedom, without boundaries. We don't fail, we learn.
We're a learning organization otherwise we can't innovate.
We are a tribe of innovators. We like to take a big step, try new things, be different.
SEs in charge of handling dilemmas – when logic alone doesn't get you there – perception, feel.
We look for curiosity in SAs.
We have a lot of inventions in our product that no one has.
Our identity is in question – do we want to be different or better? Do we want to be an integrator or have unique technology?
We do really well building and testing risk-oriented prototypes.
This is a technology playground.

Market (Compete)

We measure SE effectiveness by the business- can we materialize the value into profit, and what is the customer feedback?
We're business to business, so don't really see the very end customer.'
Customers recognize that we make green button complex machines that are simple to use.
Is the point to be different or be better? I think that a little more concern about competitiveness and comparison to others would be good. We go on customer visits but not well organized.
Very big pressure in projects to deliver something to market, and then we sometimes forget we could work together to come up with a solution together for both projects.
Mentality: there is only one project – this one! Suffer from Project Passion.



Org C Culture As Described in Interviews

Clan (Collaborate)

We're open, but some siloed behavior (you're V&V and you're Software)
 Moving to a more open transparent cross functional culture.
 Knowledge matters.
 When there is a problem we want to help.
No room for failure. When its good, open and transparent; when things go bad, closed and siloed.
 We swap people to get around silos.
 Interventional Applications has a more open culture.
So many stakeholders and people involved sometimes prevents us from releasing products faster.
 We have no doors. 5 levels above sits next to me.
 Collaborative once the goal is clear.

Adhocracy (Create)

Effectiveness: Internal innovation prize for the product, especially if on a different stage in different area of the world- Bangalore – with people from all over.
An example effectiveness last year: we chose technical solutions that are right for future – we had the guts to deviate from company policies to benefit our system. Courage.
 Architects constantly refresh roadmaps, incorporate feedback.
We use standard process to create products – but don't have process for bringing in ideas for investing in SA/SD tools.
 Fact-based culture – go out and get the facts.

Hierarchy (Control)

Strive for predictability over the long term – 3 years from now.
 I see effectiveness of SE as: architecture enables modularization and reuse; No nasty surprises, no unexpected delays, no complaints from field.
 Execution needs to be more effective.
 The plan is still valid from 3 years ago, just shifted 4 years.
 We have a biannual process: Architects constantly refresh roadmaps, incorporate feedback.
 Applications: struggle to simplify QMS used for large systems to our needs with process owners.
Regulated business very process heavy; overhead.
Larger corporation focus on agility - a tension point here. Still on journey with Lean.
 “We tried it before and it didn't work,” “we've always done it this way.” Need more “let's give it a try” open-mindedness.
 “Great” would look like no surprises, predictability, no chaos, go to right stakeholders, ID tech risk early, early user testing.
 Older generation still in waterfall mindset.

Market (Compete)

We are results-driven.
 High sense of commitment to keep this important business unit successful.
 We're cash cow but still growing.
 Delivering on time is more important that delivering good quality when the pressure is on (not all agree).
PM is saying, “time, time, time”; Dept Manager saying “I need right quality.”
Expect SEs to step up and say, “I won't deliver with this bad quality.”
 We budget short term, affects long-term architecture.
 I define SE effectiveness as: if you can create products that are better than the competition but also in a way that can sustain that leading position.
 Our plans are ambitious.
 We capture user needs but SA/SD still a distance from the market.
 Have a formal and an informal way to get users needs.
It annoys me that we don't know how our system is used in the field. Need performance metrics on features to kill them.

Notice Mixed-Messages in all quadrants reflects dispersion of CVF and Qi Results



Org A Culture As Portrayed Online

Clan (Collaborate)

We believe in openness, trust and togetherness.
We empower talent.
We are passionate.
We value you as a person and professional.
Here, you can be your best self.
Create extraordinary multi-disciplinary and cross-cultural teams.
Everyone contributes to writing the future.

Adhocracy (Create)

We innovate for a living.
We are constantly challenging ourselves to spark creativity and discovery.
We are creating products and applications the world has never seen before.
Our mission is to accelerate new digital X technologies and transform them into local products and services.
We are never satisfied with doing things “the way they’ve always been done.”

Hierarchy (Control)

Corporate web page information aligns with current and future desire to be a strong Adhocracy culture.

Competing Values Framework: Hierarchy, process and control don’t appear in their mission.

Qi Index: Strong empowerment and generative collaboration shows up in mission.

Market (Compete)

We are global leaders in technology X, Y, and Z.

Our business to business products are flagships in the “parent company” portfolio.



Org C Culture As Portrayed Online

Clan (Collaborate)

We're committed to offering an inclusive workplace that's engaging and which helps you personally develop, setting you up for success as you mentor and grow teams and capabilities.

Adhocracy (Create)

XX without bounds.

Hierarchy (Control)

Corporate web page information focuses more on Clan and Market characteristics, similar to the current view reflected in the Competing Values Framework.

Collaboration is valued within the company and with partners.

Market (Compete)

Market message: Innovation. Transformation. Collaboration. A relentless pursuit to make life better.

True partnership means rolling up our sleeves and working side-by-side with our customers...we together tackle the toughest challenges. Our alliances focus on implementing meaningful innovations, centered on xx and yy, designed to break down barriers and complexity and to offer better value to xx, yy and the overall xx system.



Value of Examining SE Cultures

- Value to participants in the research
 - Current snapshot of perceived cultural values and drivers of effectiveness
 - Indicators of congruence and disconnects among systems engineers and others about the “what” (values and drivers) and the “how” (organization climate they operate in)
 - The research process created multiple opportunities for individual and group reflection on the current state of systems engineering
 - Opens the door for leaders to continue dialogue on values, strategies, and systems engineering development and leadership
- Value to systems engineering community
 - Explication of an easily replicable model and tools for obtaining culture and climate data that can be used for reflection, dialogue, strategy development and change in any organization
 - Eventually, identifying cultural patterns and trends in technologically sophisticated, complex organizations that contribute to systems engineering innovation and effectiveness



- Integrating the culture data with the remaining survey and interview data on structure, governance, processes, tools, and effectiveness
- Workshops with organizations that have participated to expand understanding of patterns, trends, and uses of the data
- If you'd like to participate, please contact the Helix Project through our website: <https://helix-se.org/>



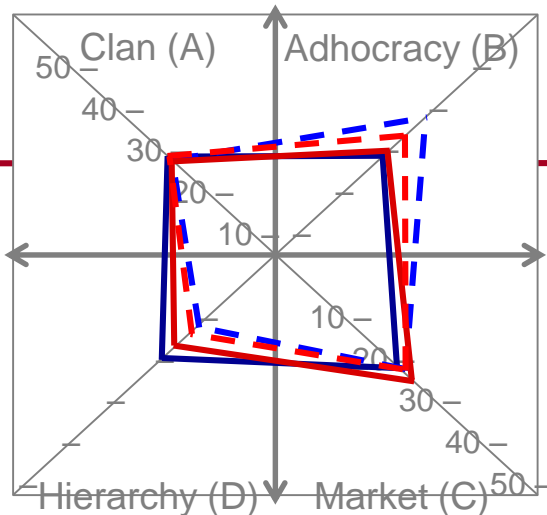
A big **THANK YOU** to the organizations who have volunteered to share their stories, dilemmas, successes and questions in this ongoing research.

Questions?



- SEs - Now
- - - SEs - Future
- Peers - Now
- - - Peers - Future

A



Key: Current to Future Change Desired

- = No change
- ↓ = 1-5 point change
- ↓ (circled) = 6-10 point change
- ↓ (triangled) = 11-19 point change
- ↓ (squared) = 20+ point change
- ↑ = 1-5 point change
- ↑ (circled) = 6-10 point change
- ↑ (triangled) = 11-19 point change
- ↑ (squared) = 20+ point change

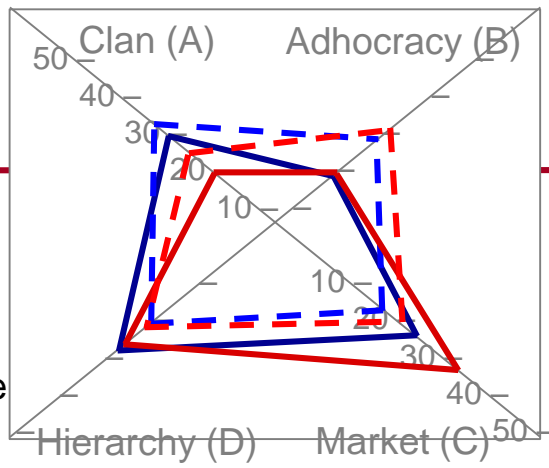
Dimension	CLAN (Collaborate)		ADHOCRACY (Create)		MARKET (Compete)		HIERARCHY (Control)	
	SE	Peers	SE	Peers	SE	Peers	SE	Peers
1. Dominant Characteristics	↑	↓	↑	↑ (circled)	↑	↑	↓ (circled)	↓ (circled)
2. Org Leadership	—	↑ (circled)	↑ (circled)	↑ (circled)	↓	↓ (triangled)	↓	↓
3. Management of Employees	—	↓	↑ (circled)	↑ (circled)	↓	—	↓	↓
4. Organization Glue	↓ (circled)	—	↑ (circled)	↑	↑ (circled)	↑	↓ (circled)	↓
5. Strategic Emphasis	↑	↑	↑ (circled)	—	↑	↓	↓ (triangled)	↓
6. Criteria of Success	↑	↑ (circled)	↑ (triangled)	↓ (circled)	↓	↑	↓ (triangled)	↓



Org C

SYSTEMS ENGINEERING
Research Center

- SEs - Now
- - - SEs - Future
- Peers - Now
- - - Peers - Future



Key: Current to Future Change Desired

- — = No change
- ↓ ↑ = 1-5 point change
- ↓ ↑ = 6-10 point change
- ↓ ↑ = 11-19 point change
- ↓ ↑ = 20 + point change

Dimension	CLAN (Collaborate)		ADHOCRACY (Create)		MARKET (Compete)		HIERARCHY (Control)	
	SE	Peers	SE	Peers	SE	Peers	SE	Peers
1. Dominant Characteristics	↑	↑	↑	↑	↓	↓	↓	↓
2. Org Leadership	↑	↑	↑	↑	↓	↓	↑	↑
3. Management of Employees	↓	↑	↓	↑	↓	↓	↓	↓
4. Organization Glue	↑	↑	↑	↑	↓	↓	↓	↓
5. Strategic Emphasis	—	↑	↑	↑	—	↓	↓	↓
6. Criteria of Success	↑	↑	↑	↑	↓	↓	↓	↓