

RESEARCH SHORT

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Using Complex Systems Practice To Assess the Youth Bulge in the Sahel

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Assessing modern intelligence problems—such as the strain an emerging youth bulge will put on Africa's already fragile Sahel—requires analytic methods that probe beyond the obvious to uncover the underlying forces and patterns at work in a complex system. This *Research Short* demonstrates how one such method, Complex Systems Practice, provides the IC with an effective tool for analyzing systems where many interdependent and adaptive components interact to create “emergence,” or a structure that is more than just its elements. Using this approach to examine the potential impact of the growing youth bulge in Africa's Sahel reveals that educating women would have the greatest potential to create positive change in the region.

Complex Problems Require New Theoretical Lenses

The looming youth bulge in the Sahel, like most of the problems the IC assesses, requires intelligence analysts to understand the inner workings of a complex system. When analyzing complex issues, analysts often rely on a variety of established methods and structured analytic techniques to mitigate cognitive biases, unhelpful mental models, and intuitive errors.¹ Linear techniques that help identify and analyze components of a complex system are less helpful for understanding the dynamics and indirect relationships operating within the system as a whole. New transformative analytic approaches that foster creativity, reward dissenting views, and expand cognitive diversity would provide a holistic look at the inner workings of complex systems.

Complex Systems Practice (CSP) is an adaptable and comprehensive approach to analyzing nonlinear, complex problems that is gaining popularity among intelligence analysts and policymakers because it can capture nuanced, indirect, and cascading cause and effect relationships among variables in a system.² Systems theory is *not* a departure from time-tested analytic techniques. Instead, it uses a series of sequential analytic methods to build a visual model that analysts further refine by sharing—or socializing—it with colleagues, experts, and interested parties. Rather than a methodology, it is a theory of how variables within a complex system interact in dynamic and adaptive feedback loops to create “emergence”—a new behavior that cannot be defined as the sum of the behaviors of the system’s constituent parts.³ CSP creates a Complex Systems Map that identifies underlying patterns that allow analysts to better understand the system, adapt to its continuous evolution, and engage it effectively.⁴ CSP does not make challenges less complex, but it provides a way to embrace that complexity.

Applying CSP to the Sahel

The Sahel region of Africa—the 5,000-kilometer belt of land below the Sahara Desert stretching from the Atlantic coast to the Red Sea—is projected to account for nearly one-quarter of the world’s population growth through 2050.⁵ Cultural traditions that value large families, as well as fragile healthcare and education systems that do not support family planning or female empowerment, will drive a youth bulge likely to compound existing problems of weak regional governance and environmental degradation due to climate change. A projected 3-5°C increase in temperature by 2050 will worsen food and water insecurity throughout the largely agricultural region.⁶ According to the UN, the youth bulge is likely to exceed these fragile states’ ability to educate, employ, or provide adequate medical care for their populations,⁷ degrading the rule of law and overall stability.⁸ Spillover from Sahelian instability could increase migration and terrorism and threaten U.S. national security.

This *Research Short* will demonstrate CSP’s ability to provide more sophisticated insight into the interaction of the entrenched cultural, healthcare, and education patterns that are driving the Sahel’s youth bulge. Much of the available literature on the growing youth bulge in the Sahel tends to focus on singular events and patterns of behavior. Analyzing each pattern in isolation paints a distorted picture, but arraying them in a complex systems map of causal

feedback loops allows convergence points to emerge that reveal the deeper patterns influencing the entire complex system.⁹ CSP shows that most of the overlapping inflection points involve traditional cultural views on gender roles, corroborating the conclusion of a body of traditional social science research that the level of *female education* is the structure most central to the Sahel's youth bulge. This conclusion suggests that international support to improve female education could propel the Sahel toward a healthier future—one marked by a youth dividend that boosts economic development rather than increasing regional instability and conflict.

Developing a Guiding Star and Near Star

The first step in CSP is to identify framing devices to serve as navigational tools as the system adapts to exogenous impacts over time. The first framing device is to envision the desired future system, or **Guiding Star**,¹⁰ which should reflect a healthier system goal rather than a specific end state. Our Guiding Star was to *increase human security in the Sahel by promoting stability*. The second framing device, or **Near Star**, is a foreseeable (5-10 year) and achievable outcome that makes significant progress toward the Guiding Star.¹¹ This Near Star is likely to be adjusted as the CSP process reveals new insights into the ever-changing system.¹² For this project, the initial Near Star was: *Children of the Sahel have access to education that enables their integration as productive members of their respective societies*.

Identifying a Framing Question and Collecting and Categorizing Data

The second CSP step is to identify a compelling framing question that helps maintain a focused effort to understand the system being analyzed and guides the building of a Complex Systems Map.¹³ Our framing question was: *What factors influence the youth bulge in the Sahel and what opportunities exist to encourage the complex system toward a healthier future state?*

Once this question was established, we identified themes and explored the upstream causes—things that lead to the theme—and the downstream effects—those the theme causes to happen. Themes were identified using Structural, Attitudinal, and Transactional Analysis (SAT)*—a structured method of looking at the system holistically.¹⁴ Several structured analytic techniques—Structured Brainstorming, Radial Venn Analysis, and Chronologies and Timelines Analysis (See Appendix A)—were used to assess demographic data from governments and international aid entities, statistical projections of demographic shifts and the impact of climate change, and discussion with area experts to identify underlying causal conditions (inputs) contributing to the Sahel's youth bulge. The brainstorming and other analytic techniques assisted in decomposing and visualizing the underlying conditions responsible for the youth bulge. Three inputs emerged: cultural norms, access to healthcare resources and information, and education. The process also revealed manifestations (outputs) of the youth bulge on the fragile Sahel: conflict, displacement, and migration, and, on a more positive note, potential workforce opportunities.

* In this instance, SAT (structural, attitudinal, transactional) Analysis refers to a specific step in Systems Practice as taught by Acumen Academy and not structured analytic techniques.

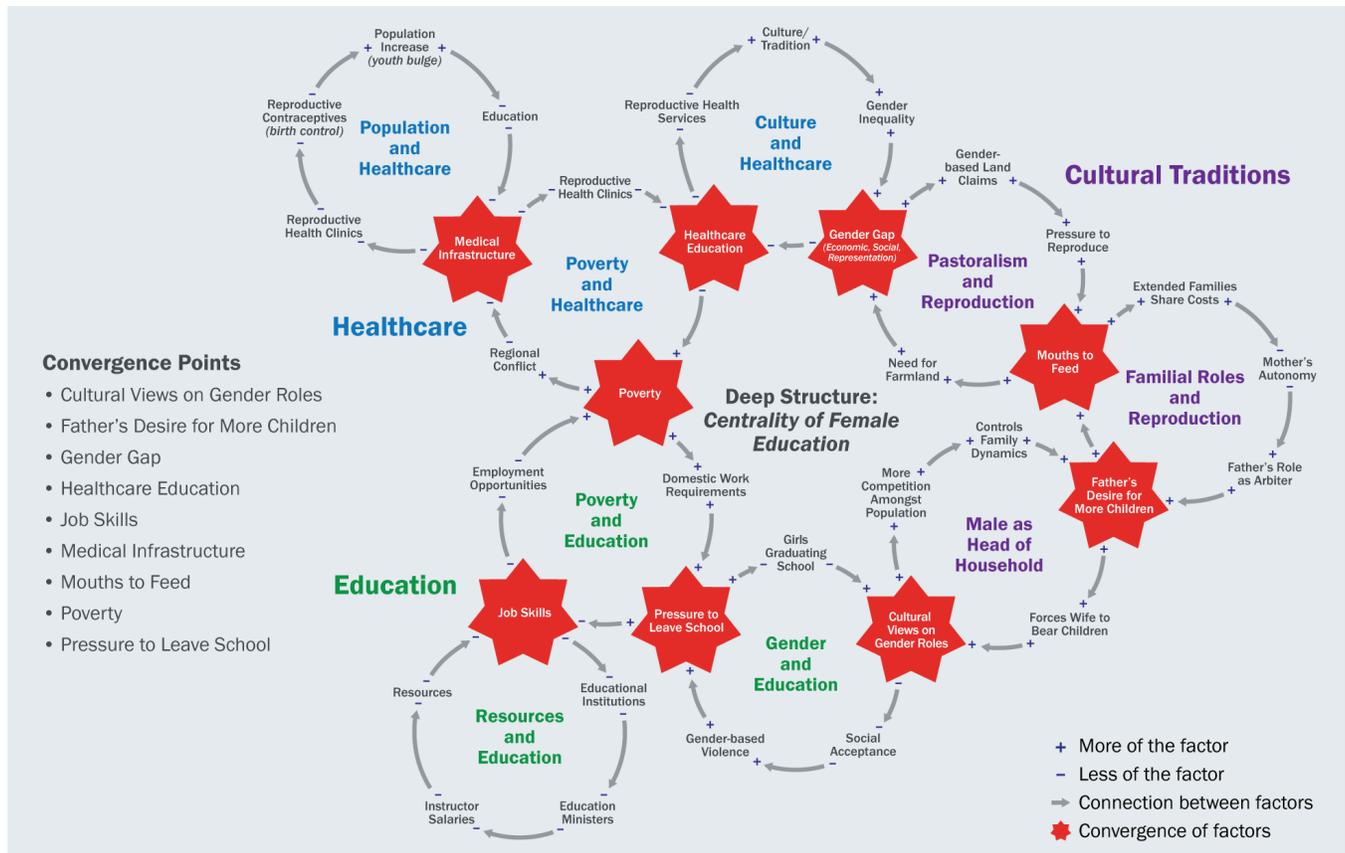
Categorizing these causes and effects as structural, attitudinal, or transactional helps capture the physical and social environment in which people in the Sahel live—both their beliefs, values, and behavior and the interactions among key people.¹⁵ This categorization of underlying conditions/inputs and manifestations/outputs is an essential prerequisite for the next step in our analytic process: creating a Complex Systems Map that addresses the emergence and interdependency inherent in the system.

Discovering the Deep Structure and Building a Systems Map

The third step of the CSP processes is forming a Complex Systems Map that links the Near Star (Children of the Sahel have access to education that enables integration as productive members of their respective societies.) to the entrenched patterns that drive the interactions among education, healthcare, and tradition/culture in the Sahel. These linkages are depicted as a series of interconnected, dynamic feedback loops. (See Appendix B to review the feedback loops in depth.)

The map overlays the underlying conditions and feedback loops with chronological modeling of population and climate maturation to identify convergence points—those areas where a comparatively modest effort or investment could significantly impact the system. These convergence points are located by identifying areas where “energy seeking change is disrupting the status quo or trying to reorganize and cause new patterns to emerge” in contrast to places

Figure 1. Convergence Points and Deep Structure

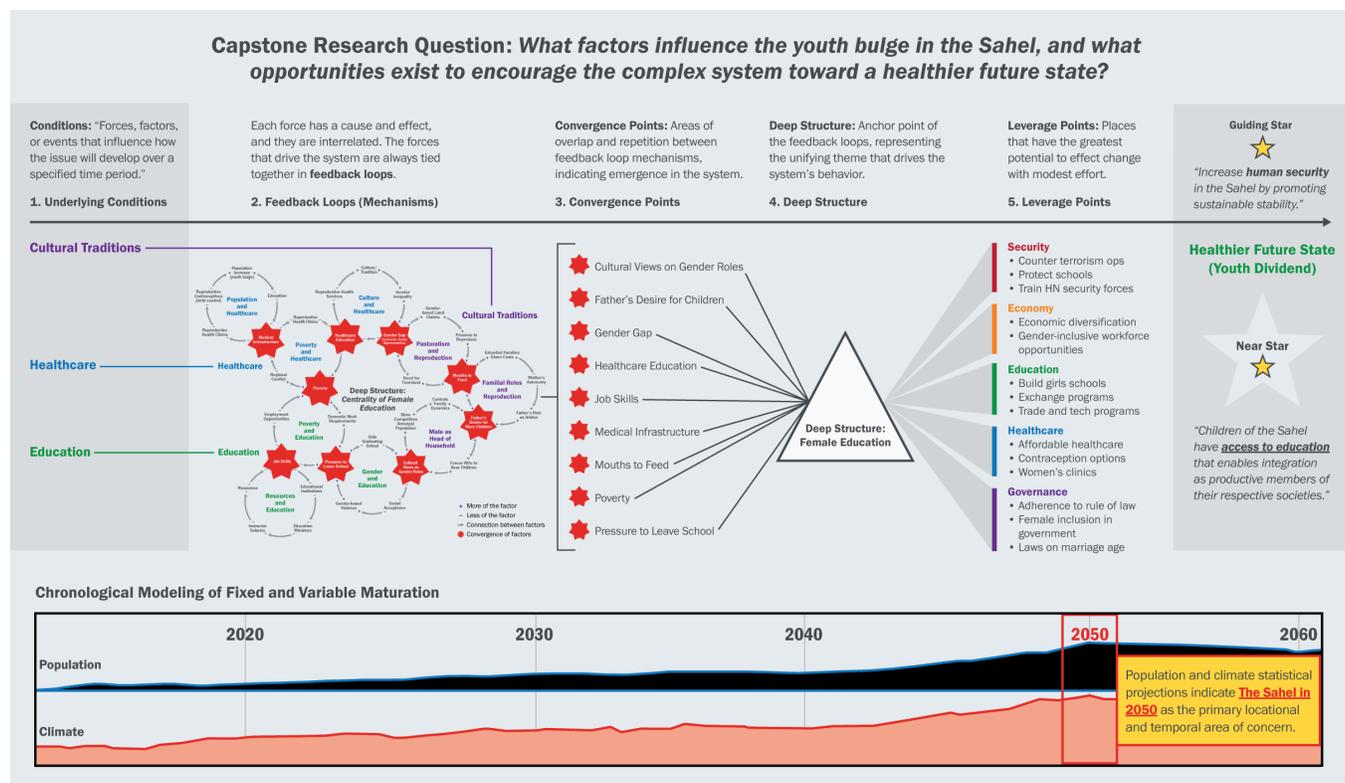


where system behavior is too entrenched to change.¹⁶ For the Sahel, these points spanned the realms of governance, stability, education, healthcare, and economic opportunity.

These leverage points are in the system’s deep structure, which is the convergence point of various loops¹⁷ and serves as the anchor point for the map. (See Figure 1) For this study, the deep structure revealed the centrality of female education to the complex system. Stepping back to review all the feedback loops around a theme will highlight the most significant and repeating elements (factors, causal relationships, and entire loops) and relationships within the feedback loops, giving analysts a good sense of the node of the system.

This process of compiling feedback loops, spotting overlaps, and identifying relationships among loops creates a Complex Systems Map—the first holistic and cohesive visualization of the system.¹⁸ (See Figure 2) The map highlights the interconnectedness and interdependencies among the driving factors or variables within a system. It is a living document that practitioners will update as they receive feedback and engage with the system over time.

Figure 2. Complex Systems Map: Youth Bulge in the Sahel



Source (population and climate data): NIC, *Global Trends 2040*, March 2021, 19, https://www.dni.gov/files/ODNI/documents/assessments/GlobalTrends_2040.pdf; NASA, *Study Confirms Climate Models are Getting Future Warming Projections Right*, <https://climate.nasa.gov/news/2943/study-confirms-climate-models-are-getting-futurewarming-projections-right/>.

Crafting the Narrative and Socializing the Systems Map

The Complex Systems Map acts as a visual table of contents for a holistic and dynamic story of the context or narration.¹⁹ After creating a map, a narrative is generated to enable those who

have not been part of the mapping process to understand the system’s storyline. By telling this narrative to others, analysts invite more participation, identify gaps in thinking, gain deeper insight into the system, and evolve their understanding as the system changes. This iterative process refines the map. Sharing the narrative with IC members, security experts, social scientists, analytic methodologists, etc. socializes the map. These audiences broaden the analysts’ perspective on contributing factors and drivers, promote the building of a shared understanding of the complex issue, and highlight the key drivers and primary factors to force practitioners to look objectively at the entire system.²⁰

Benefits of Complex Systems Practice

Complex Systems Practice applies a unique combination of analytic methods, including structured techniques and Systems Practice,[†] to complex intelligence issues, even if the intelligence question is not well defined. Rather than merely being a starting point for linear analysis, CSP shows that structured analytic techniques have demonstrable value when applied to individual variables within the complex system. They guide research, record the analytic process, and build the structure for a Complex Systems Map. CSP further defines the issue by objectively accounting for the dynamic relationships and emergent properties within the system. However, building the contextual framework for viewing the intelligence issues is only the start of an iterative process that becomes more robust as new information impacts the system. Iteration and socialization of the Complex Systems Map promote understanding of the system’s adaptive tendencies and exogenous factors’ interdependencies. Further analysis is required to understand the relationships among the factors leading to the complexity of the system; CSP takes that next step into exploring the relative intricate interactions among the key drivers that affect the intelligence issue.

Lessons for the Sahel

CSP identified several leverage points that could guide the Sahel to a healthier future state as it undergoes large demographic change. Local and national forces that create hubs of systemic change that interact with leverage points within the complex system should influence positive systemic change. These points can be grouped into categories: economic, education, governance, healthcare, and security. Our results support the need for a multifaceted solution affecting each of the categories of leverage because improving the prospects for youth in the Sahel can create ripple effects in human security that will enhance global security.

- The youth bulge is a complex system that possesses emergent properties that needs a Complex Systems Practice approach to properly analyze.

Leverage point categories are where interested parties may enjoy asymmetrical benefits in global security for moderate investments of time, effort, and/or money. Such investments will affect fundamental dynamics, causing ripple effects that eventually create a healthier system.

[†] An analytic method that focuses on visualizing analytic problems involving multiple variables that interact to create emergence.

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- The youth bulge alone is not a security concern; if provided adequate economic opportunities, a large youth cohort stimulates national and regional economies.
 - Sahelian female education is an anchor point and unifying theme around which the emergence created by the feedback loops is most easily visible.
 - Examining the youth bulge through the prism of Sahelian female education reveals leverage points with the most potential to effect change with modest effort.

Relevance to the Intelligence Community

Anticipatory intelligence alerts policymakers to global trends before they become dangerous and irreversible, reducing strategic surprise and uncertainty when national interests are at stake. Rapid Sahelian population growth is a global security concern because the region is largely “undergoverned” and lacks education and employment opportunities for its youth.²¹ This study seeks to reveal specific challenges in the Sahel that exponential population growth may worsen and identify ways to encourage the complex system toward a healthier future.

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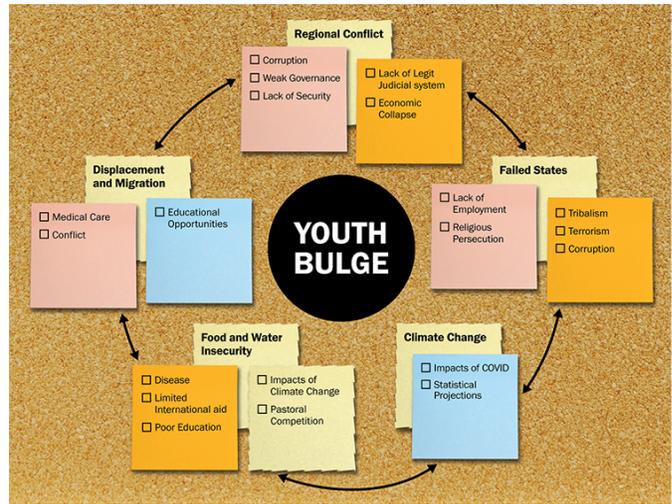
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Appendix A

Using structured analytic techniques, such as Structured Brainstorming, Radial Venn Analysis, and Chronologies and Timelines Analysis, can deepen understanding of how each constituent part of a system relates to the whole, aiding in developing a Complex Systems Map. Creating visual aids can help analysts organize data sets, which increases productivity, provides clarity of analysis, and ensures a more accurate assessment of the complex intelligence problem.

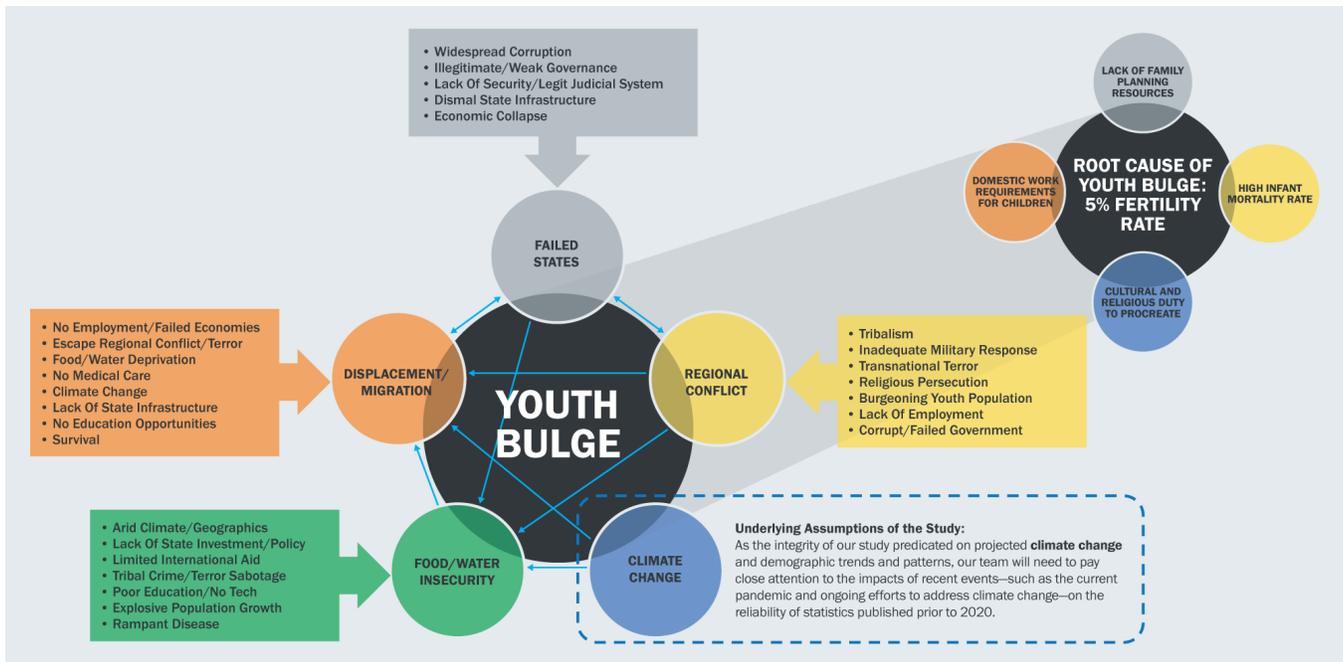
Structured Brainstorming (SB) is an exploration technique used to compile extensive lists of forces, factors, events, and constituents' roles that affect the complex system—a useful starting point for identifying the system's key variables. (See Figure A-1) Using SB broadens the scope of information and possibilities and helps counter satisficing—a tendency to look only for information that fits a preferred answer.²² Conducting SB and maintaining an archive of thoughts and notes that can be continually updated as the system changes can mitigate personal bias and “groupthink.”²³

Figure A-1. Structured Brainstorming (Virtual)



Radial Venn Analysis is a simple method to promote idea generation and identify critical causal factors and underlying interdependencies within a complex system. It also may identify underlying assumptions in the analytic methodology by revealing relationships among

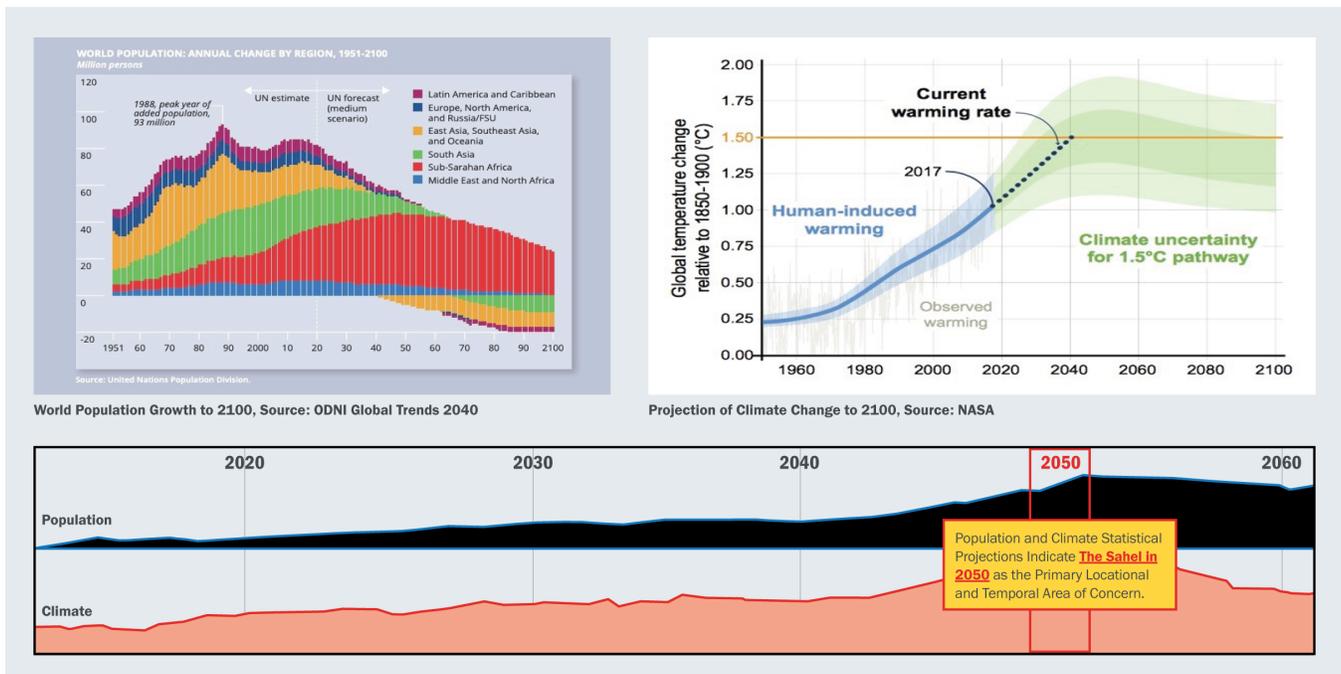
Figure A-2. Radial Venn Analysis



interdependent factors that underpin a proposed theoretical framework. Analysts first determine the central problem and center it in a basic Radial Venn diagram, which can be created in Microsoft PowerPoint SmartArt. Analysts then arrange factors driving or contributing to the problem along the perimeter to indicate their relation to the central problem, which creates a visual representation of factors within a complex system. (See Figure A-2)

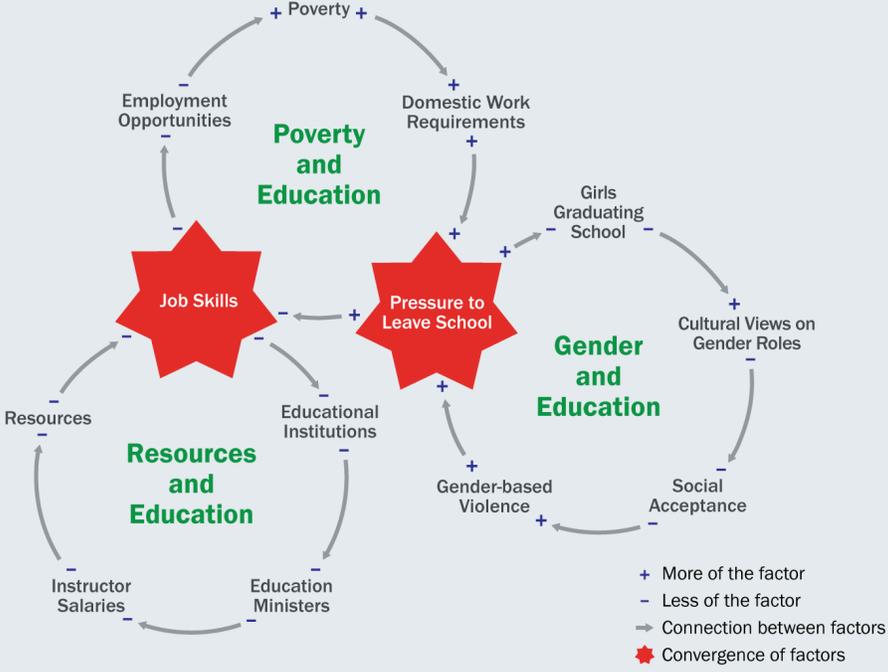
Chronologies and Timelines (C&T) Analysis graphically overlays fixed timeline events with the key forces, factors, and drivers of a complex system to place the events in historical and chronological context. C&T breaks a problem or issue into its component parts so each can be considered separately and then captures all the parts in an organized visual representation to aid understanding of how they interrelate.²⁴ C&T identifies the intersection of geographic, behavioral, and temporal variables, and the analysis discerns correlation from causation among linked events to allow analysts to view a data set from a more strategic vantage point.²⁵ It can help mitigate intuitive traps, such as relying on first impressions or ignoring inconsistent evidence or the absence of information,²⁶ and encourage analysts to challenge existing mental frameworks and continuously update analytic models. This technique can also highlight critical information to drive collection. It is an effective way to order information when processing daily message traffic, often taking the form of a spreadsheet or sequential graph. Using C&T, analysts gather all relevant information; place the data along a line that depicts the convergence or divergence of actors, organizations, or streams of information; and create a summary chart detailing key events, identifying gaps, and weighing the implications of an absence of evidence.²⁷ (See Figure A-3)

Figure A-3. Chronologies and Timelines



Source: Data: NIC, *Global Trends 2040*, March 2021, 19, https://www.dni.gov/files/ODNI/documents/assessments/GlobalTrends_2040.pdf; NASA, *Study Confirms Climate Models are Getting Future Warming Projections Right*, <https://climate.nasa.gov/news/2943/study-confirms-climate-models-are-getting-futurewarming-projections-right/>.

Feedback Loop 3: Education



Endnotes

- 1 Richards J. Heuer and Randolph H. Pherson, Jr., *Structured Analytic Techniques for Intelligence Analysis*, 2nd ed. (Washington: CQ Press, 2015), 3-15.
- 2 The Omidyar Group, Systems Practice (The Omidyar Group), <https://docs.kumu.io/content/Workbook-012617.pdf>.
- 3 Thomas Pike, "Analysis and Artificial Intelligence in Integrated Campaigning 2019," *Invited Perspective Series: Strategic Multilayer Assessment (SMA)*, 2020, <https://nsiteam.com/social/wpcontent/uploads/2020/02/Pike-IP-Final-17Jan20-v2R.pdf>.
- 4 The Omidyar Group, *Systems Practice*, 30.
- 5 Laura Saavedra, "The Demographic Explosion in the Sahel Region: Its Governance's New Challenge," Instituto Espanol de Estudios Estrategicos (June 27, 2019), http://www.ieee.es/Galerias/fichero/docs_opinion/2019/DIEEEO61_2019LAUTOR_demografia_ENG.pdf.
- 6 Marcus Arcanjo, "Risk and Resilience: Climate Change and Instability in the Sahel," *A Climate Institute Publication*, October 2019, <http://climate.org/wp-content/uploads/2019/10/Risk-and-Resilience-Climate-Change-and-Instability-in-the-Sahel.pdf>.
- 7 United Nations High Commissioner for Refugees (UNHCR), Refugee Data Finder, Geneva, Switzerland, 2020, <https://www.unhcr.org/refugee-statistics/>.
- 8 Fragile States Index, "Measuring Fragility: Risk and Vulnerability in 178 Countries," [Fragilestatesindex.org](https://fragilestatesindex.org), 2020, <https://fragilestatesindex.org/>.
- 9 Robert Ricigliano and Diana Chiga, *Systems Thinking in Conflict Assessment: Concepts and Applications*, USAID, 2011, <https://www.cdacollaborative.org/wp-content/uploads/2016/08/Systems-thinking-in-conflict-assessment.pdf>, 3.
- 10 Acumen Academy, "Systems Practice Course," (workshop, Acumen Academy online, March 16, 2021), <https://acumenacademy.org>; see also The Omidyar Group, *Systems Practice*.
- 11 Acumen Academy, "Systems Practice Course."
- 12 The Omidyar Group, *Systems Practice*, 28-29.
- 13 The Omidyar Group, *Systems Practice*, 20.
- 14 The Omidyar Group, *Systems Practice*, 32.
- 15 The Omidyar Group, *Systems Practice*, 34.
- 16 The Omidyar Group, *Systems Practice Workbook*, 36-37.
- 17 The Omidyar Group, *Systems Practice Workbook*, 40.
- 18 The Omidyar Group, *Systems Practice*, 44.
- 19 The Omidyar Group, *Systems Practice*, 50.
- 20 The Omidyar Group, *Systems Practice*, 54.
- 21 Office of the Director of National Intelligence, *Annual Threat Assessment of the U.S. Intelligence Community*, April 9, 2021, <https://www.dni.gov/files/ODNI/documents/assessments/ATA-2021-Unclassified-Report.pdf>.
- 22 Herbert Simon, "Rational Choice and the Structure of the Environment," *Psychological Review* 63, no. 2 (1956): 129-38, <https://pages.ucsd.edu/~mckenzie/Simon1956PsychReview.pdf>.
- 23 Susan Cain, "The Rise of the New Groupthink," *New York Times*, January 13, 2012, <https://www.nytimes.com/2012/01/15/opinion/sunday/the-rise-of-the-newgroupthink>.
- 24 Heuer and Pherson, *Structured Analytic Techniques*, 67.
- 25 Sarah M. Beebe and Randolph H. Pherson, *Cases in Intelligence Analysis*, 2nd ed. (Los Angeles: Sage/CQ Press, 2015), 35.
- 26 Heuer and Pherson, *Structured Analytic Techniques*, 138.
- 27 Heuer and Pherson, *Structured Analytic Techniques*, 140.