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Towards a Framework for Transdisciplinary Problem Solving

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We live in trying times because of the rapid convergence of technologies such as artificial intelligence, brain-like computer chips, bio-engineering, intelligent pharmacology. At the same time we live with complex societal problems related to issues including global warming, hunger, and aging. The collision of these factors means that we face many serious ethical issues in our daily lives, which often leads to a myopic and self-centered view of the world. Indeed, as we struggle to balance our own dreams and needs, we often forget that we are members of the whole. This article is an attempt to use a transdisciplinary approach to tackle the complex issues in our world by seeking a methodological framework that uses the best aspects from multiple disciplines. The desired end result is a solution that can bridge the profound (higher consciousness) and the practical (innovation) in a way that empowers us to direct our lives in ways that will honor the whole.

Keywords: Framework for transdisciplinary problem solving, complex issues, consciousness, inner transcendence.

1 Introduction – A Tale of Two Kobayashis

In 1978, I was invited to be an honorary research fellow at Fujitsu's research institute. During my visits to Japan I had the opportunity to meet many wonderful Japanese leaders. Dr. Tai Yu Kobayashi, former Chairman and CEO of Japanese computer giant Fujitsu Systems, once shared his secret of success with me:

> "*I get up every morning at 5:00 AM and spend an hour in my Bonsai garden, immersing myself in nature and becoming totally tranquil. I strive to maintain this state of mind throughout the day, which allows me to make decisions without emotional attachment.*"

With this serene practice of easing into a calm state of mind every morning, Mr. Kobayashi could see the world with more clarity. With this clear vision he was able to lead Fujitsu to be the first major Japanese company to go global.

The other Kobayashi I met was Dr. Kanji Kobayashi, long time Chairman and CEO of NEC.

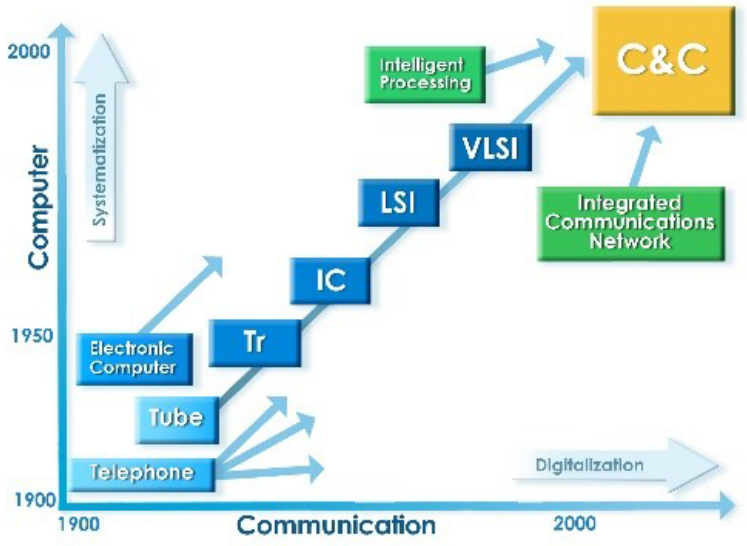

Figure 1: NEC's C&C strategic map.

The letters NEC stood for Nippon Electric Company, and its primary business was providing electric power. When I asked Dr. Kobayashi to describe the most important decision he made as the leader of NEC, he shared the following with me:

> "*When I took over as the President of NEC, I made the decision to phase out our business in nuclear reactors. It was clear to me then that the future of NEC must be in the emerging technology areas of computers and communication.*"

Kobayashi took a huge risk by steering the company away from its existing energy business, and focusing on the uncertain futures of the two nascent industries. But Kobayashi clearly saw how the computer and communications industries would collide in the coming 30 years, creating huge opportunities for companies poised to exploit the resulting new markets. Kobayashi created a strategic map (the now famous C&C map–see Figure 1) to prepare his company for the intersection of the computer and communications. This roadmap identified competencies NEC would need to maximize the potential of the C&C intersection over the next 30 years. The map provided tremendous clarity and focus, helping the company to anticipate the intersection points between the growth of the computer and communications industries. NEC could then proactively create products and services to serve those points of intersection. The map defined NEC's new "Blue Ocean"[1] strategy by defining a new competitive space, allowing the company to prepare products/services that took advantage of each new breakthrough in either industry, and empowering the company to be first in those new markets.

While Kanji Kobayashi did not share insights about his inner journey with me, I can imagine the huge internal corporate resistance when he chose to steer the company away from its traditional business, drastically changing the human resource profile in a culture where lifetime employment was taken for granted. He must have had tremendous inner calm to overcome the day to day disturbances created by the company's new direction.

The encounters with the two Kobayashis gave me my first lesson on *transdisciplinary thinking*. Tai Yu Kobayashi showed me how inner transcendence helped him maintain his serene clarity so that he could merge the profound with the daily mundane challenges faced by any corporate CEO. Kanji Kobayashi showed me how disruptive innovation could be derived by leveraging the strengths of two distinct disciplines.

There are three perspectives of our "transdisciplinary problem solving framework"[2] , namely: *historical, spiritual/ecological, and actionable*. The his-

[1] W. Chan Kim and Renee Mauborgne, Blue Ocean Strategy, Harvard Business School Press, Boston, Mass, USA.

[2] Deduced from Prof. Basarab Nicolescu's opening remarks at the 2018 ATLAS Conference at Cluj-Napoca, Romania.

torical perspective is concerned with the unity of *knowledge*. Specifically, this approach leverages disciplinary knowledge, across time, space, and cultures, which leads to *innovative transformations* as demonstrated by Kanji Kobayashi's 30-year roadmap.

The *spiritual/ecological perspective* is primarily concerned with *inner transcendence* towards higher consciousness and achieving an *expansive worldview*. The result is the eventual transcendence beyond dualisms such as space-time, subject-object, and birth-death, leading to the concept of our *interconnectedness* (*oneness/deep ecology*). Tai Yu Kobayashi's morning meditation, which allowed him to reach the mental tranquility needed to be one with nature, illustrates an approach of transcending to a higher level of consciousness.

The *actionable perspective* is mainly concerned with the unity of actions by bridging the *profound* (such as vision from a higher consciousness) and the *practical* (such as innovations). This approach leads to *responsible living*[3] in the sense that the resulting innovation has taken into consideration elements of our surroundings, such as people, community, society, environment, and economy. The famous speech *I Have a Dream*, delivered by American civil rights activist Dr. Martin Luther King Jr. in 1963 is a good example of *responsible living*. Dr. King created a strong social movement that eventually resulted in African-American's gaining equal rights, and, 45 years later, the election of the first African-American President of the United States. While Dr. King's speech is extremely inspiring and powerful, it took countless African-Americans and Caucasians joining the social movement to create these results. One notable Caucasian, United State President Lyndon Johnson, heroically spear-headed the creation of "a great society" to provide the necessary legal foundation for the movement. This is an example of the unity of collective actions by many people, linked across time and space, to honor the *whole*.

This paper is an attempt to use examples to illustrate how these three approaches can solve problem in a transdisciplinary way. Hopefully, a more systematic methodology will emerge from this initial understanding.

[3]Ronald Epstein, Responsible Living: Explorations in Applied Buddhist Ethics–Animals, Environment, GMOs, Digital Media, Perfect Paperback, march, 2018.

2 The Historical Perspective

> "*Give me a lever long enough and a fulcrum on which to place it and I shall move the world.*" – **Archimedes** –

Perhaps the greatest early transdisciplinarian was Leonardo da Vinci–a philosopher, scientist, artist, inventor, and designer during the Renaissance. According to Fritjof Capra, "*Leonardo often worked on several projects in parallel, and that in trying to understand a phenomenon, Leonardo would often try to connect it with other phenomena through a similarity of patterns. And when his understanding advanced in one area he would revise his ideas in related areas accordingly.*"[4]

In 1943, Nobel laureate physicist Erwin Schrödinger delivered a series of lectures in Dublin to offer his views on how physics could shed light on the puzzling ability of living organisms to maintain molecular order and organization in the face of what seemed to be the randomizing forces of nature. Schrdinger's lectures were collected into the book *What Is Life*?,[5] published in 1944. It turned out to be one of the most influential scientific books of the twentieth century, attracting scientists from other fields, including physicist Francis Crick and zoologist James Watson. Watson used Schrödinger's approach to study genetics and the molecular mechanisms, which led to the birth of molecular biology and the subsequent discovery of DNA. Schrdinger's lectures made the case that profound questions about the natural world are not owned by any single discipline as scholars from different disciplines all have a stake in the future of life.

In 1998, biologist E. O. Wilson published the book titled *Consilience: The Unity of Knowledge*[6] in which the author discusses methods that have been used to unite the sciences, and might in the future unite them with the humanities. The word consilience literally means a 'jumping together' of knowledge, and describes the synthesis of knowledge from different disciplines to create a common basis of explanation.

[4]Fritjof Capra, Learning From LEONARDO – Decoding the Notebooks of a Genius, Berrett-Koehler Publishers, Inc. San Francisco, 2013.

[5]Erwin Schrodinger, *What is Life*? Amazon.com, ISBN-13: 978-1107604667.

[6]Wilson, E.O. *Consilience: The Unity of Knowledge*, Vintage Books, NYC, NY, 1988.

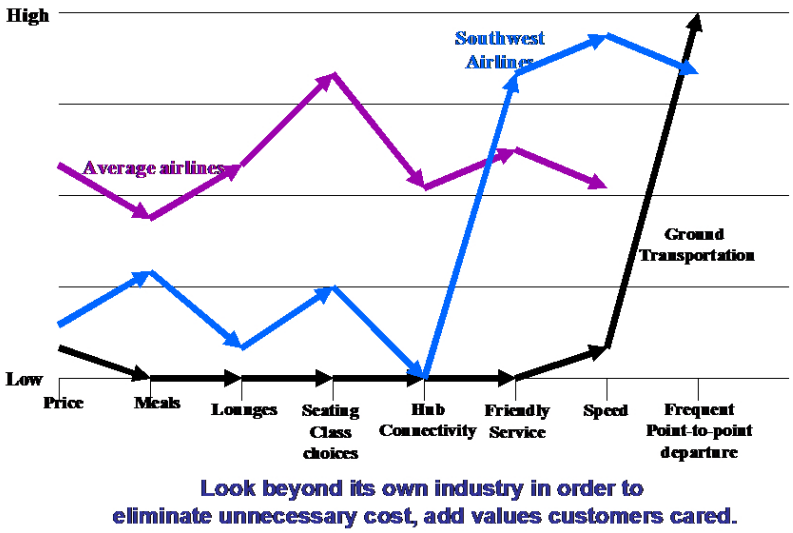

Figure 2: SWA's strategy.

In 2014, the U. S. National Academy of Sciences published a book titled *Convergence* to promote a strategy that merged life sciences with other fields, including physical, chemical, mathematical, computational, engineering, and social sciences. The goal was to use the convergence of multiple fields to solve complex challenges, and achieve new and innovative solutions. The report summarizes the lessons learned, and provides organizations with strategies to tackle practical needs and implementation challenges.

These short surveys hopefully provide sufficient evidence about the importance of *leveraging* the knowledge/practices of different disciplines so that meaningful innovations or transformations can emerge, as suggested by Archimedes centuries ago.

Not surprisingly, effective leaders have been using transdisciplinary thinking for centuries. During the Three Kingdom era (220-265A.D.) in China, General Kung Ming battled the Wei army across a river. One day, the officer in charge the front line reported the bad news to Kung Ming that his army had run out of arrows, and replenishment supplies were delayed. To tackle this urgent problem, Kung Ming needed to leverage all his assets to survive the battle. He noted that the weather had been foggy in the mornings. After some thought, he suggested borrowing some arrows from the enemy across the river. Early next morning, he launched an armada across the river in the fog toward the enemy camp, with each boat filled with straw men dressed as soldiers. Predictably, the enemy shot waves of arrows at the straw men, which looked like real soldiers in the fog. By mid-morning, Kung Ming's navy returned with tens of thousands of arrows–gifts from the enemy. Kung Ming's success was based on his ability to leverage the foggy weather as well as the psychology of the enemy to shoot arrows any time the enemy approached.

The contrarian airline, Southwest Airlines (SWA), offers a modern example about the success of transdisciplinary thinking. Herb Kelleher, co-founder of SWA, expressed his philosophy of always being alert and utilizing resources efficiently by saying:

> "*Think small and act small, and we will get bigger. Think big and act big, and we will get smaller.*"

Put another way, when a leader thinks small, he or she must leverage all the available forces. When SWA began operations, the goal was to provide high quality service to customers while charging low prices so that many more people could afford fly. As a small start-up company, SWA could not afford the extra services offered by other airlines, such as airport lounges, meal services, or gates in major airports. SWA used transdisciplinary thinking to create forces that could be leveraged. For instance, SWA's top management studied the ground transportation systems, and then modeled the same system in the airline market. By leveraging the ground transportation model, SWA chose to become a create a new "strategic canvas"[7] as shown in Figure 2. SWA became the first airline to forsake the spoke-and-hub

[7]W. Chan Kim and Renee Mauborgne,*Blue Ocean Strategy*, Harvard Business School Press, Boston, Mass, USA.

system, occupy gates in smaller regional airports, discard the notion of assigned seating, and serve no meals. By promoting efficiency, cutting costs, and keeping things simple, SWA is able to turn its airplanes around much faster than other airlines. As such, SWA transforms its competitors' assets, including large fleets of mixed airplanes and the spoke-and-hub system, into disadvantages.

Two other modern examples of leverage, both in the music industry, are worth mentioning. The first music revolution of *portable music*, Sony's *Walkman*, and the 2^{nd} music revolution, Apple's *iPad*, both provided users with an easy to use method for music discovery and delivery on portable devices. Both companies leveraged multiple technologies to create their ground-breaking music delivery systems. It is interesting to note that Sony, which is very proud of being an innovative organization, did not detect the potential leverage points for the 2^{nd} music revolution.

Consider another story:[8]. "*In 1869, the presidents of the Union Pacific and Central Pacific railroads met in Promontory, Utah, to drive the ceremonial spike that connected their railroads. That made transcontinental railroad travel possible, for the first time." What if railroad tycoons thought of their business as the transportation business rather than railroad transportation business*? They probably would own the airlines and the truck/auto business as well today.

But the above stories are not immediately useful for daily use as most of us are not able to break down our "associative barriers."[9] To see far enough to replicate one's own transdisciplinary market disruption, one needs to transcend to higher levels of consciousness.

3 The Spiritual/Ecological Perspective

> "*No problem can be solved from the same level of consciousness that created it.*" – **Albert Einstein** –

According to Capra, Leonardo Da Vinci always put life at the center of his work, recognizing the fact that "*all-natural phenomena are fundamentally interconnected and interdependent.*" Indeed, Da Vinci emphasized the point when he commented, "*One who does not respect life does not deserve it.*"[10] With such an expanded world view, Da Vinci pursued scientific and engineering work to honor nature rather than dominate it as Francis Bacon did a century later. Bacon's influence of a self-centered bottom-line thinking continues to dominate our society today with a focus on *expansion, competition, quantity, and domination.*

Returning to the SWA example, one can see that the heart of SWA's success is its vision "*to free the sky*" so that everyone can fly. To achieve this goal, the airline must have low fares, as well as provide high quality service. To offer low fares, SWA leveraged the ground transportation's point-to-point strategy as mentioned previously.

The foundation of SWA's success is the Yin and Yang of its culture. SWA's culture is based on the *whole person* concept. This concept contains two seemingly opposing forces: *freedom and accountability fueled by trust.* This means each employee has the *freedom* to act as he or she thinks is best. At the same time, employees remain accountable for their actions, based on a sense of trust between company and employee. This culture allows each employee to truly be and act as a whole person rather than as a cog in a machine governed by rules and regulations. Indeed, I was totally charmed the first time I strolled through the SWA headquarters on Love Field airport in Dallas. The walls were filled with captivating photos, news clippings, articles, letters, and mementos of employees at various company events. Unlike headquarters of many the Fortune 500 companies, characterized by marble floors and works of original art, the SWA corporate headquarters felt like a big family room filled with the love and warmth emanating from the family photos.

At SWA there exists a rare covenant between company and employees. SWA provides a meaningful cause, great freedom and flexibility, a fun atmosphere, and excellent benefits. SWA employees provide hard work, dedication and, most of all, accountability and responsibility for their own actions. In a world in which employees no longer expect companies to take care of them and companies no longer

[8] Robert Block,"The Many Ways of Thinking", talk presented at the ATLAS conference 2016, China

[9] Frans Johansson, The Medici Effect, Harvard Business School Press,2004, Boston Massachusetts.

[10] Fritjof Capra, *Learning From LEONARDO – Decoding the Notebooks of a Genius*, Berrett-Koehler Publishers, Inc. San Francisco, 2013.

expect employee loyalty, such a bond of mutual trust is a rare and precious asset. It's easy to see the many expressions of that trust everywhere in the SWA culture. For instance, the airline grants its employees great flexibility in creating their own work schedules. Within each employee work group, people can adjust shifts and days off, or trade work days with each other. In addition, employees have complete freedom to act and make decisions to serve and assist customers and other employees.

Once employees are part of the family, they are always part of the family. Can a company as large as SWA really be one big, happy family? Absolutely! Nothing less would produce the hardworking, fun loving, dedicated workforce that strives heroically on a daily basis to fulfill their vision of freedom in the skies. For employees, becoming an integral part of the SWA family not only gives their work meaning and fun, but it gives them the freedom to be who they are. As a result, the division between work life and family life becomes blurred. Family problems become a part of the tapestry and culture of the airline. The company exerts itself to help employees with family problems, often taking the initiative without being asked. Says Kelleher:

> "*We get thousands of notices about something serious that has happened to a family member. Everybody at Southwest Airlines pitches in instantaneously. That's the way we are. We get tickets for relatives to fly in when someone appears to be terminally illdon't ask, just go do it.*"[11]

4 The Actionable Perspective

> "*Whatever befalls the earth, befalls the sons and daughters of the earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself.*" – **Ted Perry, inspired by Chief Seattle**

Consider again the SWA story from the perspective of the above quote. When SWA built its corporate headquarters in Dallas, Texas, Kelleher appointed himself a windowless office away from a corner. Though flamboyant and often loud by nature, Kelleher is nevertheless humble at heart. Throughout his professional life, he has held true to the early values he gleaned from his mother, always treating each person as an equal. At SWA, Kelleher does not differentiate people by the positions they hold, choosing instead to honor the sacredness of each person as a human being. Says Kelleher, "It's very important to value people as individuals."

Before the tragic events of September 11, 2001, Southwest Airlines (SWA) was the sixth largest airline in the U. S. Only one year later, SWA was "valued at $10.8 billion", more than all the other majors combined.[12] Perhaps what is most revealing about SWA were Kelleher's thoughts right after the tragedy. Kelleher recalls:

"*The first thing on my mind, quite honestly, was the well-being of our crews and our passengers. Are we getting the airplanes down safely? Do we know where everyone is? Are we taking care of them? The second thing was, just instantly, this is an economic catastrophe which is going to have widespread effects for a long time to come and survivability is going to depend on cash. So cash is king! Forget profitability. Get all the cash that we can, so we went out and borrowed a billion dollars because I figured this was going to be a war of attrition. Whoever had the most cash could last the longest.*"

Driven by its vision of freeing the sky and its whole person trusting culture, Kelleher led SWA with a value-centered culture that has always provided job security for employees. This establishes a collective identity for the airline's 36,000 employees, bridging the divide of work and family, and creating a principle-based relationship. The concern for survivability led to its unusual "filling in" market strategy. SWA simultaneously does the following in new markets:

- Lowers the fare while increasing the number of flights to *saturate* the market.
- Maintains a service mentality and long-term partnership with all of its extended families based on inclusion
- Focus on low cost, speed, high quality service, flexibility, and simplicity. For instance, SWA uses only one kind of airplanes (B737), which means a shallow learning curve for staff, lean maintenance costs, and fast turn times at the gate.

[11] Raymond T. Yeh and Stephanie Yeh, *The Art of Business*, Zero Time Publishing, 2004, Olathe, Co. USA.

[12] Ibid.

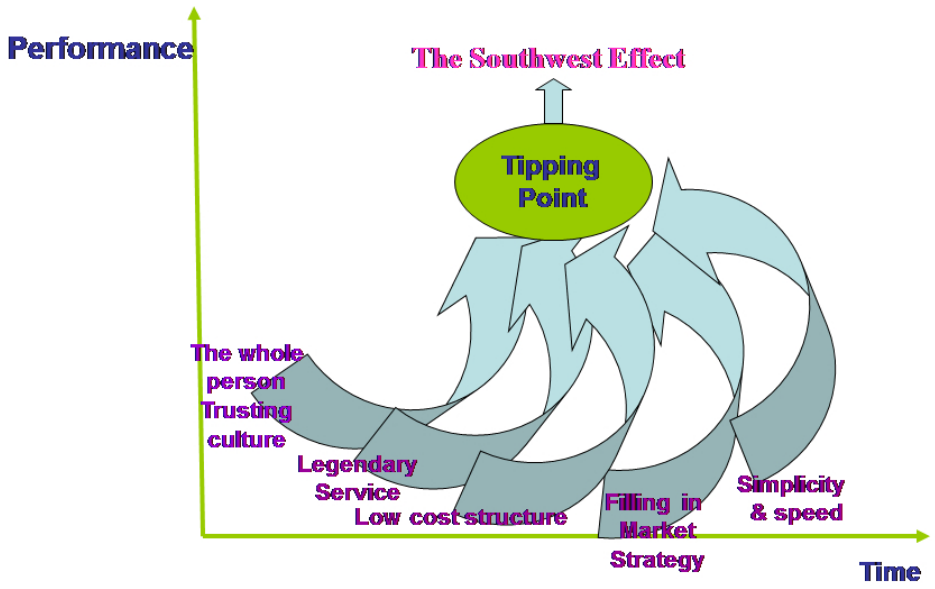

Figure 3: The SWA Effect.

Taken together, these factors create a tipping point, known as the *Southwest Effect*[13] (see Figure 3) that have propelled SWA to become one of the most successful airlines today.

We may call the SWA example a *back from the future or enlightened* approach in the sense that when one is on top of the mountain, it is clear where one needs to go. However, when we cannot see the future clearly we need to use the *incremental* approach, learning our way to future as we plow slowly ahead on a winding country road.

Grameen Bank is an organization that has been astoundingly successful using the *incremental* approach. Grameen Bank pioneered the approach of Micro Lending for the Poor. During the famine of 1974, Muhammad Yunus, a Professor of Economics at the University of Chittgong, was shocked at the utter devastation he found in the villages situated around the University. He came to understand that the poor people in these villages were committed to a form of labor, or slavery, in which they traded their labor for a mere 22 cents per day, barely enough for survival. This cycle continues day in and day out, from one generation to the next. Yunus recalls: "*I never heard of anyone suffering for the lack of 22 cents. It seemed impossible to me, preposterous.*"[14] He personally lent the equivalent of $27 to 42 people, which amounted to about 62 cents per person. With this money, each person bought materials for the day's work, weaving chairs or making pots. At the end of their first day as independent business owners, each of the 42 people sold their wares and paid back the loan. With this understanding and success, Yunus went to the bank to persuade the bankers to help a whole village. The bankers were not willing to make such loans, because "poor people do not have *credit*." However, with Yunus willing to co-sign the loan, Micro Lending helped a whole village with resounding success. Yet, despite this success, the bankers remained unable to break away from their associative banking barrier that "poor people do not have credit," and remained generally unwilling to loan money to poor people. To solve this problem, Yunus, together with a group of like-minded colleagues and students, formed Grameen Bank (the word Grameen means "village") as a micro-lending organization dedicated to lifting the poor out of the perpetual cycle of poverty.

Grameen Bank was created out of the deeply held belief that the poor are as trustworthy as the wealthy or middle class. By studying the villages around him, Yunus came to understand that the poor are poor not because they are untrained or illiterate, but because they cannot retain the returns of their labor since they have no control over capital. Once they are economically empowered, however, they "are the most determined fighters in the battle to solve the

[13] Ibid.

[14] Yunus, Muhammad. *Banker to the Poor – Micro-lending and the Battle Against World Poverty* 1999, Public Affairs, New York.

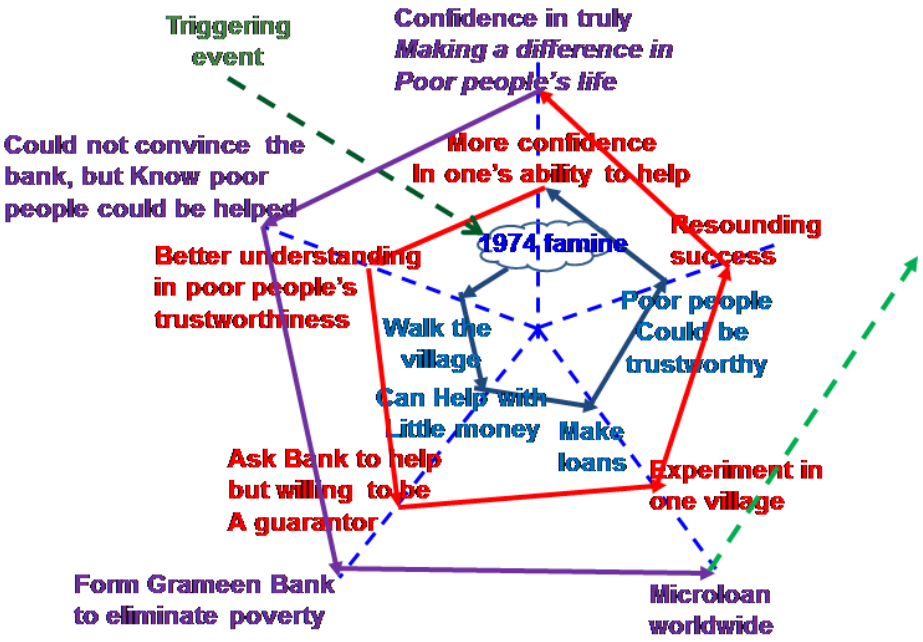

Figure 4: The Adventures of Prof. Yunus.

population problem, end illiteracy, and live healthier, better lives." Grameen Bank considers credit to be a basic human right, and operates on the faith that the poor will repay their debts. Unlike traditional banks, Grameen exists in a counter-culture of its own creation, focused not on making money but on helping people get out of poverty. While profit is a necessary condition of success, the officers at Grameen Bank use profit only as a measure of efficiency. If borrowers are unable to repay loans, the bankers at Grameen focus on assisting borrowers in overcoming problems, not punishing them. This unconventional approach, rare in the banking industry, springs from the belief that each person should be given the necessary tools and assistance to control his or her destiny.

As a no-handout, inexpensive program that helps the poor with a hand-up to build businesses, micro credit goes directly to the poor. In contrast to many welfare programs, micro credit actually creates long-term jobs in the villages, and helps women develop confidence and independence in a masculine-dominated culture. The economic multiplier effect of micro lending is significant because the poor reinvest the money they earn back into the local economy, buying basic goods such as food, clothing, and shelter. By limiting the size of the loans to small amounts of money, micro credit institutions are able to avoid borrowers motivated by greed. Now decades later, the practice of micro credit lending has spread to more than 50 countries, including some highly developed countries such as the United States. Furthermore, an unprecedented 98% of borrowers have paid their loans back in full.

It is important to point out that while the 1974 famine served as a triggering event for Professor Yunus to help poor people, it's a long journey to come up with the vision of "*a world that is free of poverty*" and then figure out ways to realize it as illustrated in Figure 4. Indeed, it is a journey of both gradual inner transcendence as well as outer transformations via innovations.

The above two examples provide a glimpse of two distinct processes leading to *transcendence inspired transformation*. While Herb Kelleher wanted everyone to be able to fly, Muhammad Yunus, on the other hand, wanted to help "poor people" become full members of the world community. Their journeys remind me of phrases in Robert Frost's poem: *The Road Not Taken*:

> *"I shall be telling this with a sigh Somewhere ages and ages hence: Two roads diverged in a wood, and I, I took the one less traveled by, And that has made all the difference.*

5 Conclusion

We hope to have illustrated with examples in the previous sections that a transdisciplinary approach to problem solving is that of "*inner transcendence inspired outer transformations.*" Put another way, the approach consists of both finding that quietude within to reach a higher level of consciousness with a more expansive worldview, and *leveraging* resources in the environment/disciplines to create innovations that are both transformational as well as responsible. Clearly, we are far from a transdisciplinary problem-solving methodology in terms of how to deal with different kinds of complexity – be it dynamic, generative, or social. We are encouraged, however, with recent development of transdisciplinary sustainable design process such as the comprehensive work by Professor Ertas.[15]

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[15] Atila Ertas, *Transdisciplinary Engineering Design Process*, John Wiley & Sons,Hoboken, New Jersy, 2018.