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**Sutardja Center**

for Entrepreneurship & Technology

Berkeley Engineering

# **Berkeley Innovation Index\* : An Approach for Measuring and Diagnosing Individuals' and Organizations' Innovation Capabilities**

February 22, 2016

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\* [www.berkeleyinnovationindex.org](http://www.berkeleyinnovationindex.org)

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## Abstract

Innovation is widely recognized as an important variable to create competitive advantage and drive economic growth. Innovation is also a relatively vague concept, but the absence of it results in stagnation and loss of competitive behaviors. Innovation capability is the ability to be innovative, and is a characteristic of individuals as well as organizations. The issue with learning and executing “innovation” is that it is often removed from actual situations, too theoretical, not time-ordered, and not holistic.

In this concept paper, we contend that if Innovation cannot be measured, then it is inherently difficult for any person or organization to improve their ability to be innovative. Most past measures have not been insightful or holistic. For example, the numbers of patents or the amount of money spent on R&D have not shown any causality with organizations’ ability to be innovative.

Berkeley Innovation Index (BII) is a concept and an open project to offer simple yet powerful ways to measure innovation capability in a holistic sense. These measures, models and tools are based on previously published research findings. The approach is also intended to cover layers of innovation that range from the following fields: 1) Strategy and Leadership, 2) Innovation Culture from an Organization’s Viewpoint, 3) Organizational Operations and Measures across functions, 4) Mindset: The Innovation DNA of the People, and 5) Tactical measures.

When measured and considered across all levels, we believe that the innovation measurement process can be made more accurate and diagnosable.

## Historical Background and Traditional Indicators for Innovation

In order to characterize the innovation performance of a firm, a broad range of metrics have been (and still are) used, such as the number of patents, labor productivity, R&D spending, and revenues due to products launched in the last 3 years. However, these measures lack precision and do not take into account the cause and consequences. Moreover, many studies have produced results showing that there is no significant relation between R&D expenses and profits, and therefore, they have not accounted for innovation (Jaffe, 1986).

Some metrics analyze the number of patents filed by companies, arguing that one of the criteria for a patent to be granted is that the technology has to be new. But patents are technology oriented and a new technology does not always make a great innovation, the same way that a great innovation does not necessarily require a major technological breakthrough. Further, many firms have begun to adopt a “trolling” strategy, filing large numbers of patents just to block potential competitors. Consequently, there is no substantive link between the number of patents and innovation in these cases.

A wide range of consulting-based approaches have also been developed to analyze a company's strategy or to assess its performance. For example, from a top-down financial strategy perspective, the BCG matrix has traditionally been used to compare different business units within companies according to their expected market growth of market share. At the other end of the spectrum, even product level design-thinking oriented strategies have emerged and been adopted by traditional firms (cf. McKinsey recently bought Lunar, a large design consulting company).

Overall, the existing variables for innovation analysis mostly use a quantitative approach inherited from financing methods.

### **Tools Have Been Developed to Take Innovation into Account**

As innovation is increasing in importance as an element in companies' strategies, the time to market is getting shorter and existing tools are not sufficiently adaptable to these rapid changes due to the apparition of new variables. This has led to the creation of new metrics and studies in the area which are increasing the accuracy as a general trend:

The approaches used in most new tools are derived from:

a) Financial analysis: Innovation Premium, based on the gap between the expected value of the company and its market valuation, is used to rank the most innovative companies. Real option theory, which gives an estimated value of a company, is based on the aggregated potential output value of its innovation projects according to several scenarios. Tools like the balanced scorecard (from portfolio analysis) are designed to help firms' management teams to improve

multi-project management methods. This approach places emphasis on portfolio management tools that promotes idea sharing between units in the company and between different types of projects.

b) Organizational and culture analysis: Some studies have shown how important it is for a company to be considered innovative nowadays. One of the desired outputs of any innovative project (even if it failed) is that it improves the image or brand reputation of the company (see “full value” analysis (Maniak, 2015)).

c) Knowledge reuse and “Learning by doing”: More and more, the “right to fail” has fostered new management habits, putting higher value on the learning experience. But how can we extract value from failed projects? The success of a current innovative project can be explained by the failure of a previous project years ago. Many famous innovations were born because the first objective failed to be reached, but people learned how to use what they found; this is called serendipity. Also, larger industrial firms have produced innovative results by reusing technology from previous projects to use it in different sectors (Chapel, 1997). It is called “multi-project lineage management” (Midler, 1995). Finally, some researchers have managed to map the knowledge used in a project and its trajectory throughout time (the Concept-Knowledge theory, Hatchuel et al., 2002).

d) Open Innovation: Innovation outsourcing has become a key variable in the race to innovation (Chesbrough, 2003), as it illustrates the ability of a company to tap into technology that emerges from outside its perimeter, such as startups or universities. In these cases, it shows how the company accepts the fact that the best innovation does not necessarily come from its own R&D facilities.

e) Considering Creativity: An emphasis on the role of creativity has begun to emerge. More and more companies rely on creativity management to boost their “creativity capital”. Methods like TRIZ or Six Thinking Hats (de Bono, reference) help teams and individuals to be more creative and to use their new ideas for the benefit of the business. Other methods can help to measure the creativity of a person, such as the Guilford Method (reference), which is based on a person’s divergent thinking ability. These methods aim at triggering new forms of creativity and therefore, lead to a new need for measurement of creative capacities based on various factors, e.g. the number of ideas shared, their eccentricity level (see the Taxonomy of creative design), or the social value of the ideas (see Csikszentmihalyi’s Systems Model).

However, even if these tools and studies are slowly taking into account the specificities of creativity and its role in fostering innovation, which is as complex as it is unpredictable, we posit that some variables have been omitted. Indeed, some variables are internally or externally focused, some are past or future focused, and can provide a good insight on the previous activity of a company. But almost none of them take the individuals’ entrepreneurship skills and mindsets into account, which are needed to pursue the realization of new ideas.

### **There are still limitations to these approaches**

Using financial tools to assess innovation projects leads to incorrect valuation of these projects. In “Innovation Killers” (Christensen, HBR 2008), author Clayton Christensen describes the variables that can suffocate innovation projects and calls out an over-emphasis on financial aspects. These variables omit other determinant variables such as creativity, behaviors and mindset, as well as culture (i.e. how people work innovatively with each other). These variables are also difficult to analyze through classical indicators as they are closely linked to the psychological profiles of stakeholders (employees, intrapreneurs, suppliers and partners, outsourced entrepreneurs, etc.). This is why we propose a new set of variables based on the data collected from assessment surveys that incorporate the psychological profiles of individuals.

Our study reveals that there exist another way of measuring an ability to innovate, based on psychological profiles of employees. We believe that a psychological analysis of a company’s employees may be a complementary level of analysis to the Culture/Organization, Operations and Strategy levels.

We also note that metrics derived from previous methods are often past-oriented and do not give a correct overview of the future abilities of the firm to innovate. Future-oriented metrics that are strongly linked to the innovative capabilities of startups and established firms could also be utilized by venture capitalists or investment companies that are focusing on the longer-term output of their investments.

## **The Berkeley Innovation Index: An Approach based on the Berkeley Method of Entrepreneurship**

The BII project includes some of the traditional approaches to measuring innovation, however it extends these approaches with a machine learning, survey-based and data-driven approach to measure innovation based on psychological profiles of individuals and their perceptions of the organizational culture. The BII provides a quantitative approach to innovation measurement based on individual and workgroup surveys.

Berkeley Innovation Index is both a concept and an open project to offer simple ways to measure innovation, but in a holistic sense. These measures, models and tools are based on previously published research findings. The approach is also intended to cover layers of innovation that range from the following:

- 1) Strategy and Leadership, (such as BCG)
- 2) Innovation Culture from an Organization’s Viewpoint, (Workgroup Culture)
- 3) Organizational Operations and Measures across functions, (Workgroup Culture)
- 4) Mindset: The Innovation DNA of the People (Innovation Mindset)
- 5) Tactical measures (situation based measures)

When measured and considered across all levels, we believe that innovation measures can be made more accurate and that the process can now be even more diagnosable.

### **The First New Elements of BII include Mindset and Workgroup Culture**

Based on previous studies that resulted in breakthrough findings on the impact of Comfort Zone on Entrepreneurship Potential, we want to look into the employee's mindset and analyze their current capacity for creativity. We know that individuals who express entrepreneurial and innovative behavior are more likely to be successful at creating when in uncertain and risky environments than the average population. We want to illustrate the strong correlation that exists between the creative and entrepreneurial psychological profiles of individuals and their innovative outputs.

### **Innovation Mindset**

An 18-item short-questionnaire was constructed to survey mindset of an entrepreneur. The Berkeley Mindset of an Entrepreneur Questionnaire (BMEQ-18) was designed for use in higher education and research. The BMEQ-18 operationalizes a game-based method for teaching entrepreneurship and employs psychological questionnaire scales. The development of the BMEQ-18, the origin of the underlying concepts, specific scales and the process of item-selection are summarized in this article.

The Berkeley Method of Entrepreneurship questionnaire (BMEQ-18) is constructed to measure mental aspects that are relevant to entrepreneurs. The goal of the questionnaire is to measure certain mental aspects of entrepreneurship in order to give students and teaching staff an impression of the strength and development fields of the students in the class. The BMEQ-18 operationalizes a game-based method for teaching entrepreneurship, as employed by the Sutardja Center for Entrepreneurship and Technology at the University of California in Berkeley.

The Berkeley Method of Entrepreneurship trains students to be more entrepreneurial by exposing them to entrepreneurial experiences. It is a holistic and student-centered teaching and learning approach. The method is based on the hypothesis that an inductive game-based teaching approach is a vehicle for introducing and re-enforcing the characteristics of mindset of an entrepreneur. Generally, the mindset is a way of thinking that influences the way someone views and acts upon a situation; the mindset is reflected in the person's attitudes. The Berkeley Method of Entrepreneurship conceptualizes the dominant characteristics of entrepreneurs through ten dimensions that describe the typical mindset of successful entrepreneurs. The dimensions are based on literature review and extensive interaction with entrepreneurs in the Silicon Valley area.

**A questionnaire for the Berkeley Method of Entrepreneurship**

The BMEQ-18 enables students to explore their current mindset and to identify the fields they want to work on during the entrepreneurship education. The first step in the development of the questionnaire was to select the mindset dimensions of the Berkeley Method of Entrepreneurship that can appropriately be measured with a questionnaire. Dimensions that are better studied through behavioral observation or experiments have been excluded from the development of the scales. In the second step psychological the mindset dimensions have been matched with psychological concepts that have been researched that describe similar have been translated to.

A first literature review has been conducted in the fields of social- and organizational psychology to identify the concepts that translate to the mindset dimensions. One of the main focuses in the selection of the psychological concepts was to work on the level of traits or attitudes and to avoid state-like variables. State-like variables are not suitable for the education context in which the questionnaire will be primarily administered. The psychological concepts that best matched the mindset description of the Berkeley Method of Entrepreneurship dimensions were the basis for the construction of the questionnaire.

A second literature review has been conducted in order to identify carefully constructed sets of survey questions that measure the chosen psychological concepts. The research was mainly focused on short scales. Some of the scales have been slightly adapted in order to fit within the context of the Berkeley Method of Entrepreneurship. Table 1 presents the mindset descriptions of the Berkeley Method of Entrepreneurship, the selected psychological constructs and the questionnaire scales that were applied to measure the concepts.



**Table 1**  
**SCET Mindset Description and equivalent psychological constructs**

Mindset and Description	Psychological Construct	Questionnaire Scale
<b>Friend or Foe</b> If you can't tell: Learn to trust others without expecting anything in return.	Social cohesion, honest behaviour (Fukuyama, 1995)	<b>Trust</b>
<b>Plan to Fail</b> It is necessary to be wrong sometimes. Plan to Experiment. Plan to Fail (Fail Fast). Analyze, Adapt and repeat. The smarter you think you are, the harder this is going to be.	Grit, resilience, entrepreneurial failure (Sarasvathy, 2001)	<b>Resilience</b>
<b>Diversify</b> Diversify your networks. Connect to people you would not normally, then go and listen. Open Up. And connect them to others.	Social capital (Dubini and Aldrich, 1991)	<b>Diversity</b>
<b>Believe</b> Believe that you can change the world.	Self-efficacy (Bandura, 1977)	<b>Belief</b>
<b>Good Enough</b> Perfection is no good but good enough is perfect.	Perfectionism (Kawasaki, 2004)	<b>Perfection</b>
<b>Collaboration</b> Individual vs. team and competitors vs. partners.	Coopetition (Vanaelst & al., 2006)	<b>Collaboration</b>

Our intent is to apply these findings to workgroups in startups as well as in larger companies. The collected data will lead to the definition of the psychological determinants of success among a workgroup. Participating individuals may be able to “compare” their own innovation profiles to famous entrepreneurs’ profiles. The machine-learning algorithm we are developing allows us to create a precise definition of success that takes the control group into account.

### **The Workgroup Culture Assessment:**

A second tool data collection instrument has also been included in the test suite for Berkeley Innovation Index. This tool focuses not on an individual, but on the culture of the workgroup as measured by the perceptions of individuals in the workgroup.

Areas of measurement that are included in this assessment include the following:

- Where ideas originate
- Transparency in decision making

- Responses to organizational failures
- Cultural understanding about operating measures such as quality, Customer happiness, cost, and market share.
- Organizational comfort with ambiguity and learning
- Culture of execution and action

### **Analysis of Responses**

As we consider the previous success cases of employees in the company, we want to see if the newly hired people are most likely to be innovative, or if the company is able to develop and improve its existing workforce to successfully produce new services, products or implement better processes. We believe that the companies that will be most likely to be successful are the ones where the psychological profiles of its employees are, or become, closest to the ones of those who previously succeeded in risky and innovative projects.

Moreover, this new approach allows a measure of learning through failure. It additionally bypasses the hard definition of success and its variables. The more data we collect, the more accurate the definition of success will be. The machine learning process illustrates the link between success and the psychological profile of employees, based on the characteristics of their psychological mindset and organizational mindset, not on the characteristics of the company or the project itself.

### **The Berkeley Innovation Index as a Process**

The Berkeley Innovation Index aims at being the reference baseline for current creativity capacity at the individual or workgroup level. We propose a process that leads to an informative and analytic report, featuring the profiles of the individuals or the workgroups. The intended use of the BII report is to enable strategic action planning to maximize existing creativity, and to expose specific opportunities to improve creative abilities within an organization, which in turn ideally increases overall innovation.

First, we collect survey data from individuals or workgroups and analyze their psychological profiles, focusing mainly on a larger share of knowledge workers. Our algorithm uses the data to create a link between current creativity levels and success in innovative projects.

The data collected forms the basis of a first report of the creativity profile of the individuals or the workgroup. It is then possible to combine the data within a company's perimeter to determine the "aggregated innovation index" of a company, which offers a new view of the company's current ability to perform on future innovative products.

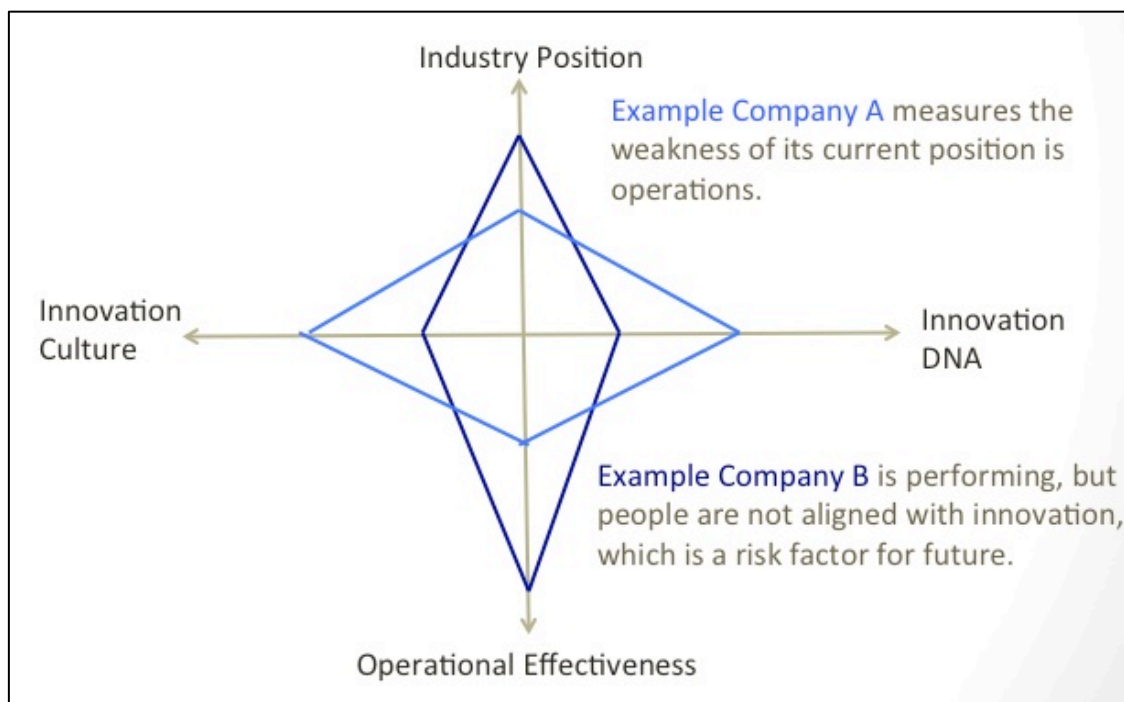
Moreover, the algorithm sorts and displays the collected data in multiple arrays to give a detailed and descriptive insight of the determiners of success for a company's future

innovations. It will be possible to produce specific subsets of data in custom reports (e.g. by function, team or other factors) to provide additional insights as needed.

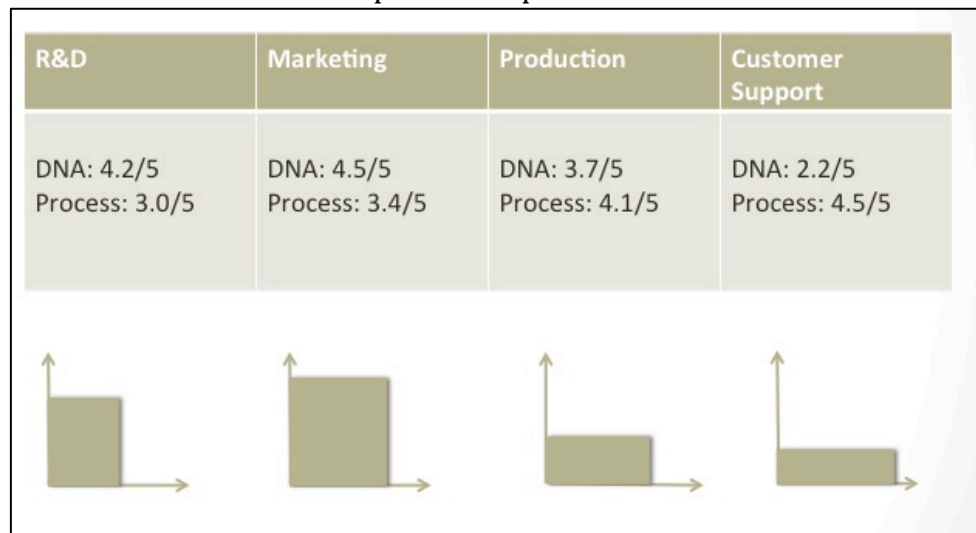
The BII results represent a current “snapshot” view of a given organization’s capacity for creativity. Therefore, once actions plans have been determined and undertaken to improve creativity for the company’s individuals and workgroups, the BII can be retaken at a future date to calibrate the increase in creative capacity and potential for innovation success. The Berkeley Innovation Index methodology can be used for firm-level assessment with diagnostic recommendations. For actionable results, this must be done with the help of an independent moderator, consultant, or with an internal project manager.

### Company and Organization Level Assessment Potential

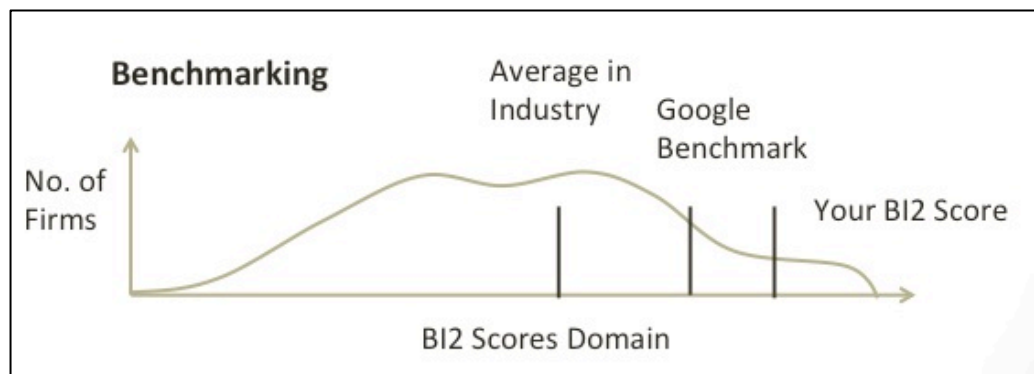
Examples of visualizations available from the BII data analysis are represented here. This first illustration is a comparison of two companies on the basis of Industry Position, Innovation Culture, Operational Culture, and Innovation Mindsets (DNA) of their employees.



A second example graphic data interpretation below shows that functional levels within a firm can assess the innovation culture and operational process culture.



At a company level and within industry groups, we believe that innovation benchmarking will also be possible based on aggregate innovation scores.



We also provide workgroup reporting in non-graphic formats. Below is an example output of an algorithm-based text report generation:

**INNOVATION CULTURE SCORE:**

*Your Innovation Culture Score for your workgroup is score is 8.07 out of 10.0*

*This score is based on the self-evaluation of your workgroup. Different people will have different perceptions of their workgroup style. A number less than 5 score means that some innovation factors were low in your estimation. These factors might include an overly internal focus, low transparency in decision-making, the organization's reaction to failure, the groups ability to work in new areas, or the commitment level of people to do what they say.*

**OPERATIONAL CULTURE SCORE:**

*Your Operational Culture Score for your workgroup is score is 7.19 out of 10.0*

*The Operational Culture score is also based on your self evaluation and perceptions. A score less than 5 in this category means that people are not generally aware of the operating measures of the firm or workgroup. Examples of measures might include market share, happiness metrics for customers, quality metrics, and cost metrics. These types of issues can be addressed with the development and commitment to processes in the workgroup.*

*Your perception of your workgroup's style is to avoid argument and yet stay in dialog during conflicts. This is a very healthy behavior. This is an important characteristics of your workgroup's culture.*

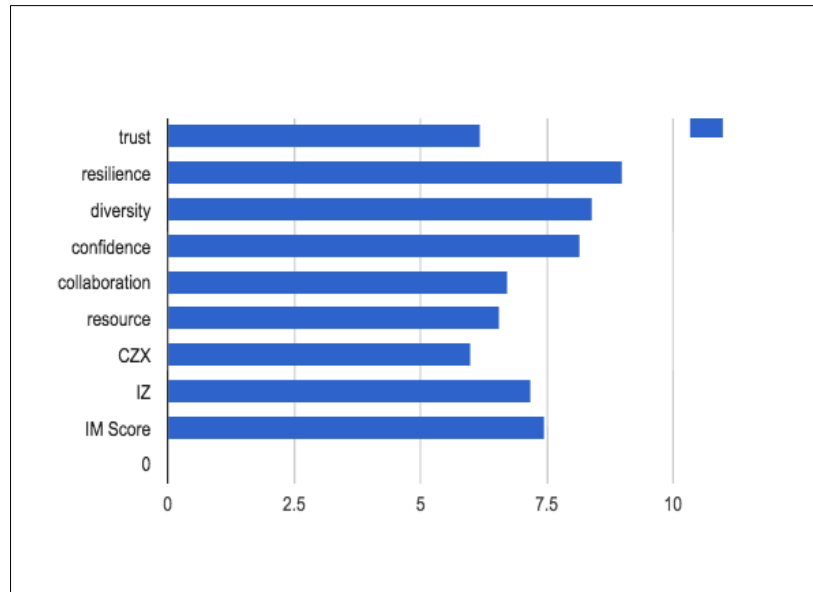
*Idea: Have a few people in your workgroup take this survey. Then compare and discuss results with each other. Think about whether your scores are a good match for the objectives of your workgroup. Do you want to improve your operations focus or innovativeness? More advanced diagnostics should be done with an independent moderator or internal project manager.*

*Remember: Culture eats strategy for breakfast -- Peter Drucker*

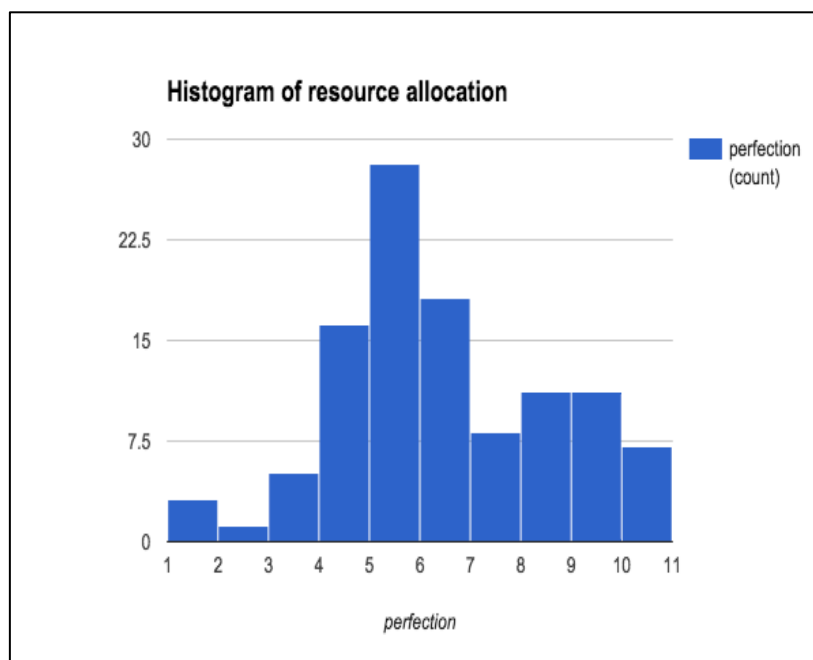
*Learn more and check for updates at <http://berkeleyinnovationindex.org/>*

### Individual Mindset Level Assessment Potential

These examples illustrate graphic representations of a Mindset for an individual or in aggregate of a group of individuals:



**Average Values of Mindset Components for a group of Individuals**



**Example Histogram of “resource allocation” scores” for a group of individuals or workgroup**

An example of a text report generated by the Berkeley Innovation Index Algorithm is provided here:

*Berkeley Method Multi-Facet Algorithm, Alpha Release 1.3*

**INNOVATION MINDSET:**

*Your personal Innovation Mindset Level is currently 7.15 out of 10*

*This is not a fixed level, anyone can grow their innovation mindset. Your level has been estimated using an analysis based on the Berkeley Method for Entrepreneurship & Innovation, the Comfort Zone Scale, and fundamental testing methods in social psychology.*

*The following factors are components of your innovation mindset:*

*TRUST level: 6.86 of 10. This is your ability to trust others.*

*RESILIENCE level: 8.64 of 10. This is your ability to overcome failure.*

*DIVERSITY level: 8.45 of 10. This is your ability to overcome social barriers.*

*MENTAL STRENGTH level: 7.16 of 10. This is a measure of your confidence and belief that you can succeed.*

*COLLABORATION level: 3.68 of 10. This is your ability to work with everyone including competitors when needed.*

*RESOURCE AWARENESS level: 5.50 of 10. This is your ability to balance your resources across multiple objectives.*

*INNOVATION ZONE level: 8.59 of 10. This is a measure of your ability to work in areas of uncertainty.*

**MINDSET ANALYSIS:**

*Based on your comfort with ambiguity, your MINDSET covers both operations and innovation, but LEANS towards INNOVATION. If you have interest in operational innovation and precision, you should pre-analyze situations and focus more on risk mitigation.*

This BII project opens a broader field concerning performance measurements for companies. The index data may also be aggregated with other information from various departments of companies (financial data, HR data) and companies' environment (country GDP, public policy for innovation and entrepreneurship...).

## Conclusion

Measuring innovativeness through the analysis of the psychological profiles of individuals or workgroups is an approach that, if combined with existing methods, can offer a holistic analysis of a company. It provides a future-oriented approach of valuation that is complementary to existing methods. It is difficult to measure soft assets and indirect effects of innovation projects as external and unexpected variables may have fostered the success of a handful of entrepreneurs, sometimes years before the success is made visible. Certainly, the more data we have, the more likely we will be able to define success and to increase the precision of our findings. In any case, the Berkeley Innovation Index represents the missing link of innovation performance analysis. We will continue to develop a holistic approach, aimed at having a tangible economic impact, that will synthesize the Berkeley Innovation Index with a given company's existing set of tools (project – program – portfolio – strategic), and could possibly lead to a study on a microeconomic level (sector – industry).



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## Appendix A: Protocol Examples

### Full Assessment – Requires Customized Project Development

1. Collect General Company Information. This information will be collected through an electronic form.
2. For various sized companies, identify the test data points for Innovation culture, operations, and company people data collection.
  - \* Size < 10: 5 Key employees including founders, possible all.
  - \* Size 10-49: 5-10 sample interviews across all functional groups
  - \* Size 51-99: 10-15 sample interviews across all functional groups
  - \* Size 100-199: 20 sample interviews across all functional groups
  - \* Size: 200-500: 35 sample interviews across all functional groups
  - \* Multiples of 500: multiples of 40 interviews or subset based on partner recommendations

Note that percentages of employees are typically representative of information workers, an target mix would be 8% of information/knowledge workers. 0.1% of non-knowledge workers. Example: 10,000 people, 1K knowledge, 9K non-Knowledge results in 80 + 10 interviews.

3. Collect data via interview from each person. This is an interview. Ask the questions to input in to the electronic. Use Innovation Mindset and Workgroup Culture Assessment
4. Collect product and market share information that can be used to create a BCG McKinsey style strategic recommendation.
5. Collect any information based on customized request if required.

**Medium Assessment: Hybrid In person plus web based, and People/Org/Process, Requires Custom Proposal. Does not use McKinsey/BCG Style Report**

1. BI2 creates a SPECIAL CODE for Company.
2. For various sized companies, identify the test data points for Innovation culture, operations, and company people data collection.
  - \* Size < 10: 5 Key employees including founders, possible all.
  - \* Size 10-49: 5-10 sample interviews across all functional groups
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Note that percentages of employees are typically representative of information workers, an target mix would be 8% of information/knowledge workers. 0.1% of non-knowledge workers. Example: 10,000 people, 1K knowledge, 9K non-Knowledge results in 80 + 10 interviews.

3. Collect data via interview from each person. Hybrid of electronic and in person data. Use Innovation Mindset and Workgroup Culture Assessment

**Mini Assessment – People DNA Only**

1. BI2 creates a SPECIAL CODE for Company.
2. CEO/HR instructed to send email test to all employees' organization. Use Innovation Mindset Test Only.
3. Code specifies firm and consulting partner. Report delivered to HR or consulting partner for internal evaluation of results and discussion of remedies.