**Foreword**

Chaomei Chen, *Turning Points: The Nature of Creativity*, Springer

Among the uniquely human capabilities is the capacity to create and discover. Understanding how humans create innovative art, music, poetry, or novels and discover scientific principles patterns, or relationships requires a recursive form of creativity and discovery.

The foundations for human creativity and discovery depend on passion for solving problems and fluency with social contexts that promote solutions. The passion produces persistence over time and enables devotion to solving important problems, filling troubling gaps, stretching annoying boundaries, or opening doors to fresh opportunities.

The fluency with social contexts helps researchers to see problems more clearly, bridge disciplines, and apply methods from one knowledge domain to another. The social context also provides powerful motivations that encourage varied forms of competition and collaboration. Sometimes competition is fierce, other times it can be friendly. Sometimes collaboration is narrow and limited to dialogs between trusted partners, other times it can be broad and long-term, producing lively conversations among thousands of contributors who are united by the passion to solve a problem. Innovators who protect their nascent ideas too closely will miss the opportunity to get feedback about their progress or learn about related ideas.

Researchers are increasingly attracted to study the dynamics of creativity and discovery. For the first time in history the databases of human scientific activity are sufficiently large and widely available. For the first time in history the tools for analyzing this data are capable of performing appropriate analyses and becoming widely available.

Retrospective citation analysis of scientific papers remains the major approach, sometimes complemented by informed ethnographic observations and interviews by researchers with sufficient knowledge-domain understanding to recognize important steps, controversies, or mistakes. However, analysis of patents, patent citations, trade journal articles, blogs, emails, twitter posts, and other social media will provide a finer-grained, more diverse, and more immediate record of how scientific breakthroughs emerge.

Citation analysis goes far beyond simple counts of who cited whom, but expands to author co-citation and document co-citation networks, while adding potent metrics such as betweenness centrality to find boundary-spanning papers that bridge knowledge domains. An important tool for these analyses is network visualization, which sometimes surprises researchers by showing important clusters, revealing bridging papers, or spotting important papers that may be tragically ignored for many years or become very hot quickly.

This latest book from Chaomei Chen makes important contributions to research on creativity because he brings a remarkably broad perspective to this topic, weaving together several strands of research. Chen clarifies existing theories, applies interesting metrics, and shows compelling visualizations. He lets readers know exactly what his point of view is: “transformative discoveries are likely to emerge from the twilight zones where multiple fields meet.” This strong conviction is validated by retrospective analyses and case studies from impressively diverse branches of science.

The importance of this book, *Turning Points: The Nature of Creativity,* is that Chen has a greater ambition than to look back, he wants to be in the moment by offering researchers the capacity to see what is currently happening in their knowledge domains, so as to spot important contributions early. The capacity to predict which papers will eventually be highly cited would be a wonderful gift to researchers, government policy planners, and industry managers. This goal is not easy to attain, but Chen suggest some promising possibilities.

The even more ambitious challenge that Chen takes on is to spot opportunities for interesting research by identifying “structural holes” or missing intersections of related knowledge domains. This is not easy since there are many unproductive intersections, so it takes informed expertise to make the right judgments or spot early signs of progress. This is a seductive idea, but Chen warns of many forms of “biases, pitfalls, and cognitive traps.” Still he boldly offers a powerful claim: “a paper with a high betweenness centrality is potentially a transformative discovery. In addition, it would be possible to use this metric to identify potential future discoveries by calculating the would-be betweenness centrality of a hypothetical connection between two disparate areas of existing knowledge networks....Thus, betweenness centrality can be translated into interestingness, which can be in turn translated into actionability.”

Readers should take time to reflect on the goals Chen lays out and appreciate the diverse sources he draws from. They should also carefully consider the metrics he proposes and study the visualizations from his CiteSpace system. Chen admirably lays out his emerging ideas, seeking constructive dialogs and engaging in fruitful conversations. This makes for provocative reading and stimulates fresh thinking. Readers can respond with even better theories, data, metrics, and visualization.

Ben Shneiderman, University of Maryland, July 2011