Using Games to Understand Tradeoffs in Designing Across Technology Domains

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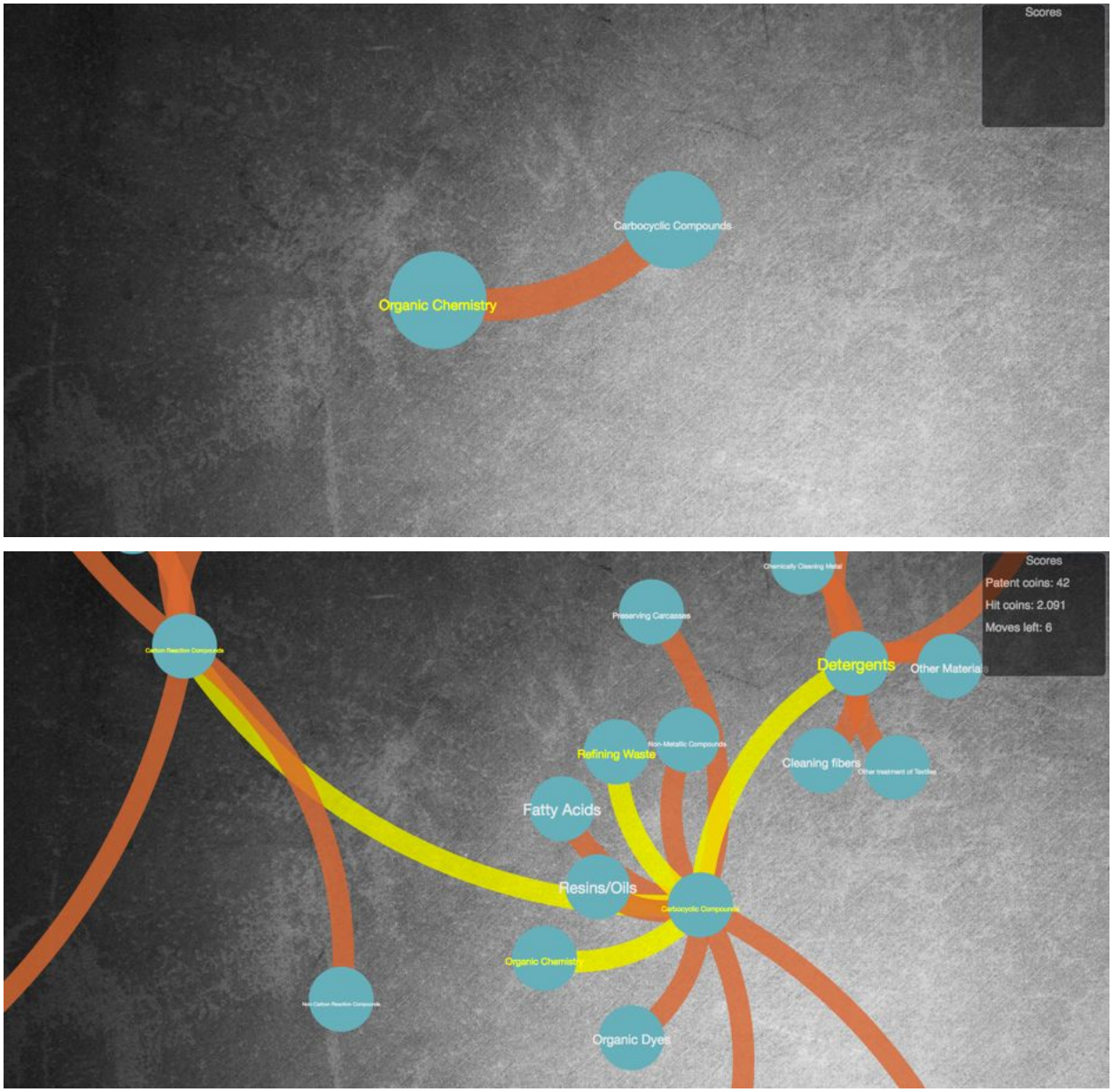

Top) A player's starting position, with knowledge of "Organic Chemistry" and access to the related domain "Carbocyclic Compounds"
Bottom) The same player after several moves, his/her expanded knowledge portfolio and access to additional domains in the technology space, and counts of patents and breakthrough patents received among the way

Design can be viewed as a process of exploration and exploitation in the space of technologies. Designers could leverage the technologies or technological knowledge that they have already mastered to create new applications in other technological fields, or draw analogical inspirations from other technologies to solve their current design problems. As a result, the technological capability positions of the designer expand as he/she learns, uses or develops new technologies across different domains over time. Meanwhile, technology domains have different knowledge proximities to each other. Designers may find it relatively easy to succeed in learning and designing technologies in new domains that are knowledge-proximate to their established domains because the knowledge required to design technologies in them are similar or related. However, such high-proximity domain crossing might be obvious and have limited potential for novel design outcome. In contrast, leveraging technologies across distant domains may be difficult to succeed, but have a greater chance for design breakthrough once succeeding. Both productivity of design efforts and impact of design outcome are important in design practices. Thus, designers need to balance between exploration across distant domains and exploitation across proximate domains in their learning, capability building and search for design opportunities, for tradeoffs in differentiated performance outcomes. However, such a performance tradeoff is often non-obvious, and the balancing is also generally challenging.

We built a game to help designers consider the space of technology domains, their place in it, and strategies for moving across different domains, and “see” possible performance outcomes. The player plays as an inventor starting their career with knowledge of a single domain, which is related to one or more other domains. The player selects one domain to add to their knowledge portfolio at a time, which in turn gives them access to additional domains related to this new domain.The player repeatedly selects domains to add to their knowledge portfolio, each time expanding their options of future domains they can access, until the game ends after a fixed number of moves. When a player selects a new domain, that domain may be related to the player’s existing knowledge portfolio strongly, modestly or weakly. Selecting a strongly-connected domain (exploitation) means the player will receive many patents (productivity), but selecting a modestly-related domain (exploration) increases the chances that the player will create a hit patent (a breakthrough from exploration). The game’s domains, relatedness values, and reward structure are based on real-world data from our previous research of inventors’ moves across technology space, as measured through millions of patents. The game may expose the game players to the performance tradeoffs of different kinds of moves, and the difficulty of balancing exploration and exploitation.