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- ▶ The influence of power on prosocial behaviour

Chris Murray talks with Marius van Dijke

- ▶ Why trust in the workplace matters and how to cultivate it

By Stefano Tasselli and Martin Kilduff

- ▶ The benefits of combining drones and trucks for deliveries

By Niels Agatz

- ▶ Is it better to look inside or outside for innovation?

By Justin Jansen and Vareska van de Vrande

- ▶ How independent research can improve investment decisions

By Egemen Genc and Marno Verbeek

- ▶ Online product reviews and whether to believe them

By Christilene du Plessis



Is it better to look inside or outside for innovation?

By *Justin Jansen and Vareska van de Vrande*

Which is a better approach to innovation: to look internally and develop a more advanced version of something you already know, or to look externally and find something new?

To find out, we analysed more than 36,000 patents applied for by semiconductor firms between 1991 and 2001. We looked at patents that relied mostly on internal knowledge and patents that relied mostly on external knowledge. At the same time, we also subdivided the data between inventions by size of team and each member's degree of invention experience.

Although it might seem counter-intuitive (after all, why should the source of knowledge used in the invention or the size of the team have any bearing on whether an idea is any good?), we found that the quality of the invention actually does tend to correlate with a number of factors, including the origin of the knowledge and the size of the team.

Internal vs external

How much you should focus internally versus externally is one of the eternal questions of management. For the most part, the conclusion has been that to thrive, companies need to be ambidextrous in this respect.

When it comes to research and development, however, this question of internal versus external focus has remained unresolved. Management and innovation scholars have suspected for some time that the source of knowl-

edge mattered, but just how was not clear. On the one hand, inventions that draw on some new knowledge are likely to be of higher quality than those that only recombine existing knowledge. On the other hand, if a team uses too much external knowledge, it may not be taking full advantage of its own expertise.

There is something to be said for "sticking to your knitting". Firms are usually better at employing and transforming the knowledge they already possess into appropriate and competitive offerings. An invention that involves too much new knowledge won't fully utilize a firm's advantage and core competence, and is thus less likely to be competitive in the market. Firms that look too far afield will also have less understanding of how best to apply the new knowledge. This usually means that a firm will be entering an area where the other firms already

have a foothold and advantage, thus decreasing the likelihood that the invention will be particularly valuable. It's worth keeping in mind that innovation is also partly a social phenomenon, so a research team coming up with something far from its home turf may find it hard to sell the product. Monsanto probably has the expertise to make a perfectly good shampoo, but would the market buy it?

Many scholars have argued that the most successfully innovative firms are those that know how to balance exploration (looking for knowledge outside of the firm) with exploitation (developing new ideas by applying knowledge you already have in a new way). However, this was mostly a feeling they had; nobody had been able to prove this empirically.

In our study, we used patent data to see if their intuition was correct. To measure the degree of exploration (external discovery outside their own domain), we used the number of external citations in the patent application as a rough proxy of reliance on external knowledge. To measure the degree of exploitation (internal discovery within their own company), we counted the number of times they cited their own

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inventions. Finally, to measure their level of innovativeness, we counted the number of times their patents were subsequently cited.

Overall, we found that balanced patents – that is, patents with a mixed pedigree of internal and external sources – tended to be a little more innovative, judging by the fact that they are cited in subsequent patents 4.7 per cent more often than the average patent application.

Team composition

Another factor that scholars have thought might affect the degree of

exploration versus exploitation is the composition of the development team. Some studies have found that the background of team members matters. For example, researchers have shown that teams with more diverse knowledge fail less often and teams with more generalists tend to come up with more economically practical inventions. However, before our study, no one had looked at how the size of the team or their level of experience might affect their propensity toward exploitation or exploration.

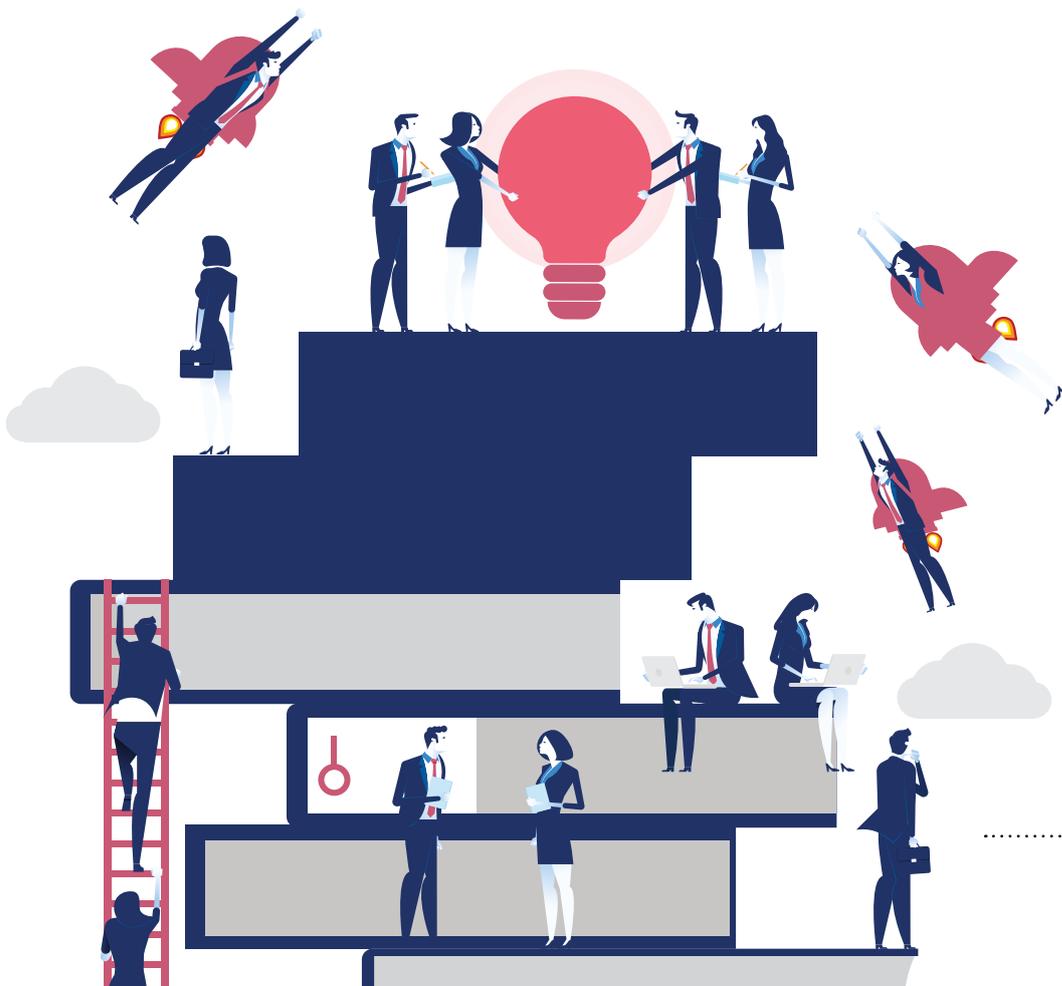
We found that balance tended to be positive here too: the most successful

inventions (in terms of forward citations) tended to have been developed by teams of moderate size (around four) with moderate experience. Why should this be?

Our hypothesis is that larger teams, because they have more expertise in-house, feel less need to search for answers beyond their own laboratory. This saves them time in that they won't over-explore, but the downside is that their inventiveness may suffer, as they may become somewhat myopic. Larger teams will have sufficient knowledge at hand to come up with inventions and solve technological problems without going outside the team. As a result, they are less likely to perceive the need to incorporate new knowledge, even though mathematically they have more opportunities to access new knowledge.

Organizational dynamics may play a role as well. Some scholars have found that larger teams tend to have more interpersonal conflicts, which can interfere the group's ability to collaborate.

Experience also appears to discourage exploration. The more prior patents the team had, the less external knowledge they tended to incorporate in their patent. Having multiple team members who know the same technology also seems to reduce exploration. This too makes some intuitive sense: after all, why would you look somewhere else if you already felt you had the answer? Experienced teams will turn first to their existing knowledge, while inexperienced teams will hunt for knowledge from external sources because they don't really have an alternative. ▶



The Goldilocks effect

Although an invention might seem like something that happens at random, the truth is more complicated. Larger teams tend to generate inventions with more internal knowledge, while smaller teams tend to create inventions with more external knowledge. Our study suggests that the best inventions don't rely entirely on either internal knowledge or external knowledge, but a "just right" combination somewhere in the middle. Team composition too tends toward this same result. This suggests

that the most effective inventing teams include neither too many people nor people with too much experience.

Another practical conclusion that practitioners should draw from our study is that separating exploration and exploitation in different development teams or different locations won't promote more creativity. In fact, our analysis suggests that if Firm A files for one patent that is 100 per cent from internal knowledge and another that's 100 per cent from external knowledge, while Firm B has two patents that were

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"...separating exploration and exploitation in different development teams or different locations *won't promote more creativity.*"

the result of a balance of internal and external knowledge, Firm B will be ahead of the game.

Finally, our research suggests that experience and size are both mixed blessings on a research team. Large teams with a lot of experience are more likely to come up with inventions based on their existing knowledge and miss important developments by paying too much attention to what they already know. Mark Twain's quip that "All you need in this life is ignorance and confidence, and then success is sure," may not be quite right, but it does turn out to have a grain of truth. ■

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