



Bonus Episode 2, The IQ of Innovation, November 16, 2021

Anne Marie Knott: I like to tell the story that large-firm R&D is, you know, the heroics of the economy, because not only do they spend 85% of the R&D in the country, and not only are they more productive with their R&D, but they're the ones who spawn these founders for the ... the firms in the tech startups.

Kurt Greenbaum: From Olin Business School at Washington University in St. Louis, I'm Kurt Greenbaum, and this is a bonus episode of *On Principle*. Yes, we're back with another deeper dive into an interview from the first season of *On Principle*, while we're working hard on new stories for season two. And as you can probably tell, I'm fighting with a few seasonal allergies right now. But let's forge ahead, shall we? So, here's a question for you. Innovation is important for businesses, right? Companies cannot survive if they only stand still. We know that, right?

But how do business leaders know they're getting enough bang for the bucks they're spending to innovate when they develop new products, update existing ones, create new services and serve new markets? Can they be sure their investments are getting a suitable return? To address those questions and a few related issues, we're returning to a conversation with a WashU Olin researcher who specializes in topics like corporate innovation and the way firms invest in research and development.

Anne Marie Knott: I'm Anne Marie Knott, I'm the Robert and Barbara Frick Professor of Business at Olin. And my research is on innovation, both corporate R&D and in entrepreneurship. And I think the two are complements to one another. I focus on innovation, and the back story on that is that before I became an academic, I worked in industry and, in particular, I did do R&D. So, I became an academic in part to solve the problems I saw when I was working in industry.

Kurt Greenbaum: Oh, that's interesting. What are some of those problems that you saw?

Anne Marie Knott: Well, the focal problem, I think, was that we ... we were considered the gold standard for innovation. I was working at a company called Hughes Aircraft Company and we ... we were the ... we were the contractor that the government went to when they didn't really know what they wanted because we did all the really cool, gee-whiz things. As an example, we did ... you know, we came up with the geosynchronous orbit for communication satellites. But we were acquired by General Motors, not known for their innovation. And they were changing the way that we were organizing R&D. And I said, this is going to be a disaster. It's going to permanently degrade our R&D capability.

But the problem is I couldn't get anybody else concerned as I was because there was no good measure of R&D capability. So, you couldn't show it deteriorated. So, my big claim to fame is that I have a measure of R&D capability. I developed it as a kind of a byproduct of another research question I was trying to solve. But once I had it, I realized, oh, this was what I'd wanted all along. And so now what you can think of this as is my hammer and I'm just sitting around looking for nails all the time to understand, you know, what makes R&D work better or worse.

Kurt Greenbaum: Well, tell us a little bit about that. This is called the research quotient. Is that correct?

Anne Marie Knott: Yes. Right. It's ... it's RQ. I really call it RQ. I wanted it to be like IQ. So, just as smart individuals are high IQ, individuals solve more problems per minute, high IQ companies solve more problems per dollar of R&D. So, I came about it because there was ... there was this idea, you know, a couple of research papers—actually many, it was one of the most cited papers in the literature—so, the notion was absorptive capacity. And the idea behind absorptive capacity was that the more you spend on R&D, the better able you are to interpret the research that's being done by other entities. So, universities and other companies. If you multiplied companies' R&D by their spillovers, that was actually significant, but it occurred to me that that can't possibly be the case. Because what happens is the more you spend on R&D, the more you're at the knowledge frontier.

Kurt Greenbaum: Now, let's pause a second. Basically, Anne Marie is saying, yeah, I hear what the conventional wisdom says about corporate R&D. I just don't believe it. And here's why. Under this theory, “spillovers” are the benefit your company gets from all the innovation happening around it, from universities, for example, or from other firms in your industry. They're the lead dogs and you're drafting off the innovations they spin off around them. But Anne Marie is saying this theory of absorptive capacity, this conventional wisdom, if you will, has it backward. If you're spending hard on research and development, you're the lead dog in the pack, you're not benefiting from spillovers. You're creating them. But the problem Anne Marie couldn't shake was this. Nobody really knew how to measure the efficiency of that spending. And that's why she developed the research quotient.

Anne Marie Knott: So, it's a statistical measure. So, in order to be able to estimate it, you have to be able to get financial data for all of ... for your company for several years, but also basically all the other companies in the economy. And what it does is it uses the production function from economics, and it links companies inputs to their outputs. And so it, RQ specifically, is the marginal contribution of R&D to company growth. So, a percentage ... it captures the percentage increase in revenues that you expect to get from a 1% increase in R&D. Because it's very common for companies to take their revenues and divide it by the R&D. And that truly is a ratio. What distinguishes RQ from that is the fact that it accounts for the changes in all the other inputs to determine how much of that change is coming just from R&D.

Kurt Greenbaum: Through her research, Anne Marie has been able to show that RQ essentially measures how smart companies are. Through a series of research papers, she's shown that the important thing for firms isn't the quantity of their R&D spending, but the quality. How does she know that? Well, Anne Marie frequently ranks a list of the 50 firms with the highest RQ, and she finds consistently that the stock performance of her portfolio—of those firms on the RQ 50—historically outperforms the S&P 500.

Anne Marie Knott: I look at data about lots and lots of companies and the kinds of things they do with respect to R&D. You know, I've found a number of things. The most important thing that I found was that companies' RQs have actually declined 65% over the past three to four decades. And that's the reason that we have stagnant economic growth. The other thing that I've done is I've tried to match companies' RQs to their different practices and have identified the ones that seem to be contributing to this decline in RQs. And one of them is outsourcing ... R&D outsourcing.

So, the decline is in how productive companies are with the R&D that they spend versus how much they're actually spending. They've increased their spending at the same time that they've decreased their RQ. And I guess it would be helpful to make a ... to draw an analogy. So, I came up with us the other day. Let me know ... let me know whether this resonates with you. But the idea was that you could think of R&D spending as the gas for your car, and you could think of RQ as the fuel efficiency for your car.

Kurt Greenbaum: What I think I hear you saying is companies are spending more for R&D. They're just getting less bang for the buck out of what they're spending. Is that another way of saying it?

Anne Marie Knott: That's exactly what I'm saying. Yes.

Kurt Greenbaum: The question ... we've kind of used the phrases, the words innovation and R&D interchangeably. Is that by design? Is ... is that ... are they kind of equated with each other?

Anne Marie Knott: The definition of innovation that I use actually comes from economics. There's a distinction between an invention—which is an idea that's potentially commercializable—and an innovation, which is actually getting it to the point where it is commercialized and then commercializing it. So, inventions would be the equivalent of patents; innovations would be things that you actually see out in the real world in use. The distinction is actually important. There's a ... because there's far more ideas than there are innovations and far more inventions than there are innovations. In fact, this is a number that gets thrown around, but 20% of ... 20% of patents account for 80% of the economic value of patents. There's a lot of patents that never get commercialized.

Kurt Greenbaum: One of the things I think a lot of us may correctly or incorrectly think is that most innovation comes out of the startup world. And my recollection from reading some of your research is no, actually, big corporations are pretty darn good at innovating and investing. Is that ... am I capturing that right?

Anne Marie Knott: Yes. Large firms on average have ... on average large firms have higher RQ. The highest IQ, however, will always be for a small firm. So, what happens is startups have both the highest RQs and the lowest RQs, so there's more variance if you're small, which isn't, you know, which isn't a big surprise. But the firms that ultimately survive on average have higher RQs than the small firms. And the other thing that I like to point out about that—and this gets back to the story I told earlier—is that the bulk of the ideas for these startups actually come from the large firms. You know this story about the large firm carrying forward an innovation up to a certain point and then realizing that it doesn't have the potential that it needs it to have for them to fund the rest of the development and having the researcher leave the company and start the, you know ... start their startup is the norm, I think.

A huge amount of the number of startups were founded with ideas that had come from the prior employer. And there's ... there's a statistic about that. I think it's over 50% that I saw on *Inc.* one year. And it turns out that corporate venture capital funds actually have higher returns than independent venture capital funds, which is really interesting. And it seems as though what's going on is that when you're ... when you create one of these funds, what you're doing is you have much deeper expertise as to what are things that are worth investing in and, in addition, you're in a much better position to help commercialize their inventions.

Kurt Greenbaum: She also talked about innovation in a startup environment being different from corporate ... innovating in a corporate environment. Did that ... did that phrase ... that ... that sentence capture your attention? Did you have any reaction to that when you heard her say that?

Anne Marie Knott: Oh, sure. Yeah, no. There are absolutely different environments. The ... I have a favorite teaching case I use that'll help illustrate the distinction. But there's far less constraints in the startup environment and there's much higher incentives. So, back in the 80s, Xerox ... there was a book about Xerox called *Fumbling the Future*, and the message in the book was that, you know, these guys were fumbling because the things that had been spun out of Xerox PARC had a market cap, collectively, that was three times that of Xerox itself. And so, Xerox responded by creating a venture fund—different than a CVC—so CVCs are scanning the environment to bring things in. And what this fund did was it took a look at the projects that Xerox had canceled coming out of PARC. And as ... as I talked about earlier, these often are projects that have merit, but they're too small for a company the scale of Xerox.

It was tremendously successful. I mean, it had like four or five times the returns of a normal VC fund. And what you see was that these guys were split up into separate areas, had these high-powered incentives, but they also had the benefit of all of the resources of Xerox. So, they ... they had access to their manufacturing, they had access to all their supplier networks, they had access to their sales force. And so, this ... this fund by itself sort of showed what were the benefits of both of these worlds.

Kurt Greenbaum: Why? Why isn't ... if that was so successful, why don't we see that all over the place? Why isn't every company doing that sort of thing?

Anne Marie Knott: Ah. Xerox isn't even still doing it. They canceled it after the fund closed. And I ... I ... I think that there's a business to be made of going into companies and taking their discards and doing something with it. But yeah, the question is why did Xerox cancel? We don't know the answer to that, but the sense was that the people inside ... people inside the ventures themselves were getting so much more highly compensated than the people at the other, the rest of all of Xerox that it wasn't sustainable.

Kurt Greenbaum: Now, by this point in our conversation with Anne Marie, we've had a chance to chat about a few concepts like corporate venture capital and the strategies companies use to foster innovation within their organizations. And, of course, we've talked a lot about RQ, but there's something about this that's worth mentioning, and it's something Anne Marie herself acknowledges. Corporate leaders haven't really adopted this measure of innovation.

Anne Marie Knott: It's not gaining traction in the academic community, it's not gaining traction in the, you know, the company community.

Kurt Greenbaum: But it's gained traction in the research community. I mean, you continue to have papers published about this, so it must be some ... some people find it valid. So why do you suppose it's not catching on?

Anne Marie Knott: Well, what will be really valuable is when other people start using it. So, I was trying to think about why it wasn't being adopted by companies because I get a lot of emails from companies that are interested in it. I think this comes from the 2012 article in *Harvard Business Review*—"The Trillion-Dollar R&D Fix." And they all seem interested initially. One of the challenges, of course, is that it's not a simple ratio. You know, you can't just take your revenues and divide them by their R&D to get to RQ. You actually have to have somebody who's a fairly sophisticated statistician to be able to get your RQ. You also have to subscribe to the data of publicly traded firms. But, you know, that ... you can ... so, I help companies with that. So that's not insurmountable. But I think the frustration for them is that, or the concern for them, is that they don't want to look bad. And so, they prefer measures where they have some ability at the margin to manipulate them, and there is no way to manipulate RQ.

Kurt Greenbaum: And that's all for our second bonus episode of *On Principle*. Many thanks to Anne Marie Knott for her interesting perspectives on corporate innovation. If you're interested in seeing which companies made Anne Marie's latest RQ 50 list, we'll have a link to that on our website at *On Principle* podcast dot com under the bonus episode section of the site. Our website also has links to all eight episodes from season one of *On Principle*, so I hope you'll go back and give those stories a listen if you missed them. And by the way, please consider subscribing to *On Principle* in your favorite podcasting app. If you have ideas for season two episodes or just want to share your feedback, send an email to Olin podcast at W-U-S-T-L dot e-d-u. That's olinpodcast@wustl.edu.

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