How To Innovate During a Crisis

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Even during a crisis like the COVID-19 pandemic, organizations must show that they can innovate and serve their clients. Follow these steps to revitalize your innovation process.

"Life's been a bit crazy to say the least." "I need to figure out a crisis plan for the team in the event we are shut down for several weeks." "The situation seems to be getting grimmer by the hour." These are some of the thoughts that clients and colleagues emailed to me in the first half of March 2020. Some even wondered out loud if they would still have a job in a few months. The response to the COVID-19 crisis has been fast and severe. As I write this, we continue to social distance and schools and universities are closed or teaching remotely.

Most chemical industry research and development (R&D) facilities have shut down or are open only to a small number of staff. While R&D leaders and organizational managers want to continue to innovate during this time, many of their established innovation strategies are now irrelevant. They are not alone in this, and neither are you; almost all companies in the chemical process industries (CPI) are struggling with these problems right now and have uncertainties about the future. Engineers and researchers are working to remain indispensable to their companies but are juggling competing demands and reduced time in laboratories or onsite facilities.

Currently, we are in a metaphorical winter. Researchers are thinking not only about lost productivity, but also about their young children at home, their senior parents' health, their kids' college savings accounts, and perhaps even their own jobs. It is a scary time, but this crisis provides an opportunity to change and improve innovation processes, as expectations about day-to-day tasks and quarterly reports have somewhat relaxed.

This article describes key steps that you can take to reinvigorate your innovation process during the COVID-19 crisis. Changes that you make now might help your research and innovation team to emerge from the pandemic stronger than they were before.

Introduction to innovation

Innovation is a lot like a simple chemical reaction process (Figure 1). The first step is to determine the product that you want to make. In an innovation process, this is akin to identifying and refining the future voice of the customer (FVoC). The FVoC is the definition of your customer's needs and wants at some future time. The FVoC is not what the customer wants right now, but what they will want in the future. Your innovation process must predict what the customer will want when the innovation launches.

In a chemical process, a feed stream flows through a reactor to create the desired product. In an innovation process, this is a lot like taking ideas and using them to synthesize goals, questions, and hypotheses — this is where the creative work happens. The required feed for the reactor comes from

fresh raw materials and from the recycle stream. Likewise, the feed into an innovation process consists of fresh ideas and concepts, as well as recycled or old ideas.

From there, in the chemical process, the product, unreacted raw materials, and byproducts are purified in a separator, just as our innovation ideas are tested in the market, lab, or pilot plant. In the innovation cycle, this is known as the evaluation step. The product should be evaluated from various perspectives before reaching the customer.

In a chemical process, unreacted material is returned to the beginning of the process via a recycle stream, which recovers raw materials to increase yield. Likewise, unused ideas are re-evaluated in the innovation process.

Finally, chemical processes often require a purge of the inert material just as we must identify projects of lower value and purge them from our innovation processes.

A process control system presides over the entire functioning chemical manufacturing process to maintain safe and efficient operation. This is akin to the management coordination of the integrated innovation team (IIT) — the diverse group of people who are responsible for moving ideas through the innovation pipeline.

Innovation typically involves a gated process in which ideas are rejected at the evaluation step for a variety of reasons. Ideas that are rejected during evaluation can be recycled back to the start of the process, where they can be reimagined or refined in the synthesis step. As a result, the recycle loop gets thicker and thicker. Recycle is a type of inventory: research that has been paid for but for which the company receives no revenue. Generally, surplus inventory is undesirable, but now it can be turned into an advantage.

This article suggests four steps that will help you make the most of your innovation process during this time of uncertainty:

1. Form an IIT with members from R&D, marketing, sales, manufacturing, legal, regulatory, safety, and leadership teams.

2. Exploit your existing inventory of ideas to identify and satisfy the FVoC.

3. Focus scarce resources (*e.g.,* lab time, onsite time) on fewer projects through proper goal setting and clear questions and hypotheses.

4. Train collectively to identify fresh concepts that address questions defined in Step 3, and for the future. Training should include a systemized and deliberate learning curriculum for the entire team.

Table 1 demonstrates a practical way to approach these four steps *(1)*. The ideas might seem simple, but they are not necessarily easy. They require initiative and courage, and you might be just the person needed to begin, regardless of your title or experience.

Step 1. Form an integrated innovation team

To determine what products or services will meet the demand of the FVoC, you must first create your IIT (Table 1, Step 1), which should consist of much more than just your R&D team. Your IIT must include cross-functional voices from R&D, marketing, sales, manufacturing, legal, regulatory, safety, and high-level leadership. Creating this team will require courage to reach out to high-level employees, including vice presidents and intellectual property (IP) experts. In my experience, these people love being involved in the early discussions about innovation and add tremendous value. It can be helpful to include at least one radically minded person to catalyze new ideas or to help integrate across sectors, since new paradigms will likely be needed after the crisis ends.

It will require tremendous initiative from an innovation leader to form such a team, which will be difficult amid everything else going on around you. The innovation leader will be vulnerable, because they will be required to speak up without knowing precise solutions.

Coordinating a kick-off meeting with the entire IIT is an important first step. Even when we are not social distancing,

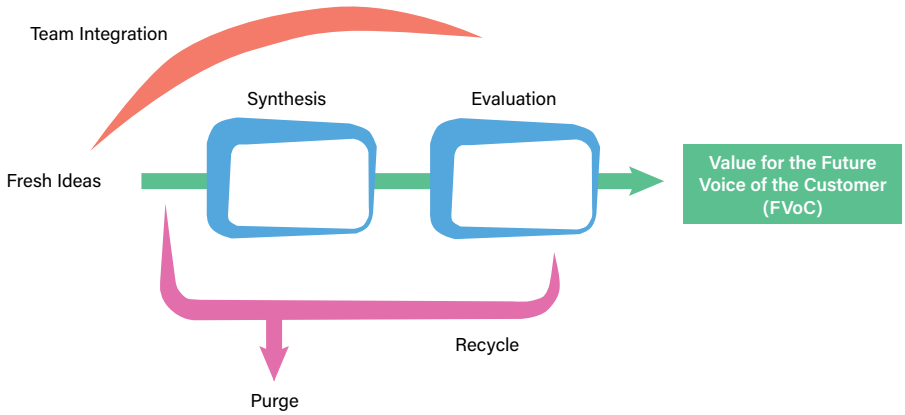

Figure 1. The innovation process is like a basic chemical engineering process. In chemical engineering, to create the desired product, we send a feed stream through a reactor. This is akin to sending a feed of ideas through a creative synthesis and evaluation process. Rejected ideas can be recycled to the start of the innovation process, just as unreacted material can be recycled back to the reactor. In a chemical process, the goal is to create a valuable product. In the innovation process, the goal is to create a product or service that meets the demand of the future voice of the customer (FVoC).

Table 1. To generate value for customers and within your organization, follow these four steps.

Step	Description
Step 1. Form the integrated innovation team (IIT)	▪ An innovation leader (of any title or experience level) decides to pursue the ideas in this article. Or, a few people might decide to do this collectively. ▪ The leader calls together an integrated innovation team (IIT). They invite representatives from R&D, marketing, sales, manufacturing, legal, regulatory, sustainability, safety, and high-level leadership.
Step 2. Generate ideas to determine the future voice of the customer (FVoC)	At the first meeting, the agenda should include: **1. An overview of existing projects.** The R&D team should give 10–15 min presentations of 3–5 research projects from their current inventory. **2. Ideation about the future voice of the customer (FVoC).** Each IIT member individually writes down ideas for innovation, as well as any clients who may be interested in the idea, estimated monetary value of the idea, and barriers and risks they anticipate. Individual written input reduces groupthink. This information starts to paint a picture of the FVoC. This is done during the presentations, with perhaps 3–5 min after each presentation granted to allow attendees to finish writing down their ideas. **3. Group discussion.** Each IIT member shares the barriers and risks to their ideas. From the discussion that follows, the top risks will emerge. ▪ **Homework.** The facilitator and leader summarize the projects, potential clients, potential dollar value, and barriers and risks. Each member generates questions they would like answered to reduce their own barriers and risks.
Step 3a. Formulate valuable questions (VQs) and multiple hypotheses (MHs)	The agenda for the second meeting of the IIT should include: **1. Summary.** The facilitator presents the summary from Meeting 1. **2. Formulate valuable questions (VQs).** The IIT works to formulate the barriers and risks into precise VQs and prioritize them. These VQs help approximately define the uncertainty about the FVoC. The VQs are not just for R&D, but also for other functions, such as marketing, legal, manufacturing, and regulatory. **3. Formulate multiple hypotheses (MHs).** The IIT generates multiple potential solutions — multiple hypotheses (MHs) — to the questions, which can be tested using scarce lab time and other resources. Creating MHs at this step requires deep thinking and is a key factor in speed of innovation. **4. Establish goals.** The IIT prioritizes the VQs into actionable goals with deadlines and a clear definition of goal completion. Critical chain project management (CCPM) is often the right approach, as long as the goals are clear *(1)*.
Step 3b. Focus your scarce resources (*e.g.,* onsite time, lab time) to do the work	▪ Do the work, and report back at the next weekly meeting. From the list of multiple hypotheses (MHs), the leader prioritizes limited time on the most essential technical experiments in the lab or pilot plant and on critical marketing experiments with customers.
Step 3c. Continue with meetings, answer questions, and prove or disprove hypotheses	▪ Based on the experiments conducted in Step 3b, the team should now have some answers or insights concerning the VQs. ▪ In this step, the IIT should meet again to summarize, refine, and adapt the VQs and MHs to identify and remove existing or new barriers and risks. ▪ If necessary, update the IIT. Some people might feel they no longer add value and will remove themselves, while the IIT might identify skills and experiences needed on the team from other people in the organization. ▪ Meet once per week. The one-week cycle time for meetings enables work to get done but adapts the IIT itself, the VQs, and the MHs frequently so that few resources are wasted.
Step 4. Learn needed skills	▪ To advance current research and reduce experimental resources needed, the IIT and other staff will likely need training to learn new skills and concepts collectively. ▪ Identify online courses or AIChE webinars that can help the team learn required skills. These skills are deliberately chosen as a team. ▪ Invite university professors to present overview seminars or workshops and answer contextualized questions related to their specialty. Experts will be more likely to accept the invitation if you offer a modest honorarium (*e.g.,* $1,000). This can be done now (and later) by video call.

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this may require the use of video conferencing, since participants may be located in multiple cities or countries.

To get the meeting moving, a facilitator might be helpful to catalyze ideas among the participants. At one company we worked with, the R&D director pulled people together from three continents by video for the first time in the company's history. By engaging a few critical people in the meeting, the company accelerated a major project by many months, gaining them millions of dollars as an end result.

Step 2. Exploit existing research inventory

The key job of the IIT is to predict the FVoC — that is, projecting beyond what the customer wants now to what they will need in the future. This requires the continual integration of R&D with other functions. Organizations in which workers remain in their silo or department will have a difficult time determining the FVoC.

At first, the FVoC is unknown to everyone, including the customer! Keep in mind that the current voice of the customer — what the customer wants right now — is not the correct place to start. When it comes to innovation, the customer may not know what they will need in the future. The IIT must determine what will be valuable to customers in five months, five years, and perhaps even longer.

The IIT can work together to identify existing research in your portfolio or recycle inventory — perhaps not quite finished yet — that can provide value for the FVoC. In his book *The Goal: A Process of Ongoing Improvement (2),* Goldratt points out that inventory is costly and unwanted; however, during times of crisis, you can turn this wisdom on its head and exploit your inventory.

As summarized in Table 1, Step 2, the R&D team presents their existing research projects to the team, including some promising projects in the recycle pipeline. These presentations serve as inspiration for the rest of the IIT as they write down potential uses — or the jobs to be done *(3)* — for the projects, as well as barriers to implementing or deploying the project.

Step 3. Focus scarce resources

Processes always have bottlenecks, otherwise they would have infinite throughput. For many companies, the current bottleneck is access to lab or onsite time. Some organizations are allowing only 25–50% of their workers to enter the lab at one time, while other facilities are simply closed. Thus, resources must be focused to avoid this bottleneck. In my experience, the biggest challenge of focusing lab resources is having too many ongoing projects. Working on too many projects at once — sometimes even small teams are working on more than a dozen at a time — lowers morale and scatters efforts.

An alternative is to accelerate the most promising ideas to the finish line, so that those projects can be cleared from your portfolio and start earning profits as soon as possible. However, it can be difficult to decide which projects to accelerate and which to put on the back burner. The IIT should work as a team on goal setting, deciding which projects are most important to identify those that merit scarce laboratory time. Methods for rapid evaluation, such as a modified Delphi method *(4)*, can help the group come to a consensus on which projects should be accelerated.

Once you have hypothesized what the FVoC might look like and selected some options from your inventory that might help the customer, the IIT should identify the barriers to developing and delivering the innovation. This involves generating valuable questions (VQs). VQs should address the barriers and risks that the IIT foresees in advancing a product or service to satisfy the FVoC. VQs should be answerable with a plot or table. Although the team might not know the shape of the curve or entries in the table, they should be able to establish the axes or column/row labels and approximate constraints.

For example, your team might want to add a polymer to a suspension mixture to alter the rheology, but there might be a risk in how this impacts the stability of the suspension. In conjunction with your marketing, legal, regulatory, and supply chain team members, the performance targets for viscosity and stability would be clarified in advance, along with hypotheses for how each of the variables might impact viscosity and stability. Then, you could plot viscosity (cP) as a function of molecular weight, structure (a list of perhaps three or four types), and chemical composition (perhaps with three or four levels of hydrophobicity). To compare the stability of possible mixtures, you might plot particle size as a function of shelf life for these same variables. The data would either support or refute the hypotheses, which enables your team to advance or adapt. Having a clear picture of the plots needed, rather than simply the experiments to be done, is essential, along with taking the time to imagine potential outcomes (hypotheses).

For each VQ, generate multiple hypotheses (MHs). The team should then set up experiments to test those hypotheses, thereby answering VQs and removing barriers to developing and delivering the innovation. In some cases, testing a hypothesis will eliminate a less-valuable idea and, in other cases, testing one hypothesis might generate more

questions. As the team does the experimental work, they will eventually begin homing in on viable solutions to deploy the innovation or idea. This iterative method greatly speeds the research process *(5)* and, in my experience, setting VQs and MHs has worked remarkably well.

The multitude of voices on the IIT can save considerable time and effort. For example, on one innovation project I was involved in, the R&D researcher mentioned that the legal department told him they had enough examples to obtain the required intellectual property (IP). However, the researcher decided to "get just a few more examples in the lab," which he thought were needed. Of course, there are many researchers who do this because they want to get things right. But, getting things right is often a matter of perspective. Because lab time may be scarce right now, it might be preferable to defer to the team's perspective (*i.e.,* the legal perspective in this case).

As this example demonstrates, working harder is not the answer to providing innovation value. Rather, you need adaptive execution — a type of agile process in which the team sets goals collectively, keeps accountability day-by-day and week-by-week, updates goals collectively, and adapts goals each week *(4, 6)*.

Step 4. Learn needed skills

The urgency of usual life and business limits the opportunities to learn new concepts. As employees join fewer conferences, take fewer courses, read fewer books, and network with fewer experts, the synthesis block in the innovation process begins to shrink with the dearth of new ideas. Lab work and modeling keep people busy, but often add little direct value for customers. Now is a great time to reverse this negative trend. With restricted travel and onsite work, training and education are safe options that can boost your innovation efforts.

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The IIT should collectively and deliberately assess the fresh concepts and skills the organization needs to learn to enhance innovation. Perhaps the R&D team needs to learn how to read financial statements, the marketing team needs to be educated on machine learning, or the regulatory team needs to learn about new techniques in process intensification. Hundreds of free massive open online courses (MOOCs) are available on these topics, as well as books and other online training opportunities. University experts are likely willing to help during this time to present an overview of various fields and answer contextualized questions, especially for a modest honorarium. All of these can be done remotely by video call — not just now, but also in the future.

Closing thoughts

It is incorrect to assume that you and your team need to work harder to innovate during the COVID-19 (or any) crisis. Employees are already working very hard — and they might be struggling with everyday life during this time. Many companies are having a hard time innovating during this global pandemic. And yet, this is not the time to freeze in your current position; this is the time to have courage, take the initiative, and adapt to change. You can use this crisis to improve, become more capable as an innovation team, and emerge with better and more refined internal innovation processes. CEP

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Additional Reading

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