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ARTICLE

Plant 1 is a biased experiment: What the first factory cannot tell us about the second



Dr Sarah Hickingbottom

VP & Global Head of Chemicals, Materials & Natural Resources, FutureBridge

Building the first industrial plant for a new technology is an extraordinary achievement. It takes years of scientific development, engineering, fundraising, negotiation and persistence to reach the point where construction can begin, let alone where the first product emerges.

But there is something about first-of-a-kind (FOAK) industrial projects that deserves more attention: the circumstances that make the first plant possible are frequently very different from those that will determine whether the technology can become a repeatable industrial business.

Essentially, Plant 1 is a biased experiment

By *biased*, I don't mean that its results are flawed or unreliable. I mean that the conditions under which the first plant is built and operated are rarely representative of an ordinary industrial investment. Its location, funding, partnerships, infrastructure and even operating arrangements may reflect an exceptional combination of opportunities and compromises.

Those circumstances are often essential to getting the first plant built. But they also influence what we can learn from it, particularly when we begin evaluating the economics of Plant 2.

The economics of what's possible

One of the clearest illustrations of this bias is *where* we choose to build the first plant.

In scale-up commercialization, we are accustomed to discussing economies of scale. But the economics of location risk being lost in the noise of FOAK. For an established industrial business, location decisions consider the availability and delivered cost of feedstocks, access to customers, infrastructure, utilities, logistics and skills. For a FOAK venture, however, the decision is frequently driven by a different question: **where can we actually make this project happen?**

Perhaps a government and/or region will provide financial support. An industrial partner offers access to an existing site. A grant programme favours a particular geography, or an investor is willing to back the project because the right partnerships have come together physically.

You beg, borrow and steal what you can to assemble the resources needed to make the first industrial investment possible. These are entirely rational decisions.

However, those decisions have consequences. The plant may be further from its feedstock than would be desirable in the longer term. It may depend on bespoke infrastructure, unusually favourable agreements or contributions from partners that won't be available elsewhere.

The result is a facility that can be entirely successful in demonstrating the technology while operating under economic conditions that wouldn't necessarily make sense for subsequent plants.

What has the first plant actually proved?

Suppose a FOAK facility successfully produces its target chemical at the required purity and demonstrates reliable operation at industrial scale. That is substantial evidence of technical and engineering capability.

But how much has it established about the commercial economics of manufacturing the same product elsewhere?

Some costs will be unusually high because it is the first plant. Engineering solutions may be bespoke, operating procedures still evolving, and the team may need to intervene in ways that become unnecessary as the technology matures.

Other elements may make the economics unusually attractive. Public support, favourable infrastructure agreements or the exceptional commitment of an industrial partner may provide benefits that cannot be reproduced.

This distinction is critical. We must understand which costs and advantages arise from the technology itself, which are temporary consequences of being first, and which reflect the particular circumstances of the original project.

Nor does replication necessarily mean building another identical facility. Licensing technology to an established industrial operator, integrating a process into an existing chemical complex or expanding an initial site can involve very different capital requirements, costs and operating responsibilities.

Plant 2 may also require exceptional support. In some cases, it may take Plant 3 or Plant 4 before the economics and operating model become more ‘routine’.

> **Plant 1 demonstrates what can be achieved under one particular set of circumstances. Plant 2 begins to test how repeatable that achievement really is.**

The danger of carrying the bias forward

Technology developers and investors already plan for replication when designing FOAK facilities. The challenge isn't persuading them to think about Plant 2. It is ensuring that the assumptions underpinning those future investments are properly reconsidered as evidence emerges from Plant 1.

For example, suppose the first plant is built in a location selected primarily because of funding and industrial partnerships. Its production costs reflect that choice, including the expense of transporting feedstock over a considerable distance.

As the technology matures, a second plant could be located much closer to an established feedstock supply. Its economics might improve substantially, even before accounting for technological learning or economies of scale.

Yet there is a danger that the original location and operating assumptions remain embedded in financial models, engineering decisions and expectations about what the next plant should look like. Equally, exceptionally favourable arrangements at Plant 1 might be carried into future forecasts without sufficient scrutiny of whether they can be repeated.

The problem isn't that the first plant was built under unusual conditions. It is that those conditions can become accepted assumptions rather than choices to be revisited.

For investors, industrial partners and technology developers, the crucial task is therefore to distinguish between the evidence that should inform the next investment and the circumstances that should not automatically be reproduced.

First-of-a-kind projects are remarkable precisely because they demand exceptional effort, resources and commitment. We should celebrate those achievements and recognise that the compromises enabling them may have been entirely appropriate.

But if we want to turn extraordinary technologies into repeatable industrial businesses, we must be careful about what we carry forward.

> **We should give extraordinary projects permission to be extraordinary… but not confuse those extraordinary conditions with the economics of ordinary industry.**

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