



INTRODUCTION TO INNOVATION MANAGEMENT

Assessment B

Abstract

This report discusses the changes made to a current manufacturing process within the company in order to improve it in terms of labour costs and overall value to the product using methods of open innovation.

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TABLE OF CONTENTS

Table of Figures	2
Introduction.....	3
i) Company Overview	3
ii) Abbreviations	5
a) The principal drivers for the innovation	5
i) Current Manufacturing Process	5
ii) Problem.....	5
iii) Current Process - Issues	6
iv) Drivers for Innovation	6
v) Solution	6
b) The barriers and risks faced by the company in developing this innovation.	6
i) Barriers.....	6
ii) Risks	7
iii) Solution	7
c) The key determinants in the process of committing to develop the innovation.	7
Determinants	7
d) The processes and technologies which the company used to carry this development forward.	8
i) Chemical Etching.....	8
ii) Laser cutting.....	9
e) The extent to which the development relied on resources external to the company and the ways in which the deployment of these resources was managed.....	10
i) Company B – Chemical Etching.....	10
ii) Company C – Laser Cutting/Folding.....	10
iii) Development.....	10
f) How management overview of the development was maintained.	13
i) Was it worthwhile?	13
g) The extent to which you feel this innovation process represents best practice.	15
i) Open Innovation	15
ii) Management of Culture Change.....	17
iii) Innovation Capabilities.....	18
References	20



TABLE OF FIGURES

Figure 1 – Mesh Sink Cover PDF Drawing	4
Figure 2 – Mesh Sink Cover sample	4
Figure 3 – Chemical Etching Process (ACE, 2022)	8
Figure 4 – Chemical Etching design sample	9
Figure 5 – Revised Sink Cover A	11
Figure 6 – Revised Sink Cover B	12
Figure 7 – Revised Sink bowl.....	12
Figure 8 – Annual Company C revenue.....	14
Figure 9 – Types of firms based on Innovation Capabilities (Tidd & Bessant, 2020).....	18
Figure 10 – Firm Types explained (Tidd & Bessant, 2020)	18

INTRODUCTION

i) Company Overview

Axium Process is a specialist stainless steel system fabricator supplying custom built process equipment, fittings, precision components and filtration equipment to companies throughout the UK and overseas. The company is made up of the following departments:

- Projects – Membrane filtration rigs, large vessels, control system rigs
- Sales – Filters, machined items, spares, bespoke
- Aerospace – Aircraft non-critical items e.g. cabin equipment

The workshop is made up of 3 areas, Fabrication, Polishing and Machining

For data protection and security reasons, company names and many drawing details had to be excluded from this report. Due to this, many drawings intended to be used throughout this report had to be excluded.

Axium currently produce non-critical spares for Company A in the aerospace division, which are used on many mid-range planes around the world. As business began to increase, there was an issue regarding the efficiency of the process used to fabricate the aircraft sink assemblies.

This report focuses on the innovative methods used to develop the process currently used at Axium to produce components for a customer, Company A. The product being a sink drainage cover that consists of two halves of a mesh layer which is then sandwiched between two frame plates and soldered together. The resulting weld is then polished away, and hinges are fitted to allow the sink cover to fold away. (see figures 1 and 2). The labour times present with this method of manufacturing were already a minor concern for Axium, so when news broke that order quantities were increasing by almost 7 times the previous year, change in the manufacturing process was required.

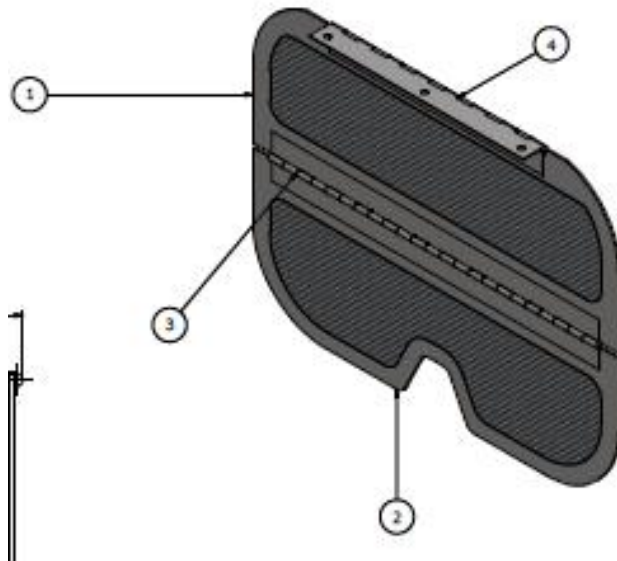


Figure 1 – Mesh Sink Cover PDF Drawing



Figure 2 – Mesh Sink Cover sample

ii) Abbreviations

Company A – Aerospace company who supply spare cabin parts to their customers (airline companies)

Company B – Chemical etching company, discovered when researching alternative methods to produce components for company A.

Company C – Laser cutting/metal forming specialists who were already an existing supplier to Axium.

a) The principal drivers for the innovation

i) Current Manufacturing Process

Axium Process began producing non-critical spares for aerospace supplier Company C in 2018. One item that was being produced regularly was a Sink Cover Assembly (see image).

The current manufacturing process for this assembly included 4 hours of labour due to the welding procedure that was being used. The welding required was not complex, but time consuming as involved a thin mesh had to be formed and soldered between two plates. Due to the nature of this procedure, regular reworks were occurring as a result of over-polishing this soft solder weld, exposing the mesh beneath.

The procedure for the sink basin was not as complicated but involved welding 4 cut pieces together to form a squared basin. The set up for this procedure consisted of clamping the pieces in place to weld, then polish the welds out to a surface finish of 0.8Ra. The current labour time for this was 2 hours.

ii) Problem

The annual figures from 2018 for Company A were £92,000 across 32 separate orders. When the first quarterly forecast for 2019 was sent to Axium, it consisted of 55 orders, almost double the previous year. Company A also assured Axium that these figures would remain consistent throughout the year, totalling 200+ orders that could be worth around £400,000-£500,000.

A board meeting was called to discuss this forecast, as concerns had already been raised on the labour times and reworks present with producing the sink cover assembly components

iii) Current Process - Issues

The current process is labour extensive and often requires reworks. When compared to the 8 wastes of lean manufacturing TIMWOOD, involves over-processing, transport, motion, underutilised talent.

Any over processing on the polishing side can also cause the mesh to become exposed and result in a rework. These reworks can add anything from 15-60 minutes on to the labour time, therefore eating into the profit margins of the sale, essentially losing the company money.

iv) Drivers for Innovation

- Reduce the labour times present with the current manufacturing process to ensure forecasted targets are met.

v) Solution

As a result of the board meeting to discuss the action to be taking to tackle the increased order forecast, rather than employing another welder to take on the workload that would be left by the current welder being taken off production to focus on Company A's orders, Axium's Business Development Director made the decision to pursue an alternative method of manufacturing external to Axium that would reduce the labour and rework times present with the current process.

b) The barriers and risks faced by the company in developing this innovation.

As the forecast of orders from Company A started to increase, it became apparent that Axium could not continue to produce the product in this way as it could result in order delays and disappointing the customer, possibly losing them if Axium could not meet their demand.

i) Barriers

- Time constraints
- Resources



ii) Risks

- Not finding a solution in time and not being able to meet the new forecast demands, potentially resulting in losing the customer.
- Financial problems and a result of having to expand workforce (add a welder to the fabrication department)
- Overloading the workforce with orders from company A and falling behind on orders for other customers, potentially harming relations.

iii) Solution

Open innovation is method of innovation that involves exchanging knowledge between trusted business partners and customers, as well as universities.

Reaching out to external companies to produce a product can provide an element of risk. When bringing in other companies from outside the walls of Axiom, there is an element of risk that they will keep that information to themselves. This requires Axiom to work with an element of discretion to keep the details of company A safe and implement disclaimers when working with external companies if need be.

c) The key determinants in the process of committing to develop the innovation.

Determinants

The company had been looking for ways to expand in the aerospace sector after losing several relationships when companies went bust after the pandemic. It appeared to be the perfect opportunity to try and make the leap to growing in this sector, giving the team driving this innovation the motivation required.

d) The processes and technologies which the company used to carry this development forward.

i) Chemical Etching

Resources were originally devoted to the use of Chemical etching, also known as chemical milling or photo etching. This is a subtractive sheet metal machining process which uses chemical etchants to create complex and highly accurate precision components from almost any metal. The complexity of components does not have an effect on cost, unlike most other manufacturing methods e.g. machining.

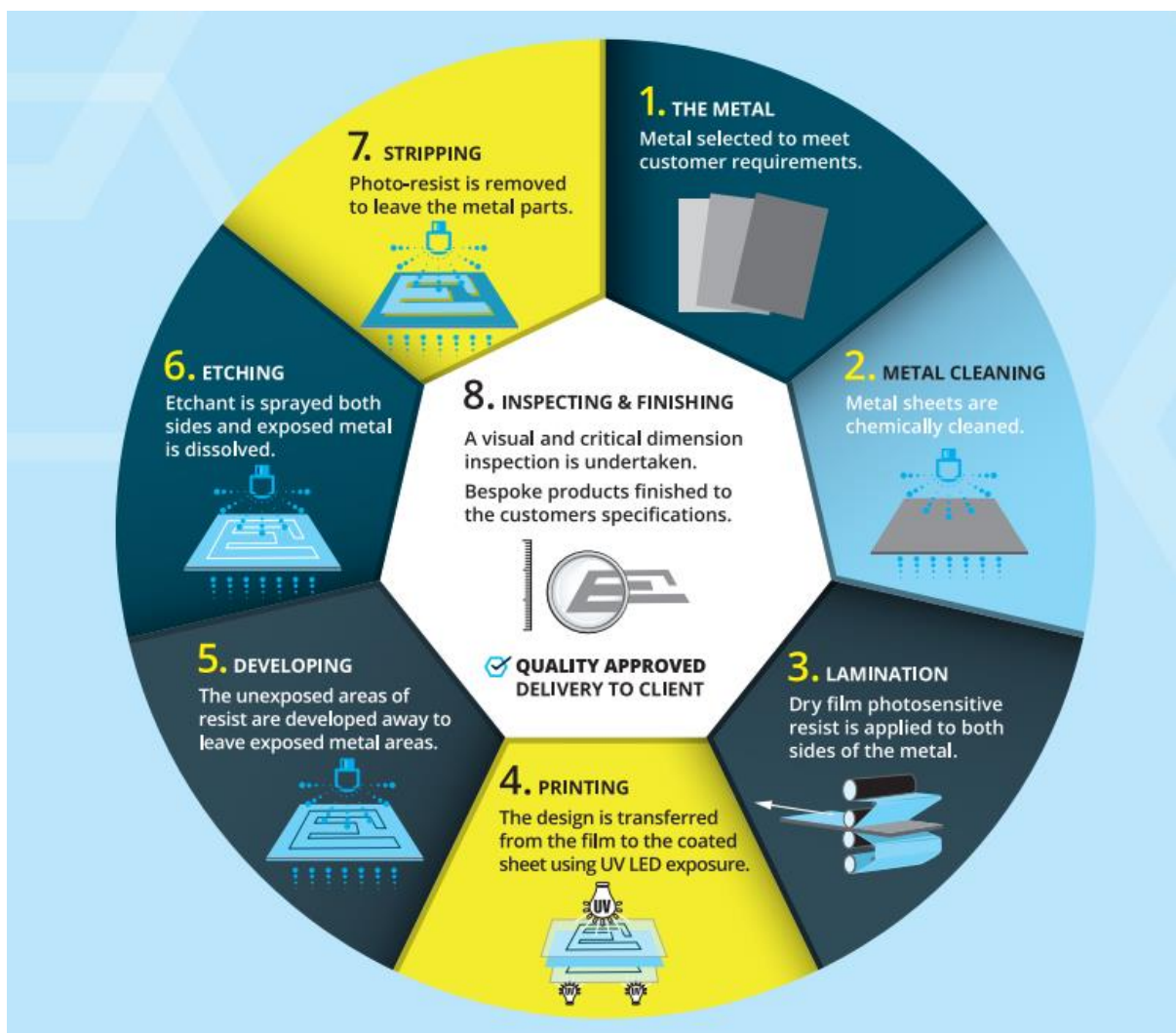


Figure 3 – Chemical Etching Process (ACE, 2022)

When the concept of chemical etching the sink covers was presented as a possible solution, it appeared that there were endless possibilities for the use of this process. The precision of this process could create products that are not possible via conventional processes such as machining and additive

manufacturing. However, midway through the R&D phase of this new process, it became apparent that the tooling may be an issue. Chemical etch tooling has a one-off cost for tooling, which is then paid back over the course of time. However, this tooling is specific to the original design and can not be modified, meaning that any modifications, no matter how small, would incur a fresh tooling cost. This was not originally a concern, as the drawings of the sink assembly provided by Company A were consistent. However, a month into R&D of this new process, Company A introduced different revisions of their drawings in the updated forecast that deviated away slightly from the original, meaning that additional tooling would be required.

This was a massive blow to the development of the innovation, as if Axium were to continue, the selling price of the item would have to increase by more to cover the cost of tooling. This was not deemed a viable option as it could risk losing Company A as a regular customer.

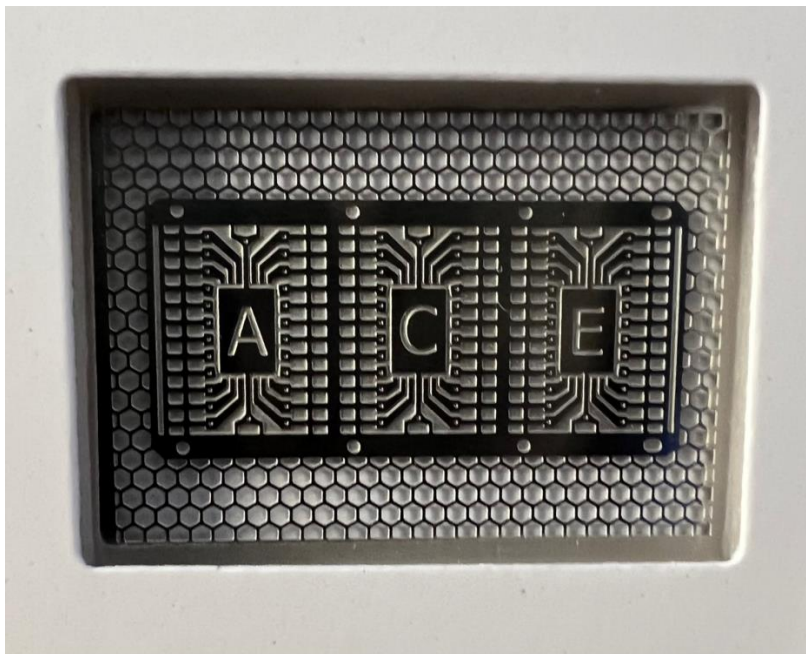


Figure 4 – Chemical Etching design sample

ii) Laser cutting

By chance while at a trade show, Axium's sales team came across the stall for one of the laser cutting and sheet metal folding companies (Company C) that were an active supplier for Axium. When viewing the stall, some of the samples that Company C had on display had some similarities between the sink basin that Axium were manufacturing for Company A. An in-depth conversation then took place into the manufacturing capabilities that Company C could offer and it quickly became apparent that they may be able to help produce some of Company A's orders. Axium Sales Team making notes to review

Company C specialise in providing a full sheet metalwork service, from laser cutting and pressing to fabricating, powder coating and assembly. They provide high quality sheet metal component manufacture at competitive price, using state-of-the-art engineering solutions and technology to laser cut for a precise finish and rapid turnaround.

e) The extent to which the development relied on resources external to the company and the ways in which the deployment of these resources was managed.

As previously discussed in section d), the deployment of resources was navigated away from Company B and delegated all to Company C. This choice ended up benefiting Axium due to the input that company C were able to contribute to the development of the new manufacturing process.

i) Company B – Chemical Etching

Company B did not contribute much, if at all to any structure related queries. The patterns that can be etched into the material would have an effect on the structural integrity of the sink cover, which will have a load placed and removed on it repeatedly throughout the duration of the flight at an altitude. Company B were just there to produce the product, meaning that additional research and development was required to ensure an appropriate pattern/design was used on the cover to enable its strength as well as it's aesthetically pleasing appearance.

ii) Company C – Laser Cutting/Folding

Company C however, were a much more helpful and offered their input on changing the manufacturing process slightly to make for an easier and cheaper build, without effecting any critical dimensions.

iii) Development

After the decision was made to pursue Company C as a potential partner, a Teams call was arranged in which snippets of the various Sink assemblies were presented. The sink cover that was causing Axium problems was presented, and Company C produced a concept design.

The revised sink cover was not aesthetically pleasing to look at, but it ticked all of the boxes relevant to the drivers listed for this innovation; and more. This redeveloped sink cover was quick, cheap, easy to make and all made outside of the walls of Axium, freeing up the workforce to delegate resources elsewhere and focus on orders for other companies.

A meeting was then held with Company C to discuss the possibility of modifying the sink cover to the cheaper, easier Company C version. Due to the low cost price of this new sink cover, Axium were able to market it slightly cheaper than the original version, prompting Company A to debate changing their design. The outcome was that Company C would add this to their parts catalogue as a standard part, with the mesh version being sold as a premium option. Figures 5 and 6 show the new laser cut sink covers that were made by company C

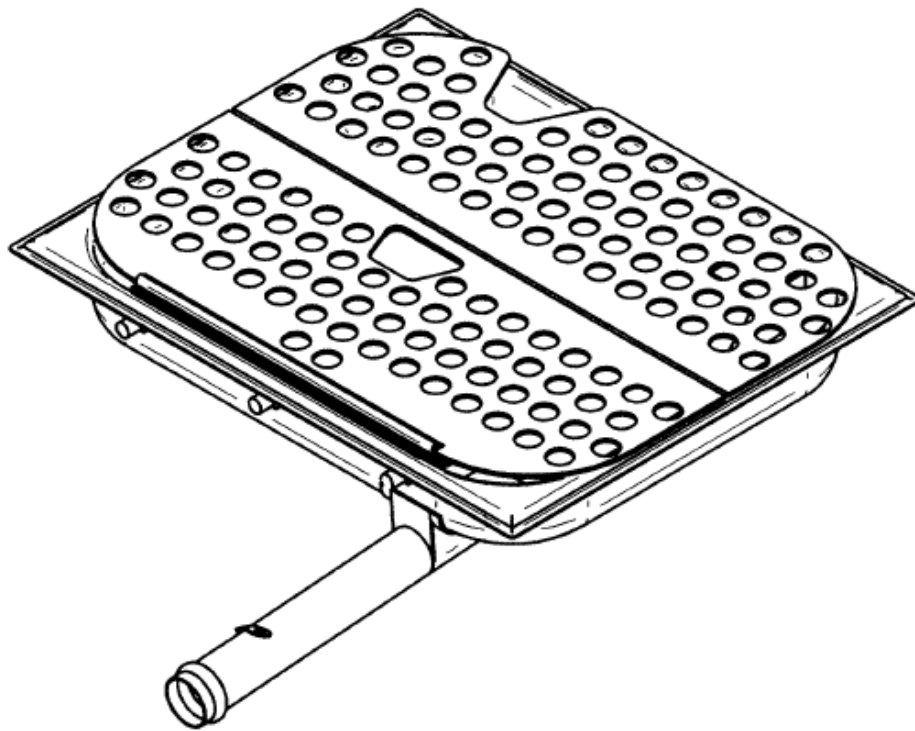


Figure 5 – Revised Sink Cover A

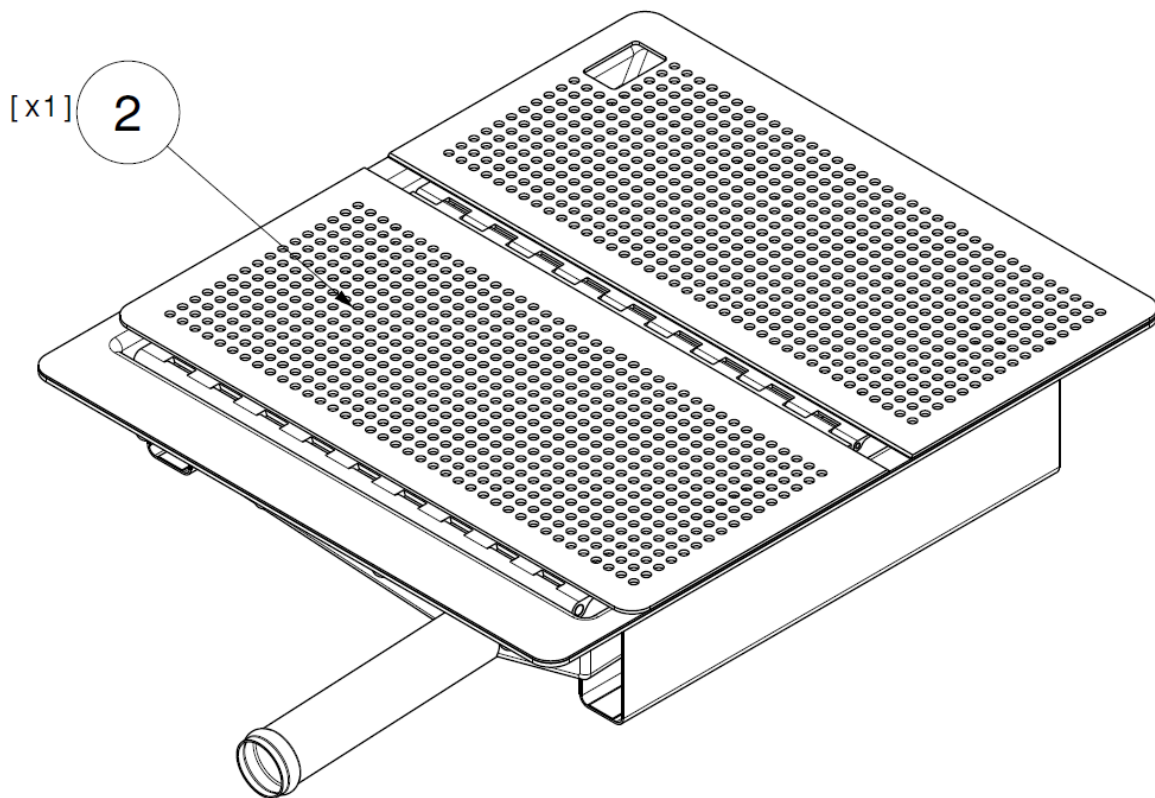


Figure 6 – Revised Sink Cover B

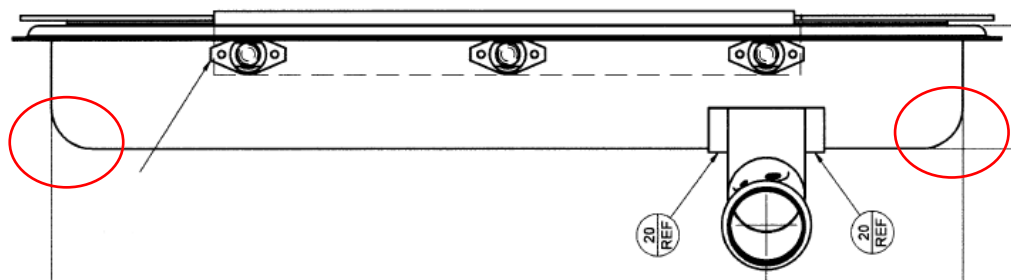


Figure 7 – Revised Sink bowl

Not only could Company C produce an alternative laser cut cover that would reduce the work required in house at Axiom, they were also able to provide the sink basins. Axiom were currently welding and polishing these basins, working with Company C meant that these could now be folded from sheet metal and welded. Although Axiom were still welding and polishing the sink components as before Company A pointed out that as most of the internal dimensions were non-critical, they could modify the design drawings slightly to allow them to fold the material into shape to be welded, eliminating

the welding set up. Figure 7 shows the new bowl design with the curved edges that have been folded by Company C.

f) How management overview of the development was maintained.

The option of chemical etching with Company B was an exciting prospect as first as the ideas discussed in team meetings appeared to have endless possibilities. The appearance of chemical etched products far outshone the appearance of anything else that many of the development team had ever seen let alone produced. However, with the impracticality and cost of the tooling for this manufacturing method would not have been a viable solution for the innovation drivers identified earlier in the report and would have deviated away from the customer requirements: a fast and reliable supply of parts.

It is essential not to deviate away from what the customer needs and replace it with something that you think the customer needs. Open innovation practices were followed with the decision to look outside of the organisation to find a company with the skills and equipment to be able to move the product forward.

When it became apparent that the chemical etching process was not the solution that it appeared at a first glance, the decision was made to stop all development into that process and begin to focus on the laser cutting and folding.

i) Was it worthwhile?

The innovation discussed in this report was definitely worthwhile for multiple reasons. The drivers mentioned in section a) were achieved as shown below:

Targets hit – 2019 was the first year this innovation was implemented (See fig 8). Revenue increased massively as orders were now easier to achieve. Values dropped off due to the COVID-19 pandemic but have rebounded in 2022. By collaborating with Company C, Axium was able to build a foundation to producing components quickly and more cost effectively, allowing for more business. This model has since been adopted for other products in Company C's line, as well as for products for other companies.

Reduced costs – Cost of labour to produce Sink Assembly – 4-6 hours at Axiom’s hourly rate. Cost of Company C to produce was roughly the same but allowed Axiom’s welder to devote 4-6 hours on other jobs, eliminating the need to hire a new welder.

Year	No. of orders	Order values
2018	32	£90,000
2019	220	£460,000
2020	237	£330,000
2021	166	£170,000
2022	196	£191,000

Figure 8 – Annual Company C revenue

g) The extent to which you feel this innovation process represents best practice.

“It’s only by understanding what the customer wants that we can identify the innovative opportunities. Then we see if there’s technology that we can bring to bear on the opportunities that exist. Being innovative is relatively easy – the hard part is ensuring your ideas become commercially viable.” (Murray, 2003)

The decision to abandon the chemical etching with Company B and pursue alternative processes was detrimental to this innovation. This being as the complexity of the innovation using chemical etching caused the product to deviate away from the product specification, adding value to the product which is not required by the customer.

i) Open Innovation

Rather than trying to take on the extra workload in house, open innovation practices were taken to have the product manufactured by Company C, who were superior to Axium in the field of laser cutting and sheet metal folding. Due to their more advanced equipment, Company C could manufacture the product in less time and using the new laser cutting process. This reduced the number of hours labour within Axium whilst producing more parts, using less internal resources than before, displaying some of the principles of frugal engineering and “making more with less” (Radjou, et al., 2012).

The main benefit, and what makes this an innovation, is the steps taken by Axium towards open innovation with other companies with the same goal; to grow and expand their business.

Innovation in large organisations and innovation in small businesses are almost two completely different things. In certain aspects, smaller businesses can be better suited for innovation than large organisations. This being as smaller companies are able to delegate resources to the relevant people/departments far easier than large ones as there are typically few laid down procedures acting as barriers (Chesbrough, et al., 2006).

“Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation,” (Chesbrough, 2003)

“Open innovation requires building such relationships with an extended cast of characters, including suppliers, collaborators, competitors, regulators and multiple other players” (Tidd, 2013)

“Open innovation can be a more profitable way to innovate. Potential to reduce costs, and accelerate time to market” (Chesbrough, et al., 2006)

The above quotations regarding open innovation can all be applied to the innovation discussed in this report,

ii) Management of Culture Change

“In order for organisations to both achieve and maintain success, changes regarding innovation, processes and employee practices are often required to move forward (Burnes, 2004). However, Harrington (2018) expresses that these changes alone are not enough to drive an organisation to success, as such changes must be accepted by those who will be working towards implementing them.

The steps taken towards the management of change are essential, as people in general are typically reluctant to change something that they have become accustomed to (Voehl, et al., 2016). This natural reluctance towards the introduction of a new process or system of doing things can prove toxic in a workplace, so it is essential that the correct steps are taken by management during implementation (Eidelman, et al., 2010).”

(Evans, 2020)

It was essential that the change surrounding the innovation discussed in this report was managed correctly, as a mismanagement of this change could have easily led to disruption within the workforce. There was initially some slight resistance by the workforce when the collaboration with Company C was first mentioned. Management at Axium called a meeting with supervisors to ensure them that work was being partially sourced out to Company C to build a working relationship, not as a means to source out work to warrant cutting any jobs in the workshop.

Although principle of the management of change culture was applied by management to the work force, management need to embrace the principles themselves. The idea of innovating the process was raised long before Company C raised their order quantities, but management were reluctant to devote any time or resources to any sort of development until forced to do so.

iii) Innovation Capabilities

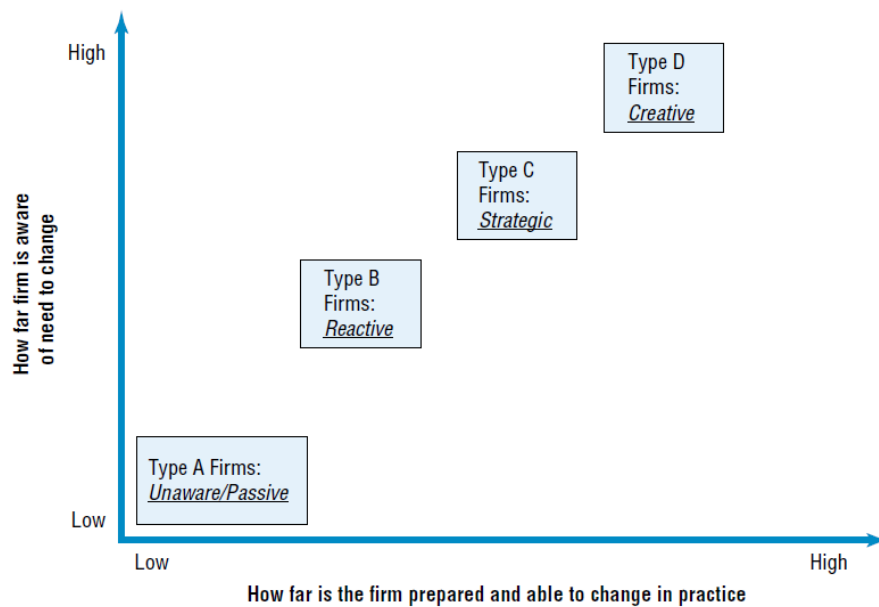


Figure 9 – Types of firms based on Innovation Capabilities (Tidd & Bessant, 2020)

Type B - firms recognize the challenge of change but are unclear about how to go about the process in the most effective fashion. Because their internal resources are limited – and they often lack key skills and experience, they tend to react to external threats and possibilities, but are unable to shape and exploit events to their advantage. Their external networks are usually poorly developed – for example, most technological know-how comes from their suppliers and from observing the behaviour of other firms in their sector.

Type C firms have a well-developed sense of the need for change and are highly capable of implementing new projects and take a strategic approach to the process of continuous innovation. They have a clear idea of priorities as to what has to be done, when, and by whom, and implement changes with skill and speed. These firms benefit from a consciously developed strategic framework in terms of search, acquisition, implementation and improvement of new knowledge. But they lack the capabilities for radical innovation – to redefine markets through new technology or to create new market opportunities. They tend to compete within the boundaries of an existing industry and may become ‘trapped’ in a mature or slow-growth sector, despite having exploited technological and market opportunities efficiently within the boundaries of the industry. Sometimes, they are limited in knowing where and how to acquire new knowledge beyond the boundaries of their traditional business.

Figure 10 – Firm Types explained (Tidd & Bessant, 2020)

Present -

Figure 9 shows the different types of innovative categories that businesses tend to fall into based on their capabilities and overall attitude towards innovation, according to (Tidd & Bessant, 2020). When

comparing to this matrix, before the innovation discussed in this report took place, Axium would fall into the Type B category as a reactive innovative firm, ticking all of the points listed in figure 10. However, with the knowledge and experience gained from this innovation, it could be argued that Axium are not a million miles off becoming a strategic innovation firm, as depicted under type C in Fig 10.

Future

Setting a company goal of becoming a strategic innovative company would not be a bad idea as the practices displayed and learnt from this innovation could be implemented in future to expand the business in many different areas. On reflection, there were already holes in the process, as well as many other processes, it should not have taken an increase in orders to prompt action. Axium were lucky to come out with the contract, could have potentially lost out on an average 250k a year. In an ideal world, Axium should focus on analysing any faulty processes or areas of improvement and try and innovate as a preventative measure for any sudden changed is future.

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