



Strategic Case Study Examination

May – August 2026
Pre-seen material



Context Statement

We are aware that there has been, and remains, a significant amount of change globally. To assist with clarity and fairness, we do not expect students to factor these changes in when responding to, or preparing for, case studies. This pre-seen, and its associated exams (while aiming to reflect real life), are set in a context where current and ongoing global issues have not had an impact.

Remember, marks in the exam will be awarded for valid arguments that are relevant to the question asked. Answers that make relevant references to current affairs will, of course, be marked on their merits.

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Introduction

Kwirmak is a quoted company that builds commercial 3D printers to customers' specification. These printers can be tailored to a variety of tasks.

You are a senior manager in Kwirmak's finance function. You report directly to the Board and advise on special projects and strategic matters.

Kwirmak's head office is located in Ennland, a developed country that has an active and well-regulated stock exchange. Ennland's currency is the E\$. Ennland requires companies to prepare their financial statements in accordance with International Financial Reporting Standards (IFRS).

Commented [TCS1]: Quoted Company

Pros

- Greater access to capital
- Increased reputation

Cons

- Shareholder pressure
- Compliance requirements

Commented [TCS2]: Senior Manager

- Strategic focus
- Deals with the board
- Actively provides leadership
- Understands wider commercial context

Commented [TCS3]: - Heavily regulated stock mkt.
- Positive macro factors (Opportunities)

Possible Exam Scenario

- Corporate Governance
- Ethics

3D printing

3D printing, or additive manufacturing, is a process whereby items are constructed by building up layers of material. These items are designed in computer-aided design (CAD) software. Different types of printer can manufacture items in plastic, metal or organic matter. 3D printers vary in size, sophistication and cost, starting with small units that are suitable for hobbyists to large units that can create parts for commercial applications. The commercial applications of this technology include prototyping new products and the manufacture of bespoke items.



3D printing starts with a three-dimensional digital model of an object. The printer creates a physical object by building up a succession of thin layers of material. This technology offers significant benefits in terms of the speed and accuracy of construction. For example, an engineer can edit a digital model of an object using CAD software before sending the result to a 3D printer for fabrication. 3D printers can create accurate physical versions of these CAD designs.

Commented [TCS4]: 3D Printing (Additive Manufacturing)

General Info

- Items made by layering material
- Items are designed using CAD SW
- Come in various sizes & costs
- Commercial application
 - * Prototyping new products
 - + Assist in design
 - * Manufacturing bespoke items
 - + Making complex parts
 - + Precise than traditional manufacturing
- Cheap to 3DP individual units
- Expensive to 3DP parts, relative to mass production

Technology

- **Design Stage**
 - * Scan an object using a HD 3D scanner
 - * Scanner creates a files
 - * File is opened & edited in CAD SW
- **Splitting** the design
 - * Splitting the object into very thin layers
- **Transfer** to 3DP
 - * 3DP creates the object according to the CAD file

Printers

- **Extrusion & DLP**
 - * Create objects by layering melted plastic filament
 - * Might need support structures
 - * Printers are relatively small
 - * Objects are of reasonable quality
- **SL**
 - * Using laser beams to cure liquid resins
 - * Might need support structures
 - * Further cured to harden objects
 - * Highly accurate
- **Laser Melting**
 - * Uses powdered materials which are melted using lasers to harden & bond
 - * No need of support structures
 - * Can create objects from plastic & metal
 - * Objects are stronger than SL/ DLP builds
 - * Finish: Rough & not so accurate
- **Multijet (Binder & Material Jetting)**
 - * Powder been compressed using a liquid binder
 - * Powder is bound using a printhead akin to an inkjet printer
 - * Can construct multi-coloured objects
 - * No need of support structures
 - * Can use a wide range of materials
 - * Objects are not strong as Laser Melted ones
 - * Finish: Accurate and smooth

Materials

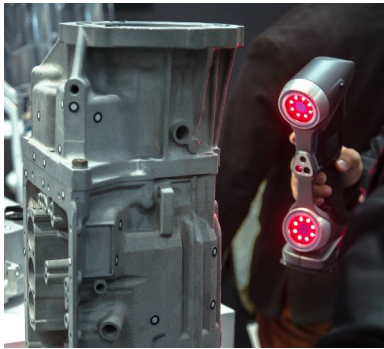
- **Plastic**
 - * Forms: Powdered & Filament
 - * Types: Nylon, Alumide, ABS (Strong), PLA (biodegradable)
- **Metals**
 - * Form: Powder
 - * Types: Aluminum, cobalt, stainless steel, gold, silver, titanium
- **Ceramics**
 - * Forms: Multiple
 - * Can use across 3DP formats, except SL
 - * Should fire after printing to harden

3D printing can be used to design and create prototypes of components that can be used to assist in design work. It is also possible to manufacture complex parts that would be difficult to fabricate using traditional manufacturing methods.

Traditional manufacturing methods such as machining and moulding are generally more expensive than 3D printing when it comes to making individual units for prototypes. They are often less accurate in terms of creating a physical object from a plan. 3D printing of parts can, however, be much more expensive than mass producing those same parts using traditional methods.

3D printing technology

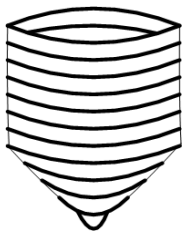
In commercial settings, 3D printing applications usually start with the construction or edit of a



model created in 3D CAD software. The design stage can often be speeded up by scanning an object that requires modification using a high-definition three-dimensional scanner. The scanner creates a file that can be opened and edited in 3D CAD software. That makes it possible to create 3D CAD files more quickly than by drawing the component in its entirety, starting with an empty file.

Once the digital model has been drafted, the software splits the resulting object into a large number of very thin layers. Each layer is intended to be added to the object with a single pass of the printer. Each layer is too thin to be seen with the naked eye.

The final stage is to transfer the processed file to the 3D printer, which creates a solid object that corresponds exactly with the digital model. There are several types of 3D printer. Each printer uses a specific material. 3D printing can create objects from:



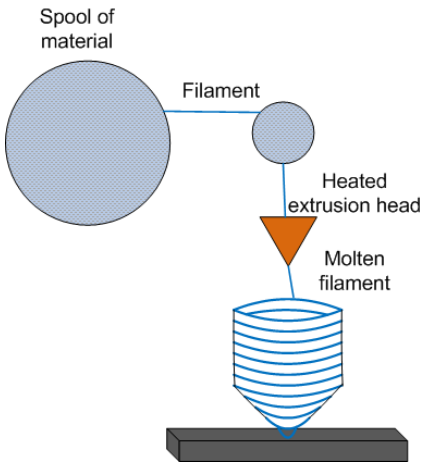
- plastic
- nylon
- ceramic
- metal
- resin

3D printers can create complex shapes that require no further assembly. Conventional production techniques might require the same items to be made in multiple parts that have to be fitted together to arrive at the final shape.

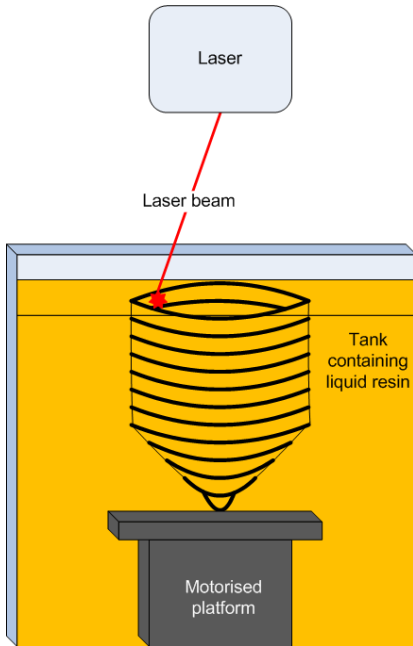


3D printing offers convenience and can save a significant amount of time in the design and development of new products. It is, however, **necessary to apply some engineering skill** in the creation of objects using 3D printing. For example, a complex shape might require a temporary support to be incorporated into the design. Once the object has been printed, it will have sufficient strength on all sides to allow for the support to be removed.

Types of printer

Extrusion	
 Spool of material Filament Heated extrusion head Molten filament	Extrusion is one of the most recognisable 3D printing technologies. The physical object is constructed from plastic filament, which is loaded into the printer in spools. The filament is fed into an extrusion head which melts the plastic and deposits it precisely, building up the object in layers. Each layer hardens and bonds to the preceding layer underneath. Extrusion might require support structures to be added temporarily to ensure that any overhanging sections of the object are supported while they cool and harden. Some extrusion printers have multiple extrusion heads, which makes it possible to incorporate different materials into an object. One application for this is the use of water-soluble material to construct any temporary support structures. These can then be removed by washing the object and dissolving the supports, which are no longer required. These printers can be relatively small and can produce reasonable quality objects.

Stereolithography (SL)



Stereolithography (SL) uses photopolymer resins. These cure very quickly when exposed to laser light.

The printer consists of a laser that is mounted above a tank of liquid resin. The tank contains a motorised platform that can be raised to the surface of the resin and then lowered in very small and precise increments.

An object is created by placing the platform just below the surface of the resin, leaving a very thin layer of liquid. The laser beam is directed over specific parts of the platform, curing the layer of liquid in selected areas and so creating the first layer.

The platform is then lowered by one increment, leaving the first layer just below the surface. The laser creates the second layer by curing the resin in the appropriate places.

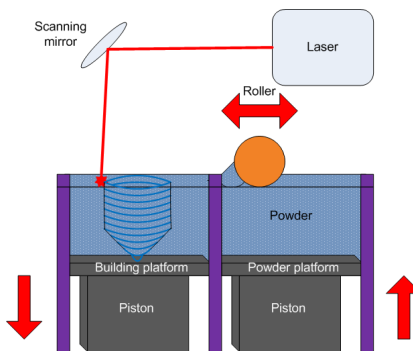
As with extrusion, SL may require temporary structures or supports for overhanging sections of the object.

Objects created with SL may require further curing by exposing them to bright light in order to fully harden the resin.

SL is one of the most accurate 3D printing processes.

There is a similar 3D printing process called digital light processing (DLP) which uses a more conventional light source that is directed using a lens and a mirror instead of a laser.

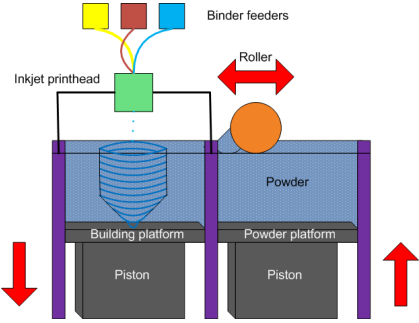
Laser melting



Laser melting uses powdered materials in a machine that has two chambers: a build chamber and a powder chamber. Both chambers have platforms that can be raised or lowered by means of pistons.

The build chamber starts at the top of its tank. The piston in the powder chamber rises slightly and a roller pushes a thin layer of powder over the building platform. The powder is spread evenly and compacted by the weight of the roller.

The laser is directed over the appropriate parts of the building platform, causing the powder to melt and fuse to create a hard layer.

	Subsequent layers are created by the piston under the powder platform, raising the platform slightly so that a further layer of powder can be spread across the building platform. The laser hardens subsequent layers, which bond with previous layers to create a solid object. This is repeated until all layers have been added. Once the object has been completed, the material in the building tank is allowed to cool and then the object is removed from the unused powder. Any remaining powder can then be brushed away. Laser melting does not require overhanging sections to be supported because the unused powder packs any empty spaces and so provides all necessary support. Laser melting can create objects from plastic and metal materials. Objects made using laser melting tend to be stronger than those from SL or DLP, although they are not always as accurate and their surface finish may be rougher.
Multijet 	There are two forms of multijet 3D printing: binder jetting and material jetting. Binder jetting has some superficial similarities to laser melting. Both rely on powder being spread evenly and compressed on a building platform. Binder jetting fuses the relevant areas of powder by spraying them with precise quantities of a liquid binder. The binder reacts with the powder, creating a layer of the object. The printhead that distributes the binder is very similar to the printhead on a conventional inkjet printer. It can be moved very precisely in two dimensions to reach any part of the platform. Binders come in different colours and can be mixed, enabling the construction of multicoloured objects. As with laser melting printers, the powder provides all necessary support during construction and so there is no need to add temporary supports to designs. Binder jetting printers can use a wide range of materials, including ceramics. Objects produced from this technology are not as strong as those from laser melting.

	Inkjet technology is also used in material jetting printers. A printhead is used to deposit a layer of liquid or molten material, usually a photopolymer, onto a construction platform. Each layer is cured using ultraviolet light before the next pass from the printhead. Material jetting allows for the simultaneous use of different materials. The resulting objects tend to be very accurate with smooth finishes.
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Materials

Plastics	Plastics are often used in powdered form in laser melting printers or in filament form for extrusion. Nylon can be used in both forms, creating strong and flexible objects. Nylon is usually supplied in white, but it can be coloured, either before or after printing. Powdered nylon can also be combined with powdered aluminium to create alumide, which makes it possible to create objects that are both stiff and heat resistant. ABS is a very strong plastic that can be used in filament form in extrusion printers. It is available in a wide range of colours. PLA is a biodegradable plastic that can be supplied in resin form for use in SL and DLP printers and in filament form for extrusion.
Metals	Several metals can be used in powder form for 3D printing: • aluminium • cobalt • stainless steel • gold • silver • titanium The metals differ in terms of their characteristics and applications.
Ceramics	Ceramic materials can be obtained in different formats, making it possible to use them in extrusion, binder jetting, laser melting, material jetting and DLP. Ceramic objects must be fired, in the same manner as any other ceramic item, after printing.

Potential benefits of 3D printing

3D printing is often associated with the rapid development of prototypes, thereby speeding up research and development projects. For example, a 3D printer can create a solid object directly from a 3D CAD file. The alternative might require a time consuming and expensive process, such as sculpting the part from a solid block of material or making a mould and using that to cast the prototype.

Commented [TCS5]: Benefits of 3DP

- Rapid development of prototypes: Speeds up R&D
- Can develop bespoke objects
- Flexibility: Laser Melting & Binder Jetting can make multiple objects in the same tank
- Produces complex shapes: Eliminates assembly time
- Sustainable: Can print locally
- * Zero transport emissions
- * Avoids material waste

3D printing offers other benefits. For example, **objects can be customised** to fit customers' particular requirements.

3D printing can be **flexible**. For example, **laser melting and binder jetting can make multiple objects simultaneously in the same development tank**. These items can either be identical or tailored to a particular requirement.

3D printing **can produce complex shapes** that would be impossible to produce using conventional production techniques. That capability can also **eliminate time-consuming assembly** from manufacturing processes. The alternative to 3D printing a single object might be the manufacture of two or more pieces that would have to be built together to create the final item.

3D printing can result in **sustainable production methods**. **Products and components can be printed locally, reducing the need for transportation**. Also, conventional manufacturing techniques often result in **materials waste that can be avoided using 3D printing**.

About Kwirmak



Kwirmak was **founded in 1992**. Initially, it manufactured small 3D extrusion printers that were popular with small commercial design workshops.

Kwirmak was **quoted on the Ennland stock exchange in 2004**.

The company's **product range** expanded over time. It continues to build 3D **extrusion printers**, but also makes **stereolithography (SL)**, **digital light processing (DLP)**, **laser melting** and **material jetting** printers. Kwirmak **specialises in printers for commercial customers**, including machines that can create relatively large objects from plastic, metal or ceramics. The company's **largest extrusion printer can create objects with a build volume of up to 1 metre cubed**.

Kwirmak supplies materials for use in its printers. **Customers are not required to purchase those materials, but many choose to do so because they are known to be compatible** and so will produce the best possible output from Kwirmak's machines.

Kwirmak's **customers** are from a wide range of industrial backgrounds, including:

Commented [TCS6]: Kwirmak (KM)

General Info

- 34 years in existence
- Quoted since 2004 (22 yrs)
- Reputation: High quality
- Business
 - * Sells a range of 3DPs to commercial clients
 - * Provides technical support to customers
 - * Supplies material for printers
 - + Most customers purchase supplies from KM
- Factories
 - * 1 in Ennland: Largest KM factory
 - * 3 in foreign countries
- Global customer base
- KL 3DPs offer
 - * Speed
 - * Property of output: Accuracy, Finish, Strength, Size

Product range

- Extrusion & DLP
- SL
- Laser Melting
- Material jetting
 - * Do not sell binder jetting printers

Customers

- **Aerospace**
 - * Spare parts built within airports
 - * Speeds up repairs: Low waiting times
- **Automotive**
 - * Switches & dashboards of luxury cars
- **Consumer electronics**
 - * Prototypes of new products
- **Jewellery**
 - * Complicated pieces
 - * CAD designed bespoke items

Technical advice provided

- **Cost**
 - * Expensive to purchase & operate
 - * KM 3DPs are high quality, thus expensive
- **Speed**: Time to create an object
 - * Depend on technology & power of components
- **Properties of objects** created: Customer needs
 - * Accuracy: Engine part Vs. Ornament
 - * Finish: Appearance Vs. functionality
 - * Strength: Plastic Vs. Metal
 - * Size: Large Vs. Small

Probable exam scenario

- Risk Exposure
 - * Political, Economic & Country
 - * Forex
 - * Operational
 - * Reputation
 - * Reliance on suppliers
 - * Resource dependency
 - * Legal & compliance
- Managing each risk
- Evaluate M&As/ Vertical Integration

Syllabus areas tested

- Risk identification & Management (P3)
- M&As/ Vertical Integration (E3)
- Sustainability & Ethics (E3)
- Competitor Analysis (E3)



- **Aerospace** – the creation of spare parts at major airports around the world in order to speed up repairs to aircraft that would otherwise have to wait for parts to be flown in if not held locally in inventory.
- **Automotive** – the manufacture of switches and dashboards for low-volume luxury cars.
- **Consumer electronics** – the rapid creation of prototypes for the development of new or improved products.



- **Jewellery** – the manufacture of individual pieces in complicated shapes that would be difficult, if not impossible, to create using traditional jewellery techniques. These might be bespoke items that can be designed using 3D CAD in accordance with the consumer's specific wishes and sized to be a perfect fit, where necessary.

Kwirmak supplies a wide range of customers, covering many different industries. The company has a strong reputation for the provision of technical advice, ensuring that customers' requirements are met in terms of several key criteria:

- **Cost** – 3D printers are generally quite expensive to purchase and to operate. They come at a range of different price points, depending on the technology of the printer and the features that are required.
- **Speed** – the time taken to create a particular item will depend on the printer's technology and the power of components such as lasers or heaters.
- **Properties of output** – customers should probably focus on the properties of the objects that they wish to create before considering factors such as cost and speed:
 - **Accuracy** – printers vary in terms of the precision that they can deliver. The need for precision depends on the application. An engine part might have to be accurate to within a tiny fraction of a millimetre, while an ornament could be perfectly acceptable even if it is created to a much wider tolerance.
 - **Finish** – different combinations of printer and material will produce different finishes on the item being created. Some parts might have to be created in a precise colour scheme and/or have a smooth surface. Appearance might not be an issue for parts that will not be visible to a consumer.
 - **Strength** – different combinations of printer and material will yield different strengths of object. Some objects will not require a great deal of strength while others will have to be quite robust. Objects will also vary in terms of their ability to retain their strength when exposed to moisture or to high or low temperatures.
 - **Size** – printers vary in terms of the size of their production platforms, which has implications for the size of the objects that they can create. It may be necessary to build some objects in multiple parts if the entire object could not be built as a single part on the platform.

Kwirmak's range of products enables it to meet most customer requirements in terms of the speed and property of output criteria. The prices of Kwirmak's printers and materials tend to reflect the high quality of its products. More advanced and capable printers tend to have higher selling prices in recognition of the superior components and better build quality that they provide.



Kwirmak largest factory is in Ennland, alongside its head office in the outskirts of Capital City. The company has three other factories, each in a different country. The company sells to a global market.

Extracts from Kwirmak's annual report

Kwirmak's mission, vision and values

Our mission

Kwirmak's mission is to transform its customers through innovation in design and production.

Our vision

Kwirmak's vision is to be the leading provider of additive manufacturing solutions across industries, to be achieved in a sustainable manner.

Our values

- Kwirmak creates wealth and success.
- Kwirmak's innovations are driven by customer need.
- Kwirmak overdelivers on promises to its customers.
- Kwirmak trusts its staff.
- Kwirmak staff are team players.

Commented [TCS7]: Mission (Reason for being)

- Transform customers via
- Innovation in design & production

Vision (Future)

- Leader in additive manufacturing solutions across industries
- Achieve sustainability

Values (Beliefs)

- Create wealth & success
- Customer need driven innovation
- Overdeliver on promises
- Trust staff
- Staff are team players

Overall Analysis

- Good alignment between Mission, Vision & Values
- Values, if achieved, drives competitive advantage
- Sustainability & customer relationships considered (GRI/IR)

- Need to analyze stakeholders based on Power & Interest

Shortcomings:

1. No mention of other stakeholders
 - * Suppliers (Refer RR)
 - * Regulators (Refer RR)
2. No mention of safety & reliability
 - * Health & Safety (Refer RR)
 - * Environmental (Refer RR)
3. No mention of collaborations
 - * Essential since KM relies on part & material suppliers
4. Is KM sustainable?
 - * Operates 4 factories
 - * Uses complex HW & SW
 - * Sells globally
 - + Energy-intensive emissions
 - * Use of plastic, metals & binding agents
 - + Damages the environment
 - + Metal extraction emissions
5. Unrealistic customer expectations
 - * Overdeliver on promises
 - + Risks of KM:
 - > Volatile demand
 - > Supply chain dependence
 - > Technical complexity
 - + Trying to overdeliver leads to:
 - > Higher service costs
 - > Pressure on staff & systems

Probable exam scenario

- Evaluate strategic options
 - * Mission, vision, values Vs. strategic options
 - * SAF analysis
- Recommend internal controls
 - * Quality/ sustainability in ops
 - * Innovation
 - * Safety
 - * Risk management
 - * Ethical practices
 - * Stakeholder management

Kwirmak's Board of Directors

Madda Fedele, **Non-Executive Chair**

Madda had a **successful career as an administrator in Ennland's Government**. She was involved in drafting several key pieces of business-related legislation during her time in office. She reached a very senior position before she retired from government service.

Madda serves on the senate of Capital City University. Her responsibilities include membership of the University Audit Committee.

Madda joined Kwirmak's Board as Non-Executive Chair in 2024.

Dr David Wallace, **Chief Executive Officer (CEO)**

David is a **mechanical engineer**. He has **BEng and MEng degrees** from the University of Central City. He completed a **PhD** at Capital City University, writing a thesis on the precision control of mechanical devices.

David joined Kwirmak as a member of the Research and Development Department after graduating with his PhD. He has **held several positions with the company, including Chief Technical Officer**.

David was **promoted to CEO in 2023**.

Kristina Eder, **Operations Director**

Kristina has a **degree in chemical engineering** from the University of Newtown. She joined a company in the **oil industry** after graduation, where she held a number of positions in production.

Kristina joined Kwirmak in 2016 as Head of Quality. She was **promoted to the Board as Operations Director in 2022**.

Dr Said Abouchdak, **Chief Technical Officer (CTO)**

Said has **BEng and PhD degrees** from the University of Central City. Said's PhD thesis was on the behaviour of molten plastics under extrusion.

Said joined Kwirmak after completing his PhD. He has **worked in both Production and Research and Development**.

Said was **promoted to Kwirmak's Board as CTO in 2024**.

Commented [TCS8]: Board members

Strengths

- Skilled, educated & experienced
- Appropriate industry knowledge
- Experience within KM
- Backgrounds/expertise
 - * Academia: INEDs
 - * Mechanical & chemical engineering: CEO & OD
 - * Economics & Finance: CFO & SID
 - * Production & RnD: OD, CEO, CTO & an INED
 - * B2B Sales & Marketing: MD
 - * Politics and legislation: NEC
 - * Entrepreneurship: an INED
- Imbalance between EDs & INEDs
 - * 5 EDs
 - * 4 INEDs
 - + Governance risk (P3)
- Some board members held academic posts
 - * Good for R&D & recruitment

Shortcomings:

1. Too many internally developed EDs
 - * May limit challenge & encourage groupthink
 - * Problematic given risk exposure:
 - + Volatile demand
 - + Global competition
 - + Supply chain
 - + Political, economic & legal
2. Capable NEDs, but limited sector-specific expertise
 - * Only exception: Nina
3. Several recent appointments
 - * NEC, CTO, CFO & 2 INEDs
 - * May reduce board stability & cohesion
 - * Weak oversight in a technically complex global player?

Probable exam scenario

- Board composition Vs. CG
- Board responsibilities/ restructuring
- Appointing a board committee
- Appointing an ED/NED
- Dismissing a director
- Director's remuneration
- Ethics: Lobbying
- Ethics: Disclosures



Agata Paluch, Chief Financial Officer (CFO)

Agata is a professionally qualified accountant. She worked for an electronics manufacturer while studying for her professional exams. After qualifying, she moved to a larger electronics manufacturer and then to Kwirtmak, joining as Chief Accountant.

Agata was promoted to Kwirtmak's Board as CFO in 2025.

Ouyang Qi, Marketing Director

Ouyang joined the marketing department of a major manufacturing company straight after school. He has since had a long and successful career in business-to-business sales.

Ouyang joined Kwirtmak's Marketing Department as a senior manager in 2019. He was promoted to Marketing Director in 2022.

Dr Ada Rothenberg, Senior Independent Director

Ada's PhD was in economics. Most of her career was spent in banking, ultimately serving as the Chief Economist of the Ennland Mutual Bank.

Since retiring from banking, Ada has served on three government advisory committees.

She joined Kwirtmak as Senior Independent Director in 2024.

Professor Ahmet Usta, Independent Non-Executive Director

Ahmet had an academic career. He taught and conducted research at the University of Newtown, before moving to the University of Central City's School of Business as head of their Master of Business Administration (MBA) degree.

Ahmet continues to serve as a part-time visiting professor at the University.

He joined Kwirtmak's Board as an Independent Non-Executive Director in 2025.

Nina Abersek, Independent Non-Executive Director

Nina founded a successful company that specialised in the commercial application of innovative new technologies. Her company was quoted on the Ennland stock exchange.

Nina has held several non-executive directorships since selling her shares and stepping back from the company that she founded. She now serves as a non-executive director on Kwirtmak's Board. She is also the Chair of Ennland Opera.

Board responsibilities

David Wallace Chief Executive Officer			
Kristina Eder Operations Director	Said Abouchdak Chief Technical Officer	Agata Paluch Chief Financial Officer	Ouyang Qi Marketing Director
- Factory operations - CAD software - Human resource management - Health and safety - Sustainability	- Research - Product development	- Financial reporting - Management accounting - Treasury	- Marketing - Customer service - Public relations

Commented [TCS9]: Board Responsibilities

- Aligned in finance, RnD & marketing
- OD is overburdened
 - * OD's role fits factory ops, HnS & sustainability
 - * CAD SW & HR seem less clearly matched
 - + CAD SW should be under the CTO
 - + HRM is extremely important as per values and ops
- No ED is responsible for:
 - * Cybersecurity
 - * Data privacy
 - * SCM
 - * Legal/compliance
 - + These are important risks to be managed

Probable Exam Scenario

- Managing system incompatibilities
- Managing the internal business environment
- Changing the business ecosystem
- Change management
- Stakeholder management
- Pursuing disciplinary action
- Appointing manager/director
 - * Risk management
 - * Cybersecurity & Privacy
 - * SCM
 - * Legal / Compliance
- Appointing a board committee: Cybersecurity

	Board committees			
	Audit	Risk and CSR	Remuneration	Nomination
Madda Fedele Non-Executive Chair	♦	♦		♦
Ada Rothenberg Senior Independent Director	♦		♦	♦
Ahmet Usta Independent Non-Executive Director	♦	♦	♦	
Nina Abersek Independent Non-Executive Director		♦	♦	♦

Commented [TCS10]: Board Committees

- 4 Committees
 - * Audit
 - * Risk & CSR
 - * Remuneration
 - * Nomination

Strengths

- NEDs dominate all committees
- Chief IA reports to the AC
 - * Aligned with CG best practices
- Experience
 - * NEC has Audit Committee experience
 - * Ada's economics & banking background

Weaknesses

- NEC should not be in the Audit Committee
 - * Governance risk (P3)
- Skill gaps
 - * Tech
 - * Cybersecurity
 - * Supply chain
 - * Sustainability
 - * HR
 - * Compliance
- Workload
 - * Each member works in 3 committees

Syllabus areas tested

- Combined Code of Corporate Governance UK (E3)

Kwirmak's **Chief Internal Auditor reports to the convener of the Audit Committee.**



Kwirmak's principal risks

Commented [TCS11]: Kindly note that a comprehensive analysis concerning the suitability of each mitigation strategy is extensively detailed in the following pages. Scroll down for an enriched understanding.

Risk impact	Risk mitigation
Kwirmak trades globally, which can leave the Group exposed to the effects of economic trends. For example, foreign governments might increase interest rates in response to unacceptable rates of inflation. Such changes can have adverse effects on Kwirmak's suppliers and customers.	Kwirmak's Treasury Department closely monitors all such trends and recommends strategies for the mitigation of associated risks. The Group also pays close attention to minimising operating costs.
Sales demand can be volatile, creating variability in reported earnings. This volatility can also make it difficult to predict demand, which can lead to overinvestment in inventory if forecast sales do not materialise.	Kwirmak's Marketing Department maintains a good relationship with major customers. Kwirmak's sales staff ensure that customers are kept informed of potentially useful new products or updates to existing products.
Kwirmak's printers are complicated in terms of the hardware and software used in their construction. Any flaws or faults can create significant quality issues. Errors in 3D printed components can often result in mission-critical failures. Customers can also be badly inconvenienced when 3D printers have to be taken offline because of breakdowns or software problems.	Kwirmak's Factory Operations Department pays the closest possible attention to the quality of hardware manufactured in the Group's factories. The Product Software Department pays close attention to updating and upgrading the software that operates products and provides their interface to leading 3D CAD packages.
Kwirmak relies heavily on third-party suppliers to provide parts and materials for manufacturing its printers and 3D printing materials. These suppliers also provide many of the spare parts used to replace worn or damaged items. Any lack of availability can disrupt Kwirmak's operations and those of its customers. Defective parts and materials can also affect Kwirmak's product quality.	Kwirmak works closely with third-party suppliers to ensure that they are aware of all of the quality standards that are required in the supply of parts and materials. Quality management systems should minimise the risk of defective output being despatched to customers.
The nature of Kwirmak's products can create significant exposure to the risk of penalties for non-compliance with health and safety and environmental legislation.	Kwirmak's Legal Department pays close attention to all applicable laws and regulations that could impose a duty in relation to products and their operation.



Evaluation of Stated Risks

1. Global economic risk

Risk: Kwirtmak trades globally, so it is exposed to inflation, interest-rate changes and wider macroeconomic instability, which can affect both suppliers and customers.

Current mitigation

- Treasury monitors economic trends & recommends mitigation strategies
- Pays attention to minimising operating costs

Assessment

- Mitigation is relevant, but too broad and reactive
- Response focuses on observing the risk than structurally reducing exposure
 - Macro-economic issues already impacted performance:
 - Dip in revenue & profit
 - Currency loss

Enhancements

- Use scenario planning, early-warning indicators & stress-testing by market
- Currency and interest-rate hedging where appropriate, including natural hedging
- Flexible pricing
- Link macroeconomic monitoring & operational planning
 - Inventory management
 - Forecasting
 - Investment decisions



2. Demand volatility risk

Risk: Volatile sales demand, creating earnings instability & creating the risk of overinvestment in inventory if forecast sales do not materialise.

Current mitigation

- Marketing Department maintains good relationships with major customers
- Sales staff keep customers informed of new products & updates

Assessment

- Commercially useful, but operationally weak
- Mitigation is focused on communication; not on demand analytics & forecasting or WCM
 - Good customer relationships do not solve forecasting / inventory problems

Enhancements

- Rolling forecasts
- Integrate sales & operational planning
- Improve CRM & order-pipeline analytics
- Tighten inventory controls
- Increase recurring revenue streams: Servicing, maintenance & materials supply
 - Reduced earnings volatility



3. Product quality and software failure risk

Risk: Flaws in HW or SW can create serious quality issues, breakdowns & mission-critical failures. Customers may also face costly downtime

Current mitigation

- Factory Operations Department focuses closely on HW quality
- Product Software Department updates & upgrades SW & CAD interfaces

Assessment

- Good mitigation: recognises both HW and SW dimensions
- Yet, “paying close attention” does not confirm the existence of robust controls
- No mention of:
 - Formal quality testing
 - Product certification
 - Failure reporting
 - Recall procedures
 - Customer incident escalation process
 - Cyber-security controls over software

Enhancements

Strengthen:

- Stage-gate product development
- Root-cause analysis
- Failure monitoring
- SW patch controls
- Post-sale service feedback loops
- Strict validation for mission-critical uses
- Product liability reviews before launch



4. Supplier dependency risk

Risk: Relies heavily on 3rd-party suppliers for printer parts, spare parts & 3D printing materials. Supply disruption / poor input quality impacts production, reliability & customer service.

Current mitigation

- Works closely with suppliers so they understand quality standards
- Quality management systems aim to reduce despatch of defective output to customers

Assessment

- Necessary, but incomplete
- Mitigation focuses mainly on quality, not on supply continuity
- Does not address:
 - Supplier concentration
 - Geopolitical disruption
 - Logistics shocks
 - Financial weakness at supplier level
 - Relying on specialist inputs

Enhancements

- Map critical suppliers
- Identify single-source dependencies
- Hold safety stock for critical spares
- Conduct supplier resilience reviews via supplier scorecards
 - Score based on:
 - Delivery
 - Financial strength
 - Compliance and sustainability
 - Quality



5. Health, safety & environmental compliance risk

Risk: Products & operations exposes to the risk of penalties for non-compliance with health, safety & environmental laws

Current mitigation

- Legal Department pays close attention to relevant laws & regulations

Assessment

- Relevant, but too narrow
- Compliance must be built into product design, manufacturing, testing & operational controls
- Mitigation does not show how legal requirements are translated into engineering standards, environmental controls / compliance audits

Enhancements

- Strengthen cross-functional compliance involving legal, quality, operations & RnD
- Should:
 - Maintain country-specific compliance registers
 - Regular audits
 - Improve traceability
 - Integrate health, safety & environmental requirements to engineering & production decisions



Notable Gaps

1. Cyber-security and data privacy risk

Risk: Depends heavily on SW, CAD interfaces & digital design files, yet no explicit cyber-security / data privacy risk is disclosed. Board responsibilities show CAD software under the Operations Director and product development under the CTO, but no director is shown as explicitly responsible for cyber-security / data governance.

Why it matters

- Customer CAD files & technical designs are commercially sensitive.
- A cyber-attack / data breach could disrupt ops, compromise customer info & damage product reliability & trust

Recommendations

- Identify cyber-security and data governance as principal risks
- Assign clear ownership
- Strengthen:
 - Access controls
 - SW security
 - Incident response
 - Encryption
 - Supplier cyber assurance

2. Intellectual property risk

Risk: Operates in an innovation-driven industry & relies on product development, SW, materials knowledge & technical know-how. Yet the risk report does not identify IP risk.

Why it matters

- IP theft, patent disputes / leakage of proprietary designs:
 - Weakens competitive advantage
 - Create legal costs
 - Undermine growth in an innovation driven sector

Recommendations

- Strengthen patent protection
- Confidentiality arrangements
- SW & design security
- Legal review of new products & RnD projects



3. Product liability risk

Risk: Report covers quality risk, but does not identify the severe liability risk arising if printed components fail in mission-critical applications

Why it matters

- In high-risk sectors, a defective component could result in:
 - Major legal claims
 - Reputational damage
 - Regulatory consequences

Recommendations

- Identify product liability risk
- Review insurance coverage
- Strengthen certification & traceability
- Apply stricter approval processes for higher-risk uses

4. Technological obsolescence & competitive disruption risk

Risk: Operates in an innovation-led sector, but the risk report does not explicitly identify strategic disruption or technological obsolescence

Why it matters

- If competitors develop better printers, materials or SW, Kwartmak loses market share & pricing power
- Recent financial performance weakened while Breskko's improved.

Recommendations

- Identify & mitigate this risk via:
 - Competitor benchmarking
 - Technology road-mapping
 - R&D prioritisation
 - Faster innovation cycles



5. Reputation and investor confidence risk

Risk: Quoted company with a volatile share price and a beta of 2.3, yet the risk report does not explicitly mention reputation or investor confidence risk.

Why it matters

- Negative news on performance, product failures, strategy or compliance could sharply affect valuation, cost of capital and takeover vulnerability
- Relevant given the company's recent profit decline & drop in share price

Recommendations

- Monitor investor sentiment
- Strengthen disclosures
- Calculate major operational / strategic risks & market-value impact

6. Talent and skills risk

Risk: Depends heavily on engineering, SW & technical capability, but the risk report does not explicitly mention talent retention, succession / skills shortages. Board responsibilities and director backgrounds suggest that technical knowledge is central to the business

Why it matters

- Loss of specialist staff could:
 - Weaken innovation
 - Increase quality problems
 - Reduce customer support capability

Recommendations

- Strengthen succession planning
- Invest in training
- Monitor turnover in critical technical roles



Extract from Kwirtmak's financial statements

Kwirtmak Group Consolidated statement of profit or loss For the year ended 31 March

	2026 E\$ million	2025 E\$ million
Revenue	2,320.0	2,856.6
Cost of goods sold	(828.0)	(913.4)
Gross profit	1,492.0	1,943.2
Selling and administration	(47.4)	(47.1)
Research	(270.0)	(285.0)
Operating profit	1,174.6	1,611.1
Finance costs	(108.0)	(108.0)
	1,066.6	1,503.1
Tax expense	(256.0)	(360.7)
Profit for the year	810.6	1,142.4

Kwirtmak Group Consolidated statement of changes in equity For the year ended 31 March 2026

	Share capital E\$ million	Currency reserve E\$ million	Retained earnings E\$ million	Total E\$ million
Opening balance	300.0	267.4	1,204.8	1,772.2
Currency loss		(44.3)		(44.3)
Profit for year			810.6	810.6
Dividend			(432.2)	(432.2)
Closing balance	300.0	223.1	1,583.2	2,106.3

Commented [TCS12]: Refer to the **Financial Analysis Video** and **Financial Analysis Slides** to gain an in- depth understanding of Kwirtmak's & Breskko's Financial Statements.

Probable Exam Scenario

- Financing Options
- Demonstrating creditworthiness
- Managing a rights issue
- Managing debt covenants
- Company valuation
- Dividend payments
- Integrated Reporting: 6 Capitals



Kwirmak Group
Consolidated statement of financial position
As at 31 March

	2026 E\$ million	2025 E\$ million
Assets		
Non-current assets		
Property, plant and equipment	2,551.3	2,321.7
Goodwill	118.6	118.6
Other intangible assets	497.2	422.6
	3,167.1	2,862.9
Current assets		
Inventory	287.5	312.4
Trade receivables	198.3	244.2
Bank	136.2	148.1
	622.0	704.7
Total assets	3,789.1	3,567.6
Equity		
Share capital	300.0	300.0
Currency reserve	223.1	267.4
Retained earnings	1,583.2	1,204.8
	2,106.3	1,772.2
Liabilities		
Non-current liabilities		
Borrowings	1,350.0	1,350.0
Current liabilities		
Trade payables	76.7	84.6
Tax liability	256.1	360.8
	332.8	445.4
Total equity and liabilities	3,789.1	3,567.6



Extract from competitor's financial statements

Kwirmak is one of eight major manufacturers of industrial 3D printers. Most of these compete directly with Kwirmak, producing similar ranges of products.

Breskko is Kwirmak's closest competitor. It sells a very similar range of 3D printers and materials.

Breskko is based in Ennland. It is quoted on the Ennlandian stock exchange. The other major manufacturers are based abroad, but all compete in the same markets as Kwirmak and Breskko.

Breskko Group

Consolidated statement of profit or loss

For the year ended 31 March

	2026 E\$ million	2025 E\$ million
Revenue	3,016.0	2,744.6
Cost of goods sold	(1,026.7)	(903.5)
Gross profit	1,989.3	1,841.1
Selling and administration	(59.7)	(55.5)
Research	(329.4)	(312.9)
Operating profit	1,600.2	1,472.7
Finance costs	(112.0)	(112.0)
	1,488.2	1,360.7
Tax expense	(342.3)	(313.0)
Profit for the year	1,145.9	1,047.7

Breskko Group

Consolidated statement of changes in equity

For the year ended 31 March 2026

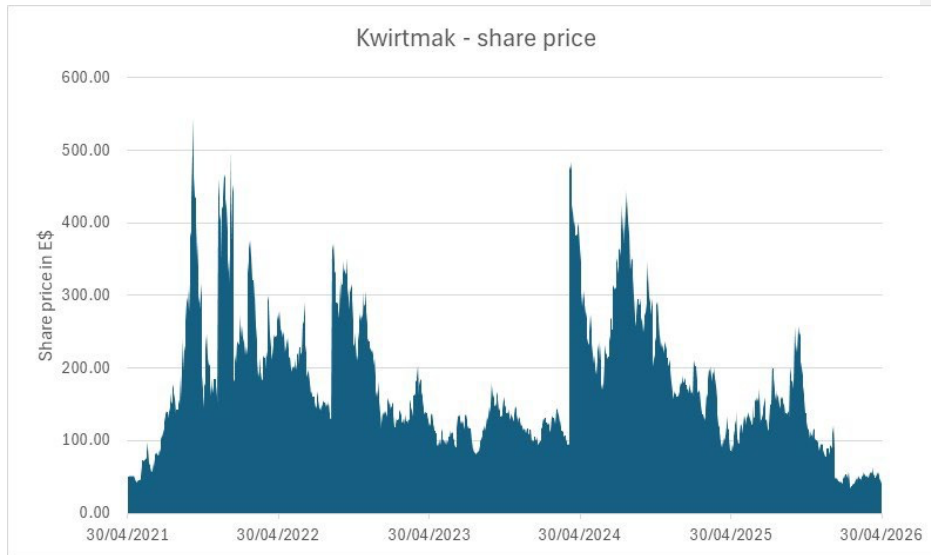
	Share capital E\$ million	Currency reserve E\$ million	Retained earnings E\$ million	Total E\$ million
Opening balance	250.0	228.7	2,463.9	2,942.6
Currency loss		(11.3)		(11.3)
Profit for year			1,145.9	1,145.9
Dividend			(799.4)	(799.4)
Closing balance	250.0	217.4	2,810.4	3,277.8



Breskko Group
Consolidated statement of financial position
As at 31 March

	2026 E\$ million	2025 E\$ million
Assets		
Non-current assets		
Property, plant and equipment	3,571.8	3250.3
Goodwill	212.4	212.4
Other intangible assets	600.3	575.4
	4,384.5	4,038.1
Current assets		
Inventory	345.0	343.6
Trade receivables	257.8	234.6
Bank	124.6	118.7
	727.4	696.9
Total assets	5,111.9	4,735.0
Equity		
Share capital	250.0	250.0
Currency reserve	217.4	228.7
Retained earnings	2,810.4	2,463.9
	3,277.8	2,942.6
Liabilities		
Non-current liabilities		
Borrowings	1,400.0	1,400.0
Current liabilities		
Trade payables	91.7	79.3
Tax liability	342.4	313.1
	434.1	392.4
Total equity and liabilities	5,111.9	4,735.0

Kwirmak's share price history



Kwirmak's beta is 2.3

Commented [TCS13]: Share Price Performance

- Highest: \$550
- Lowest: \$40
- Closing price: \$50

Overall Analysis

- Share price depicts a decreasing trend since 2024
- * Beta of 2.3 depict high volatility
- + Large spikes & collapses
- * Adverse financial performance
- + Falling revenue, profit & margins
- + Weaker than Breskko, which improved financially
- > Loss of investor confidence
- Increased the dividend payout to 53%
- * To support the share price in the S/T
- * Shouldn't the company reinvent?
- + Product development
- + Commercial recovery
- + Competitive response
- The SP have been re-rated from a high-growth to risky
- * Weak growth expectations
- * Weak future earning potential
- + Less attractive investment

Probable Exam Scenario

- Risks Vs. share price
- Options Vs. share price
- Managing a share price drop
- Managing shareholder concerns

Syllabus areas tested

- Efficient market hypothesis (F3)
- Risk Management (P3)
- Mendelow's Matrix (E3)

Commented [TCS14]: Beta: 2.3

- Shares are highly risky relative to market avg.
- * Very high share price volatility
- * Share price reacts sharply to good/bad news
- * Due to KM's high risk exposure
- + Volatile sales demand & earnings
- + Exposure to economic, inflation & interest % risks
- + Intense competition
- + Product quality & SW failure risk
- + Dependence on 3rd-party suppliers
- + Dependence on material availability
- + Regulatory, HnS, & environmental compliance risk
- Sustainability claims may be questioned
- Falling revenue, profit & margins in 2026
- Weak recent share price trend
- * Market is less confident about growth potential
- Attracts risk-tolerant investors
- * Ke is likely high
- * Shareholders demanding a high return for high risks

Probable exam scenario

- Evaluate risk exposure & strategies to mitigate

Syllabus areas tested

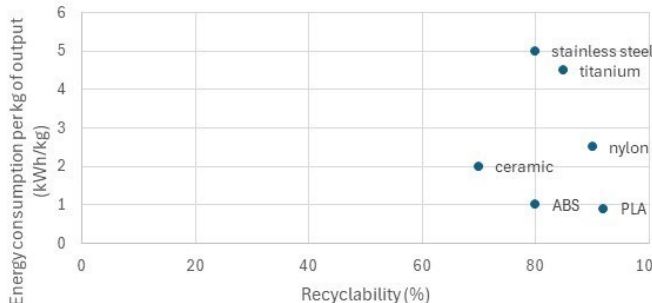
- Beta Vs. CoC (F3)
- Beta Vs. Share Price (F3)
- Risk management (P3)
- Reacting to a share price drop (E3)
- Improving SH confidence (E3)
- Risks Vs. Share price (E3/P3)



Kwirmak's sustainability

Governance	Kwirmak's Operations Director has a specific responsibility for the oversight of sustainability issues. The Operations Director is expected to report on sustainability issues at all routine Board meetings. Kwirmak also has a Risk and CSR Committee, which monitors sustainability issues on behalf of the Board as a whole.
Strategy	3D printing offers several benefits for the promotion of sustainability in comparison to traditional manufacturing methods: • Efficient use of materials – The additive nature of 3D printing generally uses less material than traditional manufacturing, which often starts with a larger block of material and removes material to create an item. • Recycling – Many of the plastics used in 3D printing can be recycled as new filament. • Carbon footprint – 3D printers can be located close to the point of use, allowing components to be manufactured nearby, eliminating the need for transportation.
Risk management	Kwirmak takes care to ensure compliance with all environmental legislation. All staff are trained in environmental issues relating to their roles and are encouraged to report any concerns. Kwirmak engages with government and other regulators with a view to assisting in the development of realistic and effective sustainability targets. All staff are empowered to halt operations in the event of any serious environmental concerns, such as excessive emissions.

Commented [TCS15]: Kindly note that a comprehensive analysis concerning the sustainability report is extensively detailed in the following pages. Scroll down for an enriched understanding of these areas.

Metrics	Kwrtmak pays close attention to the impact of the machines that it sells on the environment. It aims to enhance the sustainability of its printers in use by customers. For example, the energy consumption associated with printing with PLA was reduced by 32% through adjustments to the nozzle temperature and the thickness of layers in building up items. Comparison of energy consumption and recyclability of 3D printing materials <table><tr><th>Material</th><th>Recyclability (%)</th><th>Energy consumption per kg of output (kWh/kg)</th></tr><tr><td>stainless steel</td><td>80</td><td>5</td></tr><tr><td>titanium</td><td>85</td><td>4.5</td></tr><tr><td>nylon</td><td>90</td><td>2.5</td></tr><tr><td>ceramic</td><td>70</td><td>2</td></tr><tr><td>ABS</td><td>80</td><td>1</td></tr><tr><td>PLA</td><td>90</td><td>1</td></tr></table>	Material	Recyclability (%)	Energy consumption per kg of output (kWh/kg)	stainless steel	80	5	titanium	85	4.5	nylon	90	2.5	ceramic	70	2	ABS	80	1	PLA	90	1
Material	Recyclability (%)	Energy consumption per kg of output (kWh/kg)																				
stainless steel	80	5																				
titanium	85	4.5																				
nylon	90	2.5																				
ceramic	70	2																				
ABS	80	1																				
PLA	90	1																				

Evaluation

1. Governance

- Reasonable basic governance structure for sustainability
 - OD responsible for sustainability oversight & board reporting
 - Executive ownership
 - Risk & CSR Committee provides board-level monitoring
 - Formal oversight
- Yet, governance framework appears immature
 - No indication of whether:
 - Board / committee members have sustainability expertise
 - Sustainability is linked to executive remuneration
 - Formal internal controls exist on sustainability reporting
 - No indication of:
 - Board-approved long-term sustainability targets
 - Robust assurance processes
 - Detailed sustainability KPIs



2. Strategy

- Sustainability strategy has some credible foundations
 - Highlights advantages of additive manufacturing
 - Lower material waste
 - Recyclability of some plastics into new filament
 - Possibility of producing closer to the point of use, reducing transport
 - Valid benefits compared with traditional subtractive manufacturing
- Yet the strategy is narrow and selective
- Sustainability is framed as an operational & compliance matter than as a strategic priority
- Disclosures do not show how sustainability shapes:
 - Long-term investment decisions
 - R&D priorities
 - Sourcing strategy
 - Factory design
 - Competitive positioning
 - Long-term value creation
- No visible transition plan
 - Moving from current position to a more sustainable model
 - Resilience of the business model under:
 - Tighter regulation
 - Carbon pricing
 - Changing customer expectations
- Strategy understates the company's real footprint
 - Less info about the environmental burden of:
 - Running global factories: High transport emissions
 - Sourcing materials internationally: Depends heavily on 3rd-party suppliers
 - Complex manufacturing processes
- The material mix weakens broad green claim
 - PLA appears relatively favourable
 - Metals: Extraction & processing
 - Ceramics: Fired after printing
 - Nylon & PLA: Low recyclability



3. Risk management

- Good operational risk practices
 - Complies with environmental legislation
 - Trains staff in environmental issues
 - Encourages reporting of concerns
 - Engages with regulators
 - Empowers staff to halt operations if environmental concerns arise.
 - Sustainability risk being considered in day-to-day control systems
- Yet, the approach is too compliance-led
 - Compliance is necessary, but it is minimum standard
 - Does not amount to sustainability leadership
- Disclosures say little about full life-cycle risks
 - Embodied carbon in components
 - Waste from failed prints
 - Packaging
 - Water usage
 - Factory emissions
 - End-of-life treatment of machines
 - Circular recovery of parts & materials
- Lack of visible value-chain thinking
 - Has not identified & assessed full environmental risks
 - Purchased materials
 - Global logistics
 - Customer use of printers
 - Disposal or recovery of machines & materials at end of life.
 - Heavily dependent on 3rd-party suppliers
 - Yet disclosures focus on quality standards
 - Not environmental / ethical sourcing standards.
- There is little discussion of the social side of sustainability
 - No mention of:
 - Workforce capability
 - Safe handling & use of printers & materials
 - Supplier labour standards
- Societal implications of its products & supply chain



4. Metrics and targets

- Disclose one quantified improvement
 - 32% reduction in energy consumption of PLA printing via process adjustments
- Yet, no evidence of a broader sustainability measurement framework
 - Scope 1, 2 or 3 emissions
 - Supplier emissions
 - Logistics emissions
 - Product-use emissions
 - End-of-life impacts.
- No evidence of:
 - Company-wide emission-reduction targets
 - Circular-economy goals
 - Recycled-content targets
 - Waste-reduction goals
 - Net-zero timelines
- Lack target architecture, such as:
 - Baseline year
 - Interim milestones
 - Target dates
 - Explanation of how progress will be tracked over time
- No evidence of:
 - External benchmarking
 - Which sustainability issues are considered most material vs. business model
 - Independent assurance
 - Robust internal controls
 - Weakens reliability, comparability & decision-usefulness of disclosures



Synopsis

Major shortcomings

1. Governance: Limited disclosure on governance quality
 - Structure exists:
 - OD responsible for sustainability oversight & board reporting
 - Risk & CSR Committee provides board-level monitoring
 - Little evidence of:
 - Board competence
 - Incentives
 - Controls & assurance
 - Materiality assessment
2. Strategy: Sustainability is treated as an operational & compliance issue
 - Should consider as a strategic driver of:
 - Long-term resilience
 - Investment
 - Supply-chain design
 - Competitive advantage
3. Risk management: Incomplete & selective sustainability disclosures
 - Focuses on the benefits of additive manufacturing & on customer-use impacts
 - Says less about the full environmental burden of its:
 - Operations
 - Global supply chain
 - Material choices
 - Full product life cycle
4. Metrics & Targets: Absence of mature metrics & targets.
 - Only focus on energy consumption & recyclability
 - Lacks:
 - Scope 3 reporting
 - Time-bound emission-reduction pathway
 - Net-zero commitment
 - Circular-economy programme
 - Target architecture

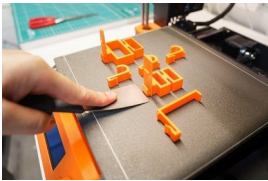


Recommendations

- Move from a narrative-based sustainability story to a more rigorous strategic framework
 - Disclose environmental impacts across Scope 1, 2 & 3
 - Introduce time-bound targets with baseline years & interim milestones
 - Develop clearer circular-economy commitments covering:
 - Waste
 - Recycled content
 - Refurbishment
 - End-of-life recovery
- Widen supplier standards
 - Assess environmental & ethical performance alongside quality
 - Report sustainability across the full product life cycle, including:
 - Sourcing
 - Factory emissions
 - Failed-print waste
 - Packaging
 - Water usage
 - Disposal
 - Differentiate sustainability by:
 - Material
 - Printing method
- Governance improvements
 - Strengthen board capability
 - Clarify accountability
 - Improve sustainability data controls
 - Link sustainability performance to executive incentives
- Support claims via external benchmarking by providing:
 - Clearer materiality analysis
 - Independent assurance
 - Move from compliance to strategic performance

Happy Comic

Readers' questions



Question: My dad has a 3D printer that he uses to make model soldiers. He has a huge collection and they are really realistic.

I have asked him to make me a new wheel for my bicycle, but he says that he cannot. Why is that?

Alice, age 11

Answer: 3D printers come in lots of different shapes and sizes and your dad's printer is probably just too small to build a bicycle wheel. Also, his printer is probably designed to produce plastic objects. A plastic wheel made by a large printer would probably be too weak to carry a cyclist's weight.

Some businesses use 3D printers just like your dad's to create small objects such as buttons and switches that need not be particularly strong. It is also possible to buy 3D printers for commercial use that can make larger objects, possibly using robust materials such as metal.



Question: My uncle restores old motorcycles. He often finds it difficult to find parts. On his current project, the bracket holding the speedometer in place was cracked and he couldn't find a replacement. He had a new one made by a specialist company that uses 3D printers. He says that the bracket they supplied is a perfect match for his bike. How did they do that?

Pranesh, age 12

Answer: The 3D printing company probably used a three-dimensional scanner to create an image of the old bracket. They might have had to edit the image a little to take out any cracks or bends in the metal. There are lots of different 3D printing technologies, some of which can create metal objects that can be quite strong.

Commented [TCS16]: The article highlights info about 3DPs

- Come in various sizes
- Commercial use
 - * Some create small objects
 - + Buttons
 - + Switches
 - * Some create large objects
 - + Uses robust material (metal)
- 3D scanners
 - * Damaged part can be scanned
 - * Edited in CAD
 - * 3DP recreates a precise part

General Analysis

- Commercial value of 3DPs depend on matching capability of printers to customer needs
 - * Printer type
 - * Size
 - * Material
 - * SW
- Unsuitable application create risks:
 - * Quality
 - * Safety
 - * Reputation
- Niche
 - * Manufacturing replacement parts
 - * Consumer mkt.s: Hobbyists

Probable exam scenario

- Expansion:
 - * Spare-part restoration
 - * Manufacture industrial replacement parts
 - + Automotive
- Recommending a wrong printer / material
- Diversification
 - * Offering scanning, CAD editing, bespoke part design
 - * Reverse-engineering service
 - * Targeting hobbyists/ consumer mkt.s
 - + New revenue streams to counteract revenue dip
- * Risks
 - + Data security & privacy
 - + Quality
 - + Safety
 - + Reputation

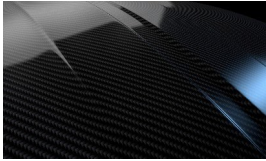
Syllabus areas tested

- Scenario Planning (E3)
- SAF framework (E3)
- Mendelow's Matrix (E3)
- Funding Options (F3)
- Demonstrating creditworthiness (F3)
- Investments Vs. Beta (F3)
- Investments Vs. Share Price (F3)
- Investments Vs. Stakeholders (E3)
- Risks Vs. Share Price (P3)
- Risks Vs. Stakeholders (P3)
- CSR & Ethics (E3)
- Sustainability (E3)
- Risk identification & Mitigation (P3)
 - * TARA framework
- Updating the risk register (P3)
- Internal controls (P3)
- IA responsibilities (P3)

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Growing demand for carbon fibre



Manufacturers of carbon fibre are reporting strong demand for their product, which is used extensively in industrial applications that require materials that combine light weight with strength.

Carbon fibre consists of very thin fibres made from organic polymers (plastics) that can be woven into fabrics or combined with resin and built up in layers to create composite materials. In either form, carbon fibre is both light and strong and so can be used in a number of ways.

In the automotive and aerospace industries, carbon fibre can be used to make car body parts or aeroplane wings that reduce the weight of vehicles or aircraft without compromising on build quality. Further uses are emerging, including the manufacture of sporting goods such as tennis rackets or bicycle frames that combine light weight and rigidity.

Commented [TCS17]: This article is about Carbon Fibre

Carbon Fibre (CF)

- Strong demand
 - * Extensive industrial applications
 - + Car body parts
 - + Aeroplane wings
 - + Sporting goods: Tennis & Cycling
- Light weight & strong
 - * Weaving into fabrics
 - * Combining with resin
- Can make stronger combined material

Probable exam scenario

- M&A: CF supplier
- Post M&A issues
- Investments to produce CF based printers
- Sustainability arguments
- Supply chain issues
- Product failure Vs. risks
 - * Reputation
 - * Legal
 - * Product liability

Syllabus areas tested

- Scenario Planning (E3)
- SAF framework (E3)
- Mendelow's Matrix (E3)
- Funding Options (F3)
- Changes to business ecosystem (E3)
- Change Management (E3)
- M&A Vs. Share Price (P3)
- M&A Vs. Stakeholders (E3)
- M&A negotiations (E3 & P3)
- Competitor Analysis (E3)
- Company valuation (F3)
- Risk identification & Mitigation (P3)
 - * TARA framework
- Risks Vs. Share Price (P3)
- Risks Vs. Stakeholders (P3)
- Updating the risk register (P3)
- Internal controls (P3)
- IA responsibilities (P3)
- Ethics (E3)
- Sustainability (E3)
 - * KPIs

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Medical profession making greater use of 3D printing



Doctors and dentists have been using artificial body parts to treat patients for many years. Perhaps the most common is the use of **dental implants** to replace lost teeth and enable patients to keep their smiles.

Medical implants are used widely in treating a range of conditions. For example, patients with serious heart problems can be treated by replacing their worn or **damaged heart valves with artificial valves**. Lost or injured limbs can be replaced with **artificial limbs**.

These replacements require considerable skill in their creation. They **must be a perfect fit** for the part that they are replacing and be **free from manufacturing defects**. Skilled technicians use measurements provided by dentists or doctors to fabricate those parts. Waiting for parts to come from the laboratory can delay urgent treatment.

Doctors and dentists are becoming increasingly reliant on 3D printing to speed up delivery of these products. The technicians enter the details provided by the medical experts into **3D CAD software** and that **interacts with a 3D printer to create** the required parts. This is both **faster** than traditional manufacturing processes and more **accurate**.

The **materials that are being used** in these medical applications have all been **submitted to the Ennlandian Health Service (EHS) for approval**. They are **not permitted for use until the EHS experts have made sure that they are safe** for use with patients.

Commented [TCS18]: The article highlights info about uses of 3DP

- Doctors & Dentists use 3DP to create bespoke parts
 - * Replacing worn out heart valves
 - * Creating artificial limbs
 - + Must be a perfect fit
 - + Should be free from defects
 - + Made only from EHS approved materials
- Process
 - * Technicians enter details to CAD SW
 - * Guidance provided by medical experts
 - * 3DPs create final part
- Benefits
 - * Accurate
 - * Faster treatment
- Material used should be approved by the Ennland Health Service (EHS)

Possible exam scenario

- Expansion to medical 3DP
- M&As
 - * Medical device manufacturer
 - * SW developer
 - * Hospital group
- Product failure
 - * Reputation risks
 - * Legal risks
 - * Regulatory risks
- Changes in regulation
 - * Disclosure requirements
 - * Risk exposure
 - * Corporate Political Activity (CPA)
- Ethics: social benefit Vs. access

Syllabus areas tested

- Scenario Planning (E3)
- SAF framework (E3)
- Mendelow's Matrix (E3)
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- Internal controls (P3)
- IA responsibilities (P3)
- Ethics (E3)
- Corporate Governance (E3)
- CPA (E3)



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