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Author comments:

The Product Design Brief has been laid out in no particular order. This is because no one specification is more important than another.

Many of the documentation rely on other documents to form a complete specification, so the system should be reviewed in its completeness by all project departments.

Installation

Considerations need to be made with regards to who and how the product is going to be installed / first used.

As the product is portable, will it be usable out of the packaging, or will some set up procedures need to be followed?

Considerations regarding the following must be made:

- Battery powered portable devices might need to be properly charged before use.
- Will the product need to be calibrated prior to first use? Will this calibration still be valid if the unit is stored for a prolonged period between manufacture and first use?
- Will a skilled/trained person need to set up the equipment?
- What first use instructions will be issued with the product?
- Will the product include any safeguards to ensure proper first use / installation processes are followed?
- Will the unit be able to be powered the same regardless of location?? I.E. It is assumed a universal power source for portable products would be USB / USB or similar, this would be globally available but the mains adapters would be dependent upon the region where the product would be used.
- Will the unit have to interface with external outputs such as computers or systems? Will the software and hardware used be compatible? Will interface hardware / software be needed?

Maintenance & Repair

How long is the device designed to remain operational? (Max amount of operations / time in years)

In its typical usage, what would be the unit's usage? (?? operations per day, ? days a week, ?? weeks a year).

We need to consider if the product will require any maintenance.

If the product is battery charged, how often will it need to be plugged into a power supply.

Do we need to allow for any cleaning operations? Can we supply a consistent and reliable sample from the user, or will contamination become an issue if it is not cleaned?

If the unit is to be cleaned, we will need to advise how often. Will this be an operation after every test sample? After every 100 samples? Or is time more a factor with the unit needing daily / weekly / monthly attention?

How much maintenance will the user tolerate before it is seen as an inconvenience.

Will the unit be sealed for life with no spare parts offered? Consideration needs to be given to parts such as batteries that have a service life.

Can the unit be repaired but only by certified staff? Will we use special tools or anti-tamper equipment to ensure the customer remains compliant with the business decision?

Will we offer customers an extended warranty which includes a comprehensive repair?

What instructions will be included with the packaging and manuals to ensure the users are aware of the maintenance to be conducted?

Environment

Operating temperature range - Maximum / Minimum

Considerations to the countries it will be in service. i.e., Will it always be used inside in a comfortable climate, or could it be used outside in Dubai / Alaska?

Survival temperature range – Maximum / Minimum

Could the unit experience temperatures that are extreme, but it is not required to be operational, only survive? i.e. inside a locked car that is in Dubai, in an unheated storage warehouse in Greenland.

Pressure range – max / min

Will the unit see service in public transport such as an aircraft? Could it be used in survey or military submarines?

Humidity – Max humidity% @ ?? temp

Could the unit see environments such as tropical, or high humidity levels if near the coast?

Shock Loading – Max G force

Should the unit survive being dropped? From what height? Is the user 6 feet tall?

Dust and sand – max grit size or IP rating

Will dirt contamination hinder the operation of the unit?

Are there any special circumstances to consider? Hospitals and medical facilities that could benefit from this type of device often use radiation within medical treatments. Would this device be exposed to any radiation environments and still work?

The use of chemicals in the medical environment used for cleaning and treatment might also offer some consideration within the design.

Environmental noise – If audio prompts are going to be used to notify when a sample has been received or when test results are in, will the user hear it?

Will the unit be subject to any vibrations that it is expected to withstand? These could be from being placed upon other equipment whilst in use, transported in a car, being put down by a user.

Materials and chemicals used in the production, storage and packaging of the device could result in accidental consumption by the user on first issue. Consideration should be taken to ensure all materials (directly in production or within the production area) cannot contaminate the product. This can be done via cleaning operations after production, or clean work areas that are free from harmful contaminants.

While the above is for guidance, it is worth considering that too high specifications may hinder the smooth progress of product development and add cost. Consideration should only be given to realistic environmental conditions and where limitations exist due to cost or technology etc. Environmental conditions can be published on the units data sheet.

Performance

First, we need to fundamentally identify what it is we are looking to achieve. For example, in the development proposed, we are looking to detect the presence of viral infection within a supplied sample.

How are we going to do this? What are the key parts that are vital for the primary operation of the unit?

Will the product be portable or stationary?

What power supply will be used? If the product is portable, what size of battery will be needed? We will need to consider the number of operations the system will carry out on a single charge, the system voltage, standby time, and re-charging.

What voltage will the systems operate on? Are we considering using standard interfaces such as USB/USB-C or will our system use its own interface / power connection?

How long will the user be expected to wait between providing a sample and the test results being issued? Is it reasonable for a user to wait 5 seconds or 500 seconds?

What will the supplied sample look like? i.e. you cannot expect someone who is ill to exhale into a machine for 150 seconds.

Will the unit be handheld or hand operated? If hand-held, what weight and size would be reasonable for someone to use it. If hand operated, would it still be portable?

What would the testing accuracy be? Would the accuracy be enough to confidently prevent a passenger boarding a plane?

What would be the frequency of operation? Would this device be expected to test a whole crowd, within a time frame or would it be used to check individuals on an ad-hoc basis.

What will the human interface look like? Would there be buttons and a screen / LED's / audio notice?

Will the output need to be confidential to the operator only?

Will there be any need for a live feed or connection to a wider system / database (such as a patient database?)

Are there any durability considerations that can be quantified within its performance? Such functionality remains unaffected when exposed to ?? g impact force?

Packing and Logistics

For this we need to consider where the unit is going to be transported. Will the product be for the domestic market only, or will it be required to travel further afield using air or sea freight?

The type of packaging is key to use. We need to review:

- The marketing and product information on the exterior of the packing
- The protection the packaging will need to offer:
 - Moisture
 - Vibration
 - Impact
 - Altitude
 - Crushing
- If products are to move across borders, what/if legislation marks will be needed?
- The unpacking experience. i.e., will the user manual be the first thing the customer removes from the box? Will the product be presented first out of the box?
- Materials used for packing; Will it offer the protection needed? Is it recyclable? Consider what cost it adds to the product.

Weight is a very important factor, not just for the use and ergonomics of the unit, but with regards to the cost to ship to the end user. It would be a pointless exercise if the product's cost was mostly shipping fees.

Consideration should also be given to the packing volume. Is a standard box or pallet that would reduce the transport cost something that we should try and comply with? What quantity could we package the product into to make the most of the space available?

Does the company have established shipping routes they use for current product dispatch or is this new to the company shipping route to reach our target customers.

Materials

Consideration must be given to the materials used in the construction and packing of the product.

The product needs to reflect the target aesthetics and user needs. Consideration to the user's feel and perception.

The material needs to fulfil its primary function of the design.

i.e., Will the case be made from a type of plastic? If so, will it be injection moulded, vacuum form, 3D printed etc?

What standards are going to be used (BS, ISO, DIN etc)?

How will the material be sourced? Check with suppliers to ensure materials sourced are ethical in their procurement? Do we want to support locally produced materials and components?

What legal responsibility will we have to adhere to with regards to the product standards, our customers and the area of supply?

Are there any expectations to comply with industrial standards and specifications within the target market?

What internal experience do we have with materials? Do we already have a supply chain of parts that will support the new development?

Do we have the knowledge in-house to review the materials, or should we consider using external knowledge to specify the materials best suited for the applications?

Processes

If the design requires it, then special processes should be accommodated in prototype and production.

Some processes will already be known and used within the current production process however, any new processes needed will need to be clearly defined such as plating, painting, wiring, coating, sealing, etc.

Also, consideration will need to be made to ensure the process conforms with any legislation that may be impacted by the processes being used.

Project markers & Milestones

Project timing and milestones need to be agreed with all departments to ensure that realistic and adequate timing are budgeted in ensuring a realistic project goal.

Throughout the project, the timing should be reviewed to ensure it is still relevant and aligns with the program goals.

Within the project timing, allowances should be made to ensure the project is progressing as desired and can continue. The phrasing of these points varies from industry to industry, but can be referred to as “milestones” “project gateways” “approval points” etc.

The project timing should consider points such as:

- Engineering design development and review
- Samples lead time
- Testing, review and certification
- Marketplace knowledge gathering
- Strategic product launch (first to market, target customer contract renewal, trade show product launch, global events)
- Manufacturing and industrialisation activities
- Project funding points
- Customers’ expectations
- Competitors product timing

Often a failure of project timing is due to lack of timing allocations. It is vital to ensure that all parties agree on the program timings at the beginning of the project.

There is often a conflict of interest between engineering time needed, target launch dates and customer expectations etc. Whilst pressure is often applied to engineering to reduce the timing needed, it must be noted that the customer relations representative must also ensure they manage the customers expectations with regards to realistic timing.

Quantities

Prototype quantities need to consider,

- The number of prototype phases.
- The objectives and testing we wish to achieve within each prototype phase. I.E. – Product lifecycle testing, IP testing, legislative testing, customer/ presentation samples.

Production quantities are:

First 3 years: no more than 750,000 / year

After year 3: 3,000,000 / Year

Are we able to refine this? Typically, new production would see a gradual production ramp up to a stable position. This stable position can vary from product and industry.

A detailed forecast would support the allocation of manufacturing resources and offer instructions where investment and resources are needed.

Clear forecasting also supports the project finances allowing accurate project profitability data and return on investment for any capital investment.

Product life span

How long is the item expected to work and what are we using to measure this?

Is this something that is measured in time or operations?

If we are using time, how often in a day is it expected to be used? How many times a week? How weeks a year etc.

What testing are we going to do to confirm the product's life testing?

What are the customers' expectations for service life?

What service life do our competitors offer?

Testing

What testing in development will be done?

The product development will need to confirm that materials and components received by any selected external suppliers meet the specification provided. To confirm this, parts received will need to be inspected and confirmed that they are to the specification and fit for purpose. We need to consider the tests that the components will be subjected to and confirm that they are as specified.

Testing will also need to be conducted upon any prototype parts built during the design process. This will be to verify that the development is meeting the design parameters as outlined by the product design specification. We will need to consider what we will be testing and how the test will be achieved.

During production, testing will need to be conducted to ensure the quality remains to the standards specified. These tests should be specified as part of the design process and incorporated into the production and assembly method.

Ergonomics

The technology used as a foundation of the new product is an alcohol breathalyser, typically used in law enforcement and by its nature portable / handheld in design.

Is this portability something that would be carried forward in the new product? If so, consideration bias to this needs to be taken into account when reviewing the product's ergonomics.

Human interface:

How will the product be held or used?

Will any textured surfaces or friction materials be used to aid grip?

How much weight will the user be expected to move the product and from what position, when using the product?

How will the user interface with the product when in use?

Will the interface use buttons? Touch screen? Voice commands? Pre-programmed operation when a sample is given etc?

How will the user receive the output? LED lights, screen interface, audio indication, interface with another device (Bluetooth phone or Wi-Fi computer etc)?

Will the user be expected to hold and operate the device at the same time?

Can the functions be done with a single hand, or will two-handed operations be needed?

Will the sample be taken via a breath? How is that sample being collected?

If an operator is needed to collect the sample, will they be at risk of viral contamination from the subject offering the sample?

Is an operator needed, or can the device be used by an unskilled person providing the sample?

How will the unit be stored when not in use? i.e. If portable will it have a holder? Will this holder be mounted to a typical unit of clothing (i.e., Belt, clip onto shirt, lanyard) or will it be stored away from an individual (in a drawer, desk, glovebox ...)?

How will the device collect samples from multiple sources without cross-contamination of the subjects? i.e. If using a collection tube as per a traditional breathalyser device, will this be swapped out for each new sample? Will there be a cleaning operation needed between user interfaces?

Aesthetics

Initial customer interface with the product often sets the impression moving forward.

Often, if the consideration looks fit for purpose it probably is; however, initial opinions can go beyond this, setting the customers opinion on build quality functionality, brand identity and can ultimately sway the buyer's purchasing decision.

The first image the customer will see is the external packaging that will hold the product. This is the first opportunity to start presenting the brand image and give the customer the correct impression. This first image can be bright, eye-catching and flashy, it could be basic and functional or could be clean and minimalistic in design.

This first impression then extends to how the product is presented within the packaging with its accessories. Function to ensure safe transport is key, but again this is another opportunity to project the company image moving forward. A champion of this first customer interface are brands such as Apple, who look to control customers' unboxing experiences, even down to the sound made when opening the product.

Now the unit itself can portray several different images depending on your end user. We will need to consider materials with regards to their texture, presentation, colour, shape, weight.

On occasions this might not always work the way a product designer intended, such as when making a hand-held unit as light as possible, it may result in the user feeling that it is flimsy. Using bright colours to attract a customer visually to a product might not fit in with an organisation's image, such as the military.

Button positions and style, the force needed to depress the buttons and if they will click or not, all add layers to the product's aesthetics that could attract or repel a potential customer.

Speaking with target customers will support this activity, along with a review of other devices being used in the target market. How they appear and why the customer likes them will help provide the direction in developing the products final Aesthetics.

Standards, Specification, Compliance and Legal

What market is the product designed for?? Is it in the USA, EU, UK, Asia etc? Each market has its own standards that should be adhered to.

While many of them have similarities, it's important to obtain a copy of each applicable standard and cross-correlate them before the project design starts.

Attempting to retrospectively apply the applicable standards will hinder the project and add unnecessary cost and time to the project.

Often industry standards will prevent a buyer sourcing a product even if it is a better solution, but without the correct certification.

What industrial standards will the new unit need to conform to?

Examples of standards relating to the existing production:

- FSS-BAU-3/02 EMC Immunity Test Procedures for Breath Alcohol Measuring Devices (2002)
- BS EN 61000-4-1:2007 - Electromagnetic compatibility (EMC). Testing and measurement techniques. Overview of IEC 61000-4 series
- OIML R126 Edition 2012 (E), Evidential breath analysers
- BS EN 60068-2-6:2008 - Environmental Testing. Tests. Test Fc - Vibration (sinusoidal)

A detailed list of all applicable industrial standards will need to be compiled for review.

Regulations and directives will need to be considered, this could include but not limited to:

- Energy Labelling Directive
- General Product Safety Directive
- In-vitro Diagnostic Medical Devices
- Low Voltage Directive
- Medical Devices Directive
- Measuring Instruments Directive
- Restriction of Hazardous Substances Directive (RoHS)
- The Batteries Directive
- The CE Marking Directive

To ensure we are compliant with all the relevant legislations, we need to understand all that applies to ensure the design is influenced from an early stage.

When selecting the applicable standards and directives we should consider:

- Where is the product being sold?
- Does it have safety implications?
- What industry will it serve?
- What does the device do?

- Is it electrically operated?
- Product specific standards that might apply

It is also vital that considerations are given to the product development with regards to the legal implications.

Any product defect can result in legal action against the company and must be considered from the beginning of the project process.

Any defects that occur within the specification can carry forward into the design and subsequently into manufacture. Because of this, it is vital that the specification is refined and correct before we proceed.

Literature and Patents

All sources of available data should be exploited at the beginning of the project.

It is important to ensure our design does not infringe upon any registered patents or trademarks. Becoming aware of this from an early stage allows the design to accommodate this and incorporate any knowledge gained from research gathered.

Considerations need to be made to the product's shape, markings, technology, marketing material, names, colours and patterns.

Costs

All costs should be considered against the overall company objectives of growth and financial targets.

Unit pricing:

What competitors' products are on the market and what is the spread of the customer price with the relation of the products' success.

How are our competitors justifying the cost of the unit? Quality, technology, reliability, price point, ease of use, low maintenance, etc

How does our development compare to that on offer by our competitors? Will our product have unique features? Will some features be omitted due to reduced overall cost?

Do we know where and how our competitors are manufacturing the units? Low-cost global manufacturing locations often have inherent risks such as security of supply, consistent quality etc.

What reputation do our competitors have in the marketplace compared to ourselves? Are we able to apply a premium price due to the perception of premium products (such as Land Rover, Rolex) or do we trade on low cost (such as Lidl, Dacia)?

What have our existing customers said would be a fair price regarding the additional functionality? Will this new product even apply to our current customer base?

Have we attempted to interface directly with our target marketplace? Are we talking to the correct people (buyers not users)? What pricing and volume would the target market consider? Would it be worth asking the target buyer what they would consider a high price, average price and a buy it now price would be?

Does the unit need to be "sold" to the customer? Is it an option to look into alternative business methods that present regular income such as lease or serviced contracts with customers?

Development costs:

How much engineering / design time and cost will be needed? Will we base this on set milestones such as concept design, product refinement, prototype, design for industrialisation, pre-production validation and certification, start of production.

Prototyping product costs? At what stage and how many units will be needed? Given the low quantities, what costs would be considered for a prototype unit? What testing will the prototype unit be subject to? Can the testing be done in house or externally due to equipment / workforce skills etc? How much will this testing be?

Development protection costs:

Will any of our development need to be protected? Will patent protection need to be applied to any new design, process or principles developed? Will any costs be set aside to defend the patents? Are there existing patents that we will need to break to manufacture safely and the cost to do this? Is it worth using patented designs to our advantage and pay royalties for its use?

Will the product be using any trademarks that are in place or will new trademarks need to be applied for?

Manufacturing Costs:

The ability and cost of manufacturing and assembling the equipment from component parts compared to using bought in sub-assemblies.

Producing our own assemblies could mean reduced component costs however, greater tooling, workforce skills and overheads. Using companies who already have experience in manufacturing components and sub-assemblies needed, could reduce capital equipment costs, improve quality due to experience and simplify the supply chain.

Given that the company already produces gas analysis equipment, consideration must be given where our own product knowledge aids the new design, where existing production equipment and processes can be utilised and when it would be beneficial to seek external sub-assembly suppliers (such as within some of the new electronics).

Will the product share any components or assemblies with the current breathalyser that it is based upon? We will need to consider the advantages of cost reduction using common parts in greater volume compared to the limiting factor that might be imposed in design or functionality.

Capital Costs:

Despite potential opportunities to use common parts, there will still need to be a consideration to capital costs for internally produced components.

Tooling might have to be modified, or new tooling produced to meet the new product design. Additional equipment to meet new manufacturing needs may also be needed.

In addition, consideration towards the existing equipment's capacity needs to be reviewed. Can the current equipment meet its current demand and the new volume introduced?

Where equipment is to be used on existing and new products, detailed volume profiles and forecasts need to be generated to review the capacity. Where capacity exceeds the ability of existing equipment, it may be necessary to invest in a new plant or existing plant improvements.

If production changes are needed for the new product, then it might also be necessary to change the production layout to use shared equipment or additional manufacturing space, to accommodate new machines. Equipment downtime, site changes and any supporting infrastructure costs should also be considered.

Logistic costs:

A review of potential storage, warehousing and packing costs need to be considered.

If products are going to be shipped, how are we going to do this? Will products be shipped by road, rail, sea? The transport method will dictate the packing standard and the costs that will result.

The transport cost itself? Size and weight of a dispatch and the transport costs?

If selling outside of the manufacturing country, a review of import/ export taxes needs to be done.

Import cost of components and storage of components need to be considered when sourcing from outside the country of manufacture.

Project cost viability review:

When all aspects of costing are available a project viability study needs to be undertaken. This will need to confirm the development, production, overhead cost in relation to a realistic selling cost and forecast volumes.

For a viable project the team should review financial parameters such as gross profit / net Profit forecast, return on assets, return on equity etc.

Competition

A market review of potential competition and products in similar market sectors, are vital to understand how our product development is placed and the potential resistance that will need to be overcome.

Considerations must be made to competitors' offerings, how established they already are in our target market, the reputation they are trading on (i.e., quality, price, lead time etc) any patents that they might have established and trademarks.

Understanding our competition will allow us to incorporate the best attributes they are able to offer, while improving upon the weaknesses or customer issues that are present.

This exercise encompasses all aspects of the project team:

Finance – reviewing the competitors offering from a commercial bias to ensure any developed product remains competitive.

Marketing – Understanding the USP that the competition exploits in their product and how we can improve upon this. Understand how our competition market their product and make a decision if this is effective or if there is a better way to gain our customers attention.

R&D – Product review of the units available by the competition. Possibly buying a unit with the view of understanding how it works, what functions could be incorporated, how it can be improved upon. Review of how the unit is presented to the customer and its overall appeal.

Design and Engineering – Compare the competitor's product and review key solutions that might be present i.e., packing, power supply, protection of venerable components etc.

It is important to note that the task isn't to copy what has been done by the competition but understand how they are operating and how we can improve on what is already being done.

References

- Abdallah Mohammad Alshanty, Okechukwu Lawrence Emeagwli. (2019). Market Sensing Capability, Knowledge, Creation and Innovation: The Moderating Roll of Entrepreneurial-orientation. *Journal of Innovation & Knowledge*.
- Alex Milton, Paul Rodgers. (2013). *Research Methods for Product Design*.
- Bai Wensong, martin Johanson, Oscan Martin. (2019). Dual Business Relationships, Opportunity Knowledge, and New Product Development: A Study on Returnee Young Ventures. *Journal of international marketing*, 26-42.
- Batat, W. (2019). *Experiential Marketing* .
- Corallo, A. L., & Secundo, G. (2012). Inter-organizational knowledge intergration in collaborative NPD Projects: evidence from the aerospace industry. *Knowledge management research & practice* , 354-367.
- Dr Harris, J., Chen, Y.-H., & D.Y. S. (2006). Linking innovative product development with customer knowledge: a data-mining approach. *Technovation*, 784-795.
- Goverment, U. (2023, April). *Evidential Breath Alcohol Analysis Instruments: A guide to type approval procedures*. Retrieved from Gov.UK:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/362271/MEBTlguidV2.pdf
- Kahn, K. (2019). NPD process formality across global regions. *International journal of innovation science*, 129-139.
- Kyriakopoulos Kyriakos, K. (2004). Knowledge Stocks and Information Flows in New Product Development. *Journal of Management Studies*, 1469 - 1498.
- Piercy, N. F. (2017). *Market led Strategic Change* .
- Su, Chao-Ton ; Chen, Yung-Hsin ; Sha, D.Y. (2006). Linking innovative product development with customer knowledge: a data-mining approach. *Technovation*, 784-795.