# Design Criteria

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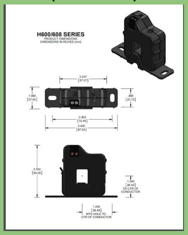
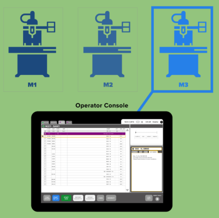
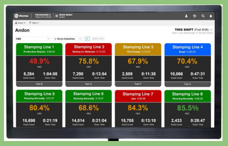
## Introduction:

Upon defining a problem statement, Team 7 compiled a table of various benchmarked products. Table 1 contains the metric and non-metric data from various companies and products. Using this data, a table of ranked design criteria and specifications was created.

| Company | Product/ Model | Cost (Specify) | Attributes | Constraints |
|---|---|---|---|---|
| Veris Industries | H608<br>(Sensor)<br> | $157.78 (USD) | - Monitors machine status through monitoring loads on vent, recirculation pumps, etc<br>- Dimensions: 87.63mm x 27.05mm x 64.26mm<br>- small<br>- Temp: -15 to 60 degrees celsius<br>- adjustable | - Pricy per unit<br>- does not come accompanied with an optimized software |
| CMMS Data Group | MP2<br> | Unspecified<br>Approx. +2000$USD | - Project equipment failures<br>- Organize and track inventory<br>- Manage equipment costs<br>- Track equipment history<br>- Schedule preventative maintenance tasks<br>- Allocate resources | - very expensive |
| ShopVue by Casco Development | Machine Monitoring Software<br> | $40,000 USD one-time cost plus a $299 USD setup fee | - Operator friendly; colour coded screens, touch-based, intuitive to use, configurable<br>- Uses direct machine interface to capture machine data automatically at frequent intervals<br>- Translates raw data from machines to usable metrics like OEE | - The system requires to have Windows/Android<br>- Expensive one-time cost |
| XL Productivity Appliance by Vorne | Machine Monitoring Software<br> Vorne<br>Andon<br>THIS SHIFT (First Shift)<br>Stamping Line 1 49.9% 8,284 1:04:08<br>Stamping Line 2 75.8% 7,290 0:13:54<br>Stamping Line 3 67.9% 2,509 0:11:38<br>Stamping Line 4 70.4% 10,066 0:47:31<br>Stamping Line 5 80.4% 15,698 0:21:19<br>Stamping Line 6 68.6% 14,014 0:21:04<br>Stamping Line 7 84.3% 15,705 0:13:10<br>Stamping Line 8 85.5% 2,433 0:28:47 | $1990 per system and 90 days free trial. | - Automated data collection<br>-Provides real-time machine monitoring<br>-Tracks machine history<br>-Provides downtime tracking<br>- Provides performance metrics<br>-Simple UI | -Does not provide cost tracking<br>-Does not support MAC OS<br>-No Quality control |
| Upkeep | Upkeep Solutions | $500-$54,000/ year | - Preventative maintenance<br>- Maintenance checklist that | -Can be expensive |

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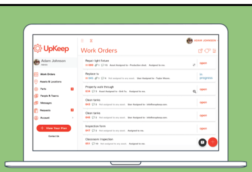
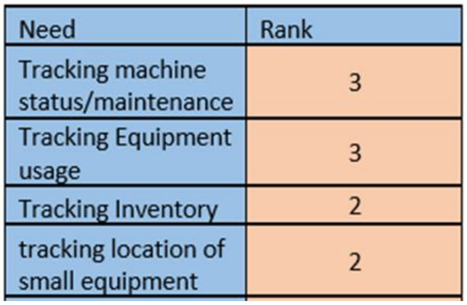
|  |  |  | aids technicians with what requires maintenance<br>- Shows current quantity of inv. and can set a minimum amount before an alert is sent<br>-Automates the process of assigning a technician to a machine<br>-Tracks depreciation rate of assets |  |

*Table 1: Benchmark Metrics*

| Needs | Design Criteria | Functional Requirements | Non-Functional Requirements | Constraints |
|---|---|---|---|---|
| Track machine and equipment maintenance<br>(Rank 3) | - Must track machine usage<br>- must be Small in size (mm)<br>- must be lightweight (g)<br>- must withstand various temperature (Degrees Celsius) | - Predicts when a machine will need maintenance<br>- Records when machines have had maintenance work<br>- Provides downtime data<br>- Calculates the overall equipment effectiveness<br>- Must provide real-time data | - Easy access<br>- Simple display<br>- Reliable<br>- Durable<br>- Accessible<br>- User-friendly | - Cost effective<br>- Adaptable to various platforms and machines<br>- Non-invasive |
| Machine and equipment usage and Data Analysis<br>(Rank 3) | - Must track machine usage<br>- Must collect data<br>- Must be compatible with different OS<br>- Must provide live data | - Provides downtime tracking<br>- Must provide performance metrics based on data analysis<br>- Must track cost | - Easy to use<br>- Easy to program<br>- Accessible<br>- Durable | - Needs to track the accurate information of the user<br>- Needs to browse through all the information to find the solicited machine/user<br>- Needs to find the exact location of the machine<br>- Needs to record the time when the machine was last used |
| Tracking Material stock, usage and location<br>(Rank 2) | - Can track the amount of material<br>- Must track the material location<br>- Must track material usage | - track amount of material used at a workspace(material/day)<br>- Tracks materials remaining<br>- Predicts when stock will run out (days) | - Easy to understand<br>-Simple code<br>- Easy to modify<br>- Reliable | - Needs to provide accurate date<br>- Must be easy to read, understand, and edit |

|  |  |  |  |  |
|---|---|---|---|---|
|  |  | - locates stocked materials |  |  |

*Table 2: Needs and Design Criteria*



| Need | Rank |
|---|---|
| Tracking machine status/maintenance | 3 |
| Tracking Equipment usage | 3 |
| Tracking Inventory | 2 |
| tracking location of small equipment | 2 |

*Table 3: Needs Prioritization*

## Design Specifications:

After compiling various benchmarked products, Team 7 has created a list of design criteria based on the needs listed in Table 3 and the design criteria, constraints, and functional/non-functional requirements defined in Table 2. The needs of greater importance were assigned a higher numerical value on a scale of 1 to 3. Based upon the research, a ranked list of the design criteria and specifications can be found in Table 4.

| **Rank** | **Design Criteria** | **Specification (If applicable)** |
|---|---|---|
| 3 | Consistent tracking of machine/equipment usage | Stores total runtime since last maintenance check; Run time: 12h |
| 3 | Must provide live data | Transmission Range: 5m to 10m |
| 3 | Must be small and lightweight | Size of hardware: 9cm x 5cm x 4cm to 12cm x 8cm x 7cm<br>Weight of hardware: 200g to 300g |
| 2.75 | Easily modifiable for different machines | Adaptability range: Must be adaptable to most machines |
| 2.5 | Knows the designated location for material and small equipment | A location is set by the user and is remembered by the program |
| 2.5 | Must withstand physical blows | able to remain operational despite bumps as it will be in a shop floor |
| 2 | Must be affordable | Cost: $100 to $200 CAD  too long |
| 2 | Must be capable of operating at varying temperatures | -15 to 60 degrees celsius |
| 1 | Must be compatible with different OS | OS: Windows, Mac, Android, IOS |

*Table 4: Design Criteria and Specification Ranking*

As observed in Table 4, the primary criteria were identified to be the system’s ability to track and store data, providing live data, size, weight and its ability to be used on various types of machines. These criteria were prioritized due to their direct relationship with the actual device and its functionality. On the other hand, criteria such as affordability and OS compatibility were placed lower on the list. It was determined that a product would be valued for its price to quality ratio. Fortunately, the CEED workshops function using Windows as their primary OS. The criteria in between were found to be necessary but not absolute.

## Lifelong learning and Conclusion:

While curating the design criteria and benchmarking real world products, Team 7 had some difficulty acquiring information from companies and manufacturers. Most of the companies that created relevant software, kept their pricing, metrics and specifications of their product hidden. The team had to infer what the product couldn’t do based on what was not publicly advertised. For example,  Ayesha had to research the individual sensors involved in the system and acquire the information (metrics) from a third party provider. Adam was able to gain information from the company website, but had to look for the cost on forums.

Most of the benchmarked software and hardware had their own advantages and disadvantages regarding various constraints, such as cost, runtime, durability etc. Considering all these criteria and constraints, the Team came up with a refined list of design criteria based on the needs of the consumers. Creating a list of design criteria tailored to the CEED managements needs was relatively easy. The team encountered difficulty comparing potential products to a competitors, and identifying ways to improve upon their product. The main advantage of Team 7’s product would be that it’s tailored for the workshops at STEM and that our solution will be much cheaper than the competition. However, it became obvious that some things had to be sacrificed to achieve a lower price. For example, the team’s product will not be factory made or undergo months and months of processing and editing. Where as, a big company may have access to enough resources and manpower to refine a product to that extent. Team 7’s product will use the knowledge gained by benchmarking to further improve the designs and specifications. This will ensure the product is of the highest possible quality whilst learning from what the competition had done wrong. This process helped in familiarizing them with the market and its customers. They also learned how the products may be evaluated in the field and how it would compare to current or preceding products. Thus, allowing them to better empathize with their clients and understand their design criteria.

# Works Cited

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