



# REACHE

A History Report

Prepared by  
MKTHINK

THINK<sup>MK</sup>



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# REACHE 3

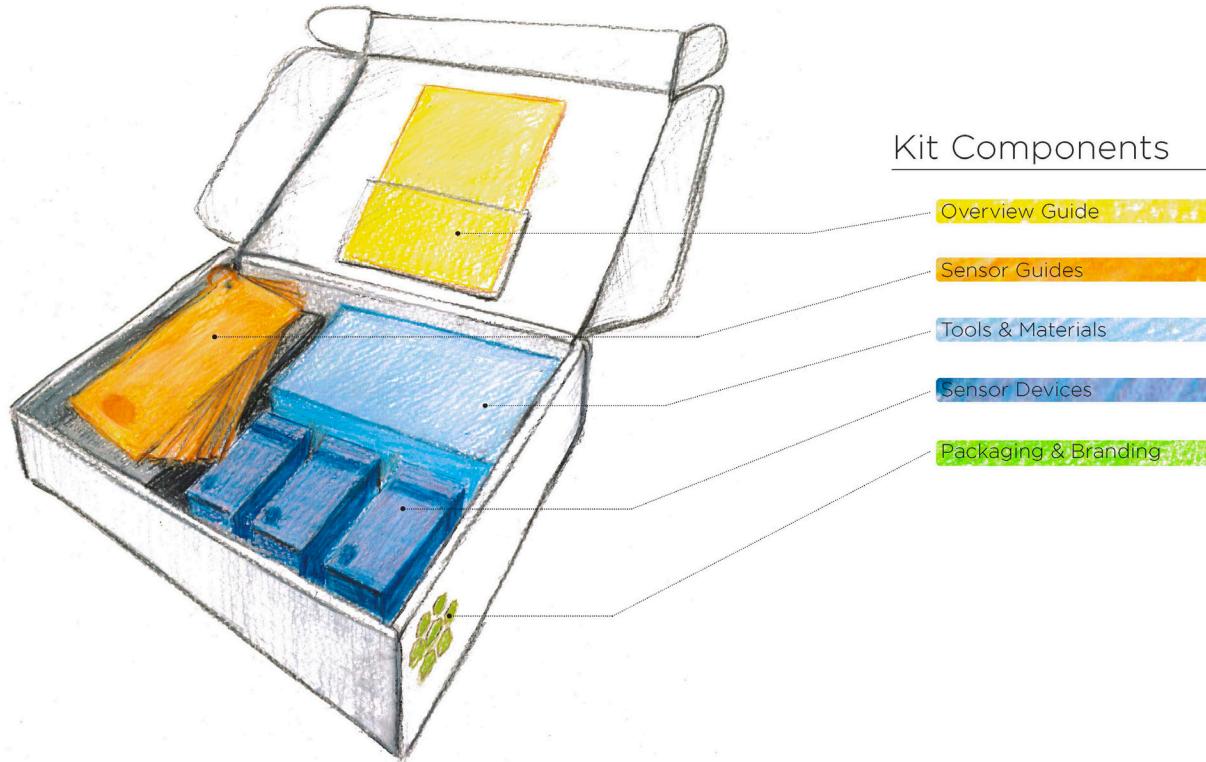
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# REACHE 3

REACHE 3 refined the sensor kit's design, functionality and usability and made it more accessible to a broader audience seeking to address issues of facility and/or resource use.



## THE PROBLEM

After deploying the sensor kit in Balikatan, MKThink recognized that the 4Daptive Database would need an even larger dataset to generate conclusive results. In order to increase data collection, MKThink made the sensor kit easy-to-use and intuitive for untrained personnel, so they could be installed rapidly and at scale.

Success in Balikatan encouraged MKThink to broaden its target market. MKThink realized the potential commercial applications of the REACHE logic set. If the relationships between the Cultural, Architectural, and Environmental factors affecting a business are understood, MKThink conjectured that similar operational and capital performance improvements, energy savings and cultural optimization can be realized.

## ■ ■ ■ ■ STATEMENT OF WORK

REACHE 3 focuses on the development of a quick-to-deploy that can be sent to remote areas of extreme environment and collect data related to resource consumption, environmental conditions, technology use, and cultural patterns.

The kit particularly focuses on the Environmental sphere of REACHE to inform energy-efficient solutions in the built environment. REACHE 3 honed the functional and design requirements of the sensor kit, ambitioning to commercialize the product.



## ■ ■ ■ ■ LOGIC

The REACHE 3 effort is motivated by the idea that energy consumption can be affected by a variety of Architectural, Environmental, and Cultural factors. By employing the REACHE logic, the tools developed in REACHE 3 seek to identify the key drivers of energy use within organizations.

## ■ ■ ■ ■ ■ TASK OVERVIEW

### IDENTIFY THE KEY DRIVERS OF ENERGY CONSUMPTION

Energy use is affected by climate, occupancy, usage modes, and dress, among other factors. Climatic conditions affect the number of heating and cooling days in a given year. Occupancy affects lighting and plug loads.

The intensity with which occupants use appliances affects energy consumption as well. Perhaps less widely considered: how an occupant dresses affects their thermal comfort and heating and/or cooling preferences.

### DEVELOP SENSOR KIT

MKThink developed a sensor kit to measure environmental conditions. The team identified the following performance categories for the sensor kit to measure:



- Utilization
- Water quality
- Acoustic comfort
- Air quality
- Thermal comfort
- Energy consumption

To increase data collection, MKThink decided to make the kits accessible to the nontechnical user. To ensure this goal was met, MKThink product designers established the following requirements:

- Quick and easy to deploy
- Able to be operated by non-technical personnel
- Able to collect accurate and verified data
- Inter-operable
- Re-deployable



## TEST SENSOR KIT

To evaluate the sensor kit against the requirements, MKThink tested the sensor kit with two high school students, who served as proxies for military personnel.

The test results indicated which aspects of the kits were working as anticipated and which aspects needed further development or refinement.



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**PACKAGING AND INSTRUCTIONS:** Easy, non-technical, and successful.

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**SENSOR INSTALLATION:** Sensors were successfully installed based off of instructions.

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**USER EXPERIENCE:** Kit exceeded our 60% threshold of desired experience criteria.

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**INTEROPERABILITY:** Proves to be one the biggest challenges with off-the-shelf sensors. Our custom-designed thermal comfort sensor aims to address this issue.

## ■ ■ ■ CONCLUSIONS

In REACHE 3, MKThink identified six performance categories for the sensor kit to measure. The data collected augmented MKThink's understanding for the relationships between Architecture, Environment, and Culture.

The MKThink team developed the kit concept, as a quick and easy to deploy tool that could be operated by a non-technical user, collect accurate and verified data, be inter-operable with a data management system, and re-deployable. To ensure the product designers were meeting their objectives, MKThink tested the prototypes with two high-school aged individuals who were unfamiliar with the kits. The kit exceeded the 60% threshold of desired experience criteria. However, the software team found it difficult to transfer information from off-the-shelf sensors to the database management system. The test results helped the product development team refine the user experience with the kit.

Incorporating the feedback collected in testing, MKThink developed a final prototype to be sent out to remote areas of extreme environments to collect data related to resource use, environmental conditions, technology use, and cultural patterns.

The REACHE 3 Sensor Kit proved the value in collecting environmental data. Data about the environmental conditions of a space informs the optimal layout and the inclusion and operation of appliances. For instance, environmental data can inform the orientation of passive and resource-efficient cooling strategies. A reduced reliance on resource-intensive systems, such as HVAC, provides significant utility savings. Data about organizational culture can improve workplace conditions that promote employee health and well-being, reduce sick days, and improve retention rates.

