

Improving corporate performance in open offices

Entweder VC is a venture studio, based in Almelo, whose expertise lies in starting and scaling ventures that innovate the office. Their lead time ranges from 5-7 years after which the venture is sold to a private equity firm. Now Entweder's interest lies in the huge market of reducing noise in office spaces.

A notable post-pandemic development involves decreased productivity among employees in office settings. During COVID-19, employees started working remotely, from home. Returning to the office after this period, individuals are more easily distracted than before, resulting in low concentration which leads to decreased productivity on an individual scale, which has consequences in a decline in corporate performance overall.

In an attempt to solve this issue, ReduSound has developed a concept solution with the following research question in mind: "How is reduced noise disturbance achievable in the traditional open office plan in order to stimulate workers' performance, without undermining the beneficial aspects of an interactive office?"

Malfunctioning of open offices

The reason for the malfunctioning of open office lies in its creation, which does not match the design principles that Frank Lloyd Wright once established for a productive environment. Overcrowded spaces, inadequate natural light, minimal personal space, insufficient acoustic control, and lower ceilings in open offices can contribute to a counterproductive environment for instance. These shortcomings mainly cause noise disturbance, especially intelligible speech is identified as the most irritating disturbance in the office.

There is a correlation between task performance and speech intelligibility. It is based on the STI (Speech Transmission Index). Lowering the Speech Transmission Index and making speech less intelligible revealed that the performance on complex tasks can be increased by 7%.

Lowering the STI

Therefore the question: "How can we lower the STI?", is the next subject to investigate. Multiple approaches will be thoroughly discussed in the upcoming section.

Sound masking

Sound covers the ambient sound, reducing the oscillation in frequency making speech hard to identify. However, its limitations in its spreading prove the method unsuitable. Regular audio propagates in a shell-shaped manner, disturbing other colleagues in the workspace.

For this issue, parametric speakers are introduced. Commonly referred to as directional speakers, speakers that use ultrasonic waves to reproduce sound in a directional beam. The principle can be seen in figure 13. Parametric speakers use ultrasonic waves modulated with an audio signal such that the sound is audible.

Testing

A testing phase was included to test on an individual and environmental scale. Does parametric sound benefit the user, and does it not disturb colleagues in the same space? With data collected from the forms, a few conclusions can be drawn. The intelligibility is reduced a lot, but there should be a universal measure to prove it. Surrounding colleagues are not significantly bothered by the user's speaker. And lastly, because these two aspects stimulate concentration, productivity is improved.

Applying the STI

Applying the STI, which is traditionally designed for sound systems, posed a unique challenge in ReduSounds's context. Typically measured with expensive equipment assessing the Modulation Transfer Function, the conventional STI approach proved unsuitable.

Consequently, the approach had to be modified. As intelligibility is a measure of how comprehensible speech is in given conditions, it can be argued that the scale from 0-1 represents the percentage of words that were identified. This method can be applied to the test results that were obtained. Converting the scoring scale of 1-5 to one from 0 to 1, increasing incrementally by 0.25 for each possible answer, provides a nuanced evaluation. Lowering the STI below 0.30 such that speech becomes unintelligible.



Figure 1 STI rating scale

Table 1 Return on investment model

| Return on Investment ReduSound | | |
|--|-----------|---|
| Max effect acoustic quality of the workplace on productivity | 6,0% | Conform research TNO, Gispen & TU Delft |
| Impact RS on acoustic quality workplace | 50% | |
| Productivity increase | 3,0% | |
| Average revenue per employee in NL | € 274.000 | (CBS 2018) |
| Yearly revenue increase with ReduSound | € 8.220 | |
| Cost price per unit of ReduSound | € 1.200 | |
| Depreciation period (years) | 5 | |
| Cost price per unit per year | € 240 | |
| Cost price per unit per month | € 20 | |
| Years | 1 | 5 |
| Revenue | € 8.220 | € 41.100 |
| Costs | € 240 | € 1.200 |
| ROI | 3325% | 3325% |
| Payback period (years) | 0,15 | |

Table 2 Aspect determining ReduSound's maximum impact

| Acoustic property | Achievable with the ReduSound product |
|-------------------------------|---------------------------------------|
| Average SPL of 50dB | No |
| No intelligible speech | Yes |
| No office equipment noise | Yes |
| Complete absorption of echoes | No |

Table 3 Design Requirements

| CATEGORY: | REQUIREMENT: |
|--|--|
| Ergonomic design | Ergonomic design principles must be incorporated for user comfort and posture support without interfering with the user's field of vision. |
| Sound delivery precision | Integration of Panphonics parametric speakers with directional sound technology is essential for precise sound delivery aimed directly at the user's ears. |
| Speech intelligibility | The smartrest® should achieve an STI < 0.3. |
| Open headrest design | The design must be an open headrest design to maintain visual approachability for discussion in office settings. |
| Compatibility | Must be compatible with any office chair and ensure easy mounting within 20 seconds. |
| Adjustable speaker position | Users should be able to adjust the position of the speakers for an optimal sound experience. |
| Wireless Bluetooth connectivity | Integration of wireless Bluetooth connectivity for seamless audio streaming from compatible devices. |
| USB-C charging port | Inclusion of a USB-C charging port for convenient and universal charging capability. |
| Adjustable height and angle | Height adjustment should range from 10 to 30 cm to accommodate diverse users. The angle of the headrest should also be adjustable for optimal comfort. |
| Sound pressure level | The sound pressure level output range should span from 60dB to 90dB to effectively mask speech without disturbing colleagues. |
| Battery life | Battery life of at least 8 hours to ensure a full workday without having to charge the smartrest®. |
| Smart design | Detecting its environment and switching off/to ambient mode when colleagues pose the user a question. |

With the requirement in mind, the rough ideation sketches followed.

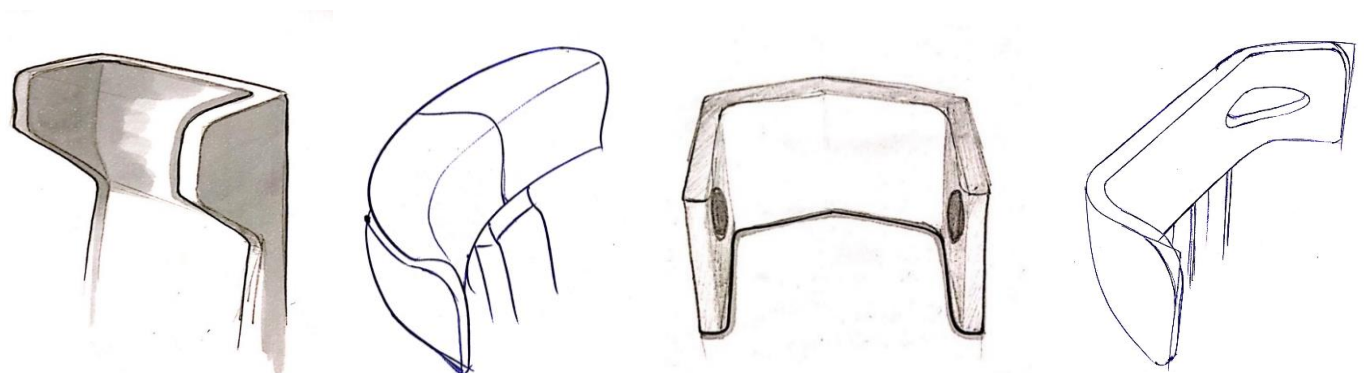


Figure 2 Ideation sketches

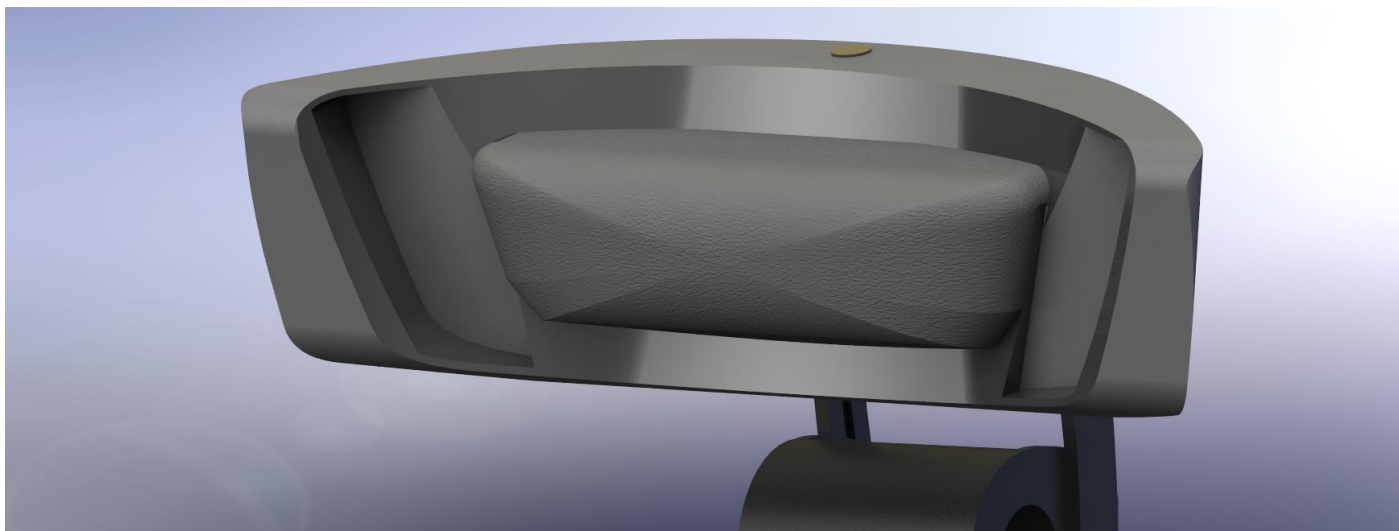


Figure 3 ReduSound smartrest®

Concept design

Introducing smartrest® - the ultimate solution to post-pandemic productivity challenges in office settings. As employees transition back to the workplace, distractions abound, hindering focus and efficiency. smartrest® revolutionizes the open office dynamic with its innovative directional speakers, empowering workers to reclaim their concentration in chaotic environments. This headrest not only provides head and neck support but also creates a personal sound oasis, effectively muffling surrounding conversations. Noise disruptions belong to the past making place for optimal productivity. Smartrest® allows businesses to thrive with enhanced individual and corporate performance.