**Flicker free driver, Innovation Skåne:**

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| **What was the purpose of the project?** |
| To make a flicker free prototype to be able to test and validate the impact on human behaviour and learning capabilities.   |
| **Chosen solution**(brief description of solution, method, process)  |
| To be able to produce a set of 20 prototypes the project needed to gather competences from different sectors. Innovation Skåne was leading the team that consisted of: Aaxsus, Lunds Tekniska Högskola (LTH), Danska tekniska University (DTU) and Lundinvova. (Also BrainLit was involved later on). Everybody contributed with their knowledge and experience in the field.  The prototypes were manufactured by Lundinova with input from the rest of the project team. This process included decisions such as how much of the DALI standard they needed to support, what components that were most economical to choose and which light levels to use as baseline (dimmed). DTU used their expertise to validate and show that the prototypes indeed were flicker free and Aaxsus contributed with a location (school). LTH was in charge of the actually study that was taking place in the school.The visual environment was evaluated by using a Visual Ergonomics Risk Analysis Method, VERAM, recently developed. The VERAM consists of both objective parts such as rating the risk for glare, access to daylight, and measuring the illuminance and luminance. VERAM also includes a subjective questionnaire answered online. The questionnaire consisted of questions about for example exposure to glare, eyestrain, headache and migraine. The participants were instructed to answer a questionnaire in four consecutive phases, in the first three they answered the questionnaire twice. The changes between the different phases took place when no students were present and there were no noticeable visual differences between the different phases. The four phases consisted of: 1. In the first phase the luminaires with the existing drivers were dimmed down to about 80 % causing a non-visual flicker of 389 Hz, a modulation depth of 80% and a flicker index of 20%. Average illuminance level: 610 lux.
2. In the second phase the prototype flicker free drivers were installed and the new drivers were dimmed to the same level as for the first phase, 80 % and a completely flicker free environment. Average illuminance level: 610 lux
3. The third phase was exactly the same as the first phase.
4. In the fourth phase the existing drivers were used at their maximum causing no non-visual flicker. 100 % and a completely flicker free environment. Average illuminance about 800 lx.

The preliminary results show that the amount of participants with reported migraine was twice as high in the flickering environment. No differences were found so far regarding eyestrain or headache.Due to delays in the study some of the questionnaires have not been analyzed yet. So the results of the study might change when a more thorough statistical analysis is being performed on all of the material.More of the participants reported migraine in the flickering environment. These preliminary results show that more intervention studies are needed. It is especially interesting focusing on the difference between the individuals that are more sensitive to visual stimuli compared to the individuals that are less sensitive. What measurements or tests should we use when diagnosing the sensitive individuals? These are questions the research team would like to investigate further.   |
| **Collaborating partners**(i.e. research, concept development, manufacturing)  |
| Aaxsus AB (delivering the troffers and the location at Kvarnby School, outside Malmö)DTU (for quality measures)Lunds Tekniska Högskola (To carry out the measurements and evaluation)(BrainLit)  |
| **Technical specifications**(make, model, software, system, service)  |
| ACDC (Zumtobel group)LU25, LEDLINEAR Kalypso RGBLC26, Zumtobel Arcos 3 LED  |
| **Measurable effects (**what values have been achieved with this solution compared with a “traditional” solution(if any)) |
| The project was presented at a ”Light and Health” conference arranged by the IES, Illuminating Engineering Society, in Atlanta, USA, in April 2018.    |
| **Lessons learnt?**(i.e. what would you do differently next time, both in process and implementation)  |
|  More thorough preparation before the installation of the new drivers, such as: what type of wire connections was available at the installation place.   |
| **Date of opening** 5th of November2018 |
| **Visiting info**(Visiting address to Demo Project, opportunities & restrictions) |
| Not applicable    |
| **Other**(links, media appearances (TV, Newspapers, etc.)) |
| **So far only the conference.**   |
| **The future** (Is it possible to scale up? What other areas could benefit from this solution?) |
|  The drawings for the driver could be placed open-access online to give other companies the possibility to develop luminaires with good flicker free drivers.    |
| **Contact info** |
| Email: | Phone: |
| Visiting address: |
| **Media files** |
| Please attach good quality high resolution **images** + **video** of the installation (minimum 1080 x 1920 pixels in dimension) for free print and online usage. *Include photographer’s name if requested.*  |