

White Paper February 2018

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HOW TO BRING LED LIGHTING MANUFACTURING BACK TO THE HOME?

Executive Summary

The LED lighting manufacturers are under increasing pressure to outsource their production to Far East in search for cheaper labor. Chinese LED lighting manufacturers have already captured example a major share of the North American \$3 billion LED lighting market. In line with that trend, outsourcing to Asia may sound attractive, but it's not an easy task and will bring several new challenges to manufacturers; product quality control becomes difficult, the risk for recalls increase, logistics get complicated, ecological production and labor ethical practices may come up, and the ability to promote and sell Local-made, top quality products is lost.

What are the alternatives to outsourcing? How to compete against lower cost imports, not only with quality, but with a profitable business operation? Applying lean manufacturing and continuous improvement methodologies at local factories may certainly help to some extent. But are there other more effective ways to compete?

As a solution, this white paper introduces a new technology concept for LED tube manufacturers: a fully automated, cloud controlled micro-factory - ANTPlant™. Developed by EIDTech Corp., with offices in Finland and Boston, MA, ANTPlant offers the most practical and fastest-to-market opportunity for automating and optimizing LED tube manufacturing. The 24/7 automated high-precision operation will secure the best possible quality and profitability, and enable LED lighting products to be sold as Made-in-Locally.

Challenges with Outsourced Manufacturing

Installing unknown quality LED tubes into an older fixture may be a safety hazard. For example, some LED tubes require a rewiring of the lighting fixture when replacing the old fluorescent light tube. This could cause fire, severe injury or death if not installed correctly. And the buyer, who selected the product, may be responsible for causing this hazard. In 2015 alone, over 700,000 T8 tube LED lights, manufactured by Osram (S.Korea) and Cree (China), were recalled, due to a potential burn hazard risk¹.

Achieving the highest product quality, while manufacturing millions of products annually, requires a perfectly fine-tuned Q&A process. In a typical Asian manufacturing facility, much of the work is done with human labor, which may be highly skilled, but can still cause a significant number of failures of individual lamps, as in the case of Osram and Cree, when products are produced in the millions.

Eventually, quality issues at the outsourced manufacturing facility will be visible in the expected lifetime of the product sold in the USA. The lower cost LED tubes manufactured in Asia typically last between 20.000 to 50.000 hours at 25 Celsius degrees, as shown below in Picture 1.

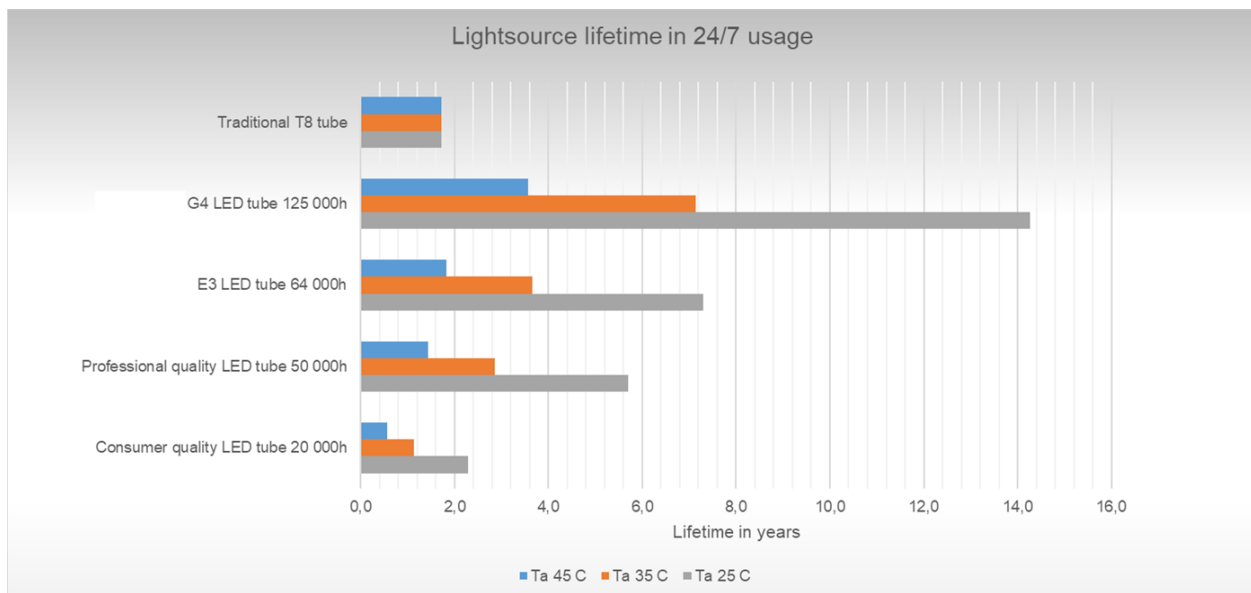
With ANTPlant automated production, it is possible to produce LED tubes locally, with 125.000 hour life expectancy, with a low recall rates, and with a competitive retail pricing.

On-time delivery to customers, while minimizing inventory cost, can also be challenging when the factory is on the other side of the globe and behind a 12-hour time difference. What lead times can I promise to my customers?

Immediate product availability is an important competitive advantage, when capturing new market share from bigger and more well-known competitors. A short lead time often convinces the first-time buyer to try something new.

With local manufacturing - leveraging the micro-factory technology, where the production runs are flexible and can be adjusted daily - the lead times can be brought down to one to two day range while still keeping the inventory cost at a reasonable level.

THE BEST TCO AND ONLY REAL LONG-LIFE LED TUBES



Picture 1: Expected life-time for different light tube types, including ANTPlant E3 & G4. Lower cost product vendors often promote a long life-time, but fail to mention that, inside the lamp enclosure and in high-ceiling environments, the actual operating temperature is not 25°C (77°F) but between 35-45°C (95-113°F).

The Solution: Automated Micro-factory

ANTPlant micro-factory offers LED tube manufacturing companies a cost-effective alternative. The micro-factory is delivered in a marine container at the destination facility. A team of engineers will follow the delivery for implementation and training.

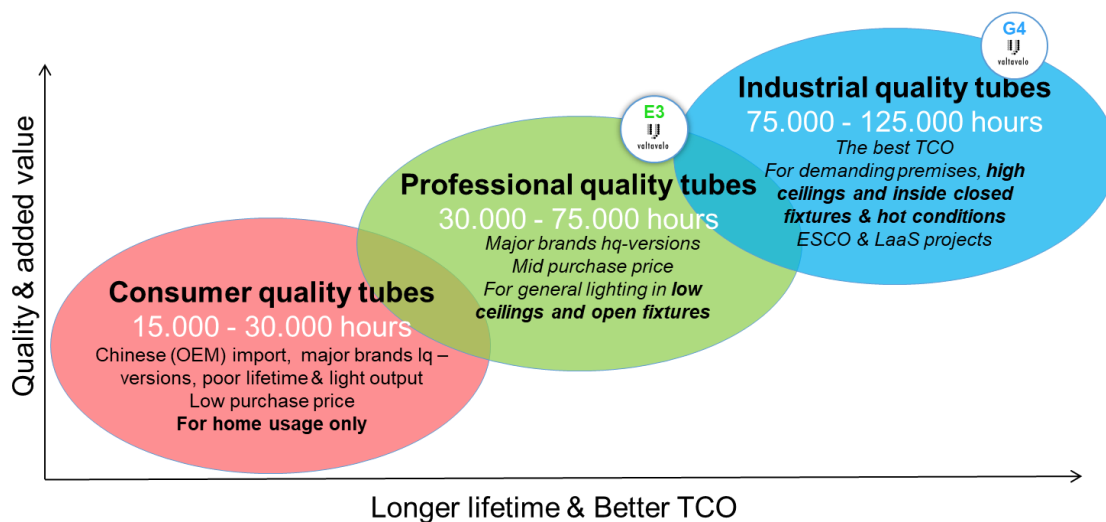
ANTPlant solution overview:

- One-day installation to be operational, with a two-week ramp up to full capacity
- 1,700 sq.ft floor space required for ANTPlant operation
- 1-2 persons per shift needed to keep the production running 24/7

- The expected annual capacity of one ANTPlant line exceeds one million LED tubes.
- Parts and materials supplied from a centralized HUB operated by EID Tech Corp.

The ANTPlant supplier, EIDTech Corp., provides a full-service package to monitor the ANTPlant production processes. The plant's daily operation is monitored remotely with the cloud-based control system; for data tracking, analysis, and preventive maintenance, and supported by a centralized regional parts-hub to keep production levels running with the best capacity, quality and cost.

LED TUBE MARKET IS DIVIDED IN THREE QUALITY SEGMENTS

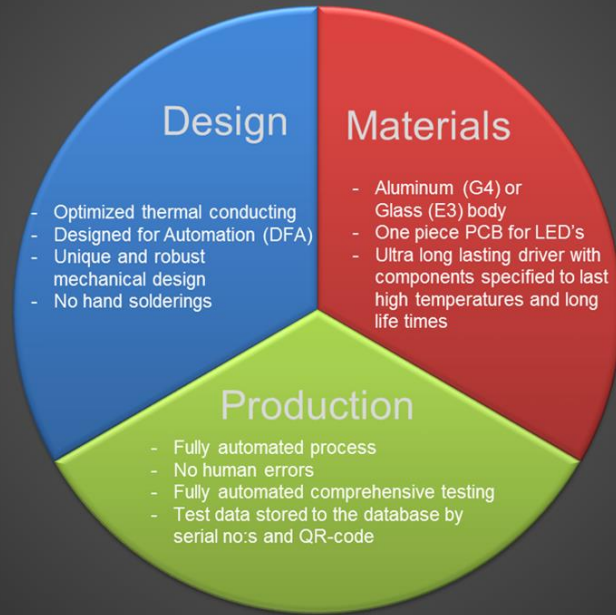


Picture 2: ANTPlant produces the highest quality LED tube products, ANTPlant E3 and G4

ANTPlant - unique innovation

With ANTPlant's unique manufacturing process, combined with the automation-adapted proprietary design of the LED tubes, the manufacturing is fully automated from the beginning of the assembly to the inventory packaging of the tested and laser marked end-products. This translates to maximized efficiency and zero-human-errors in the product. The ANTPlant process and the end-product are designed at the same time, which means no compromises with the process or product design.

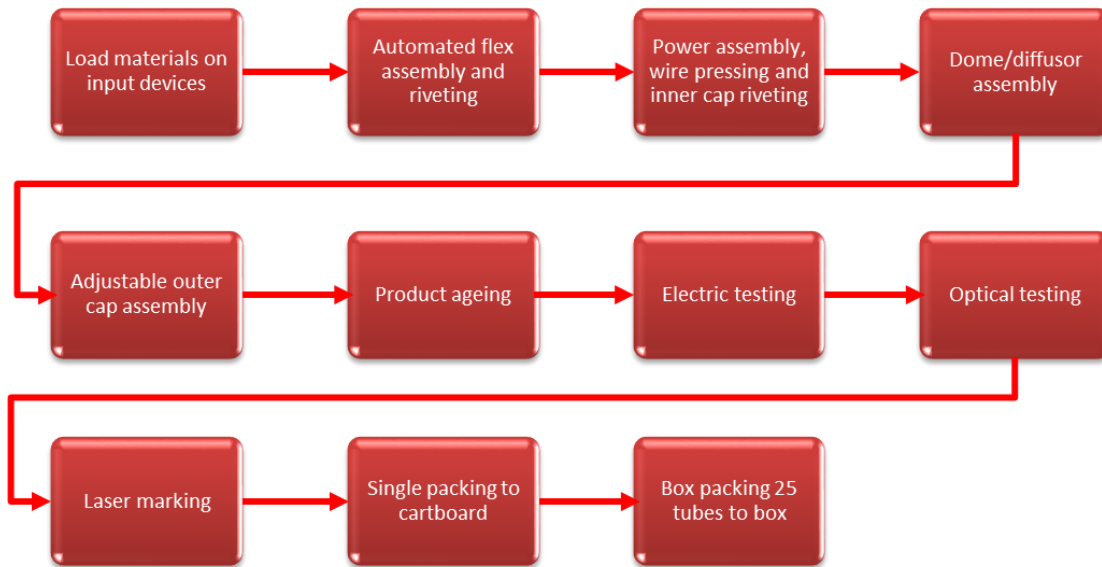
Product quality chain can be only as strong as it's weakest link



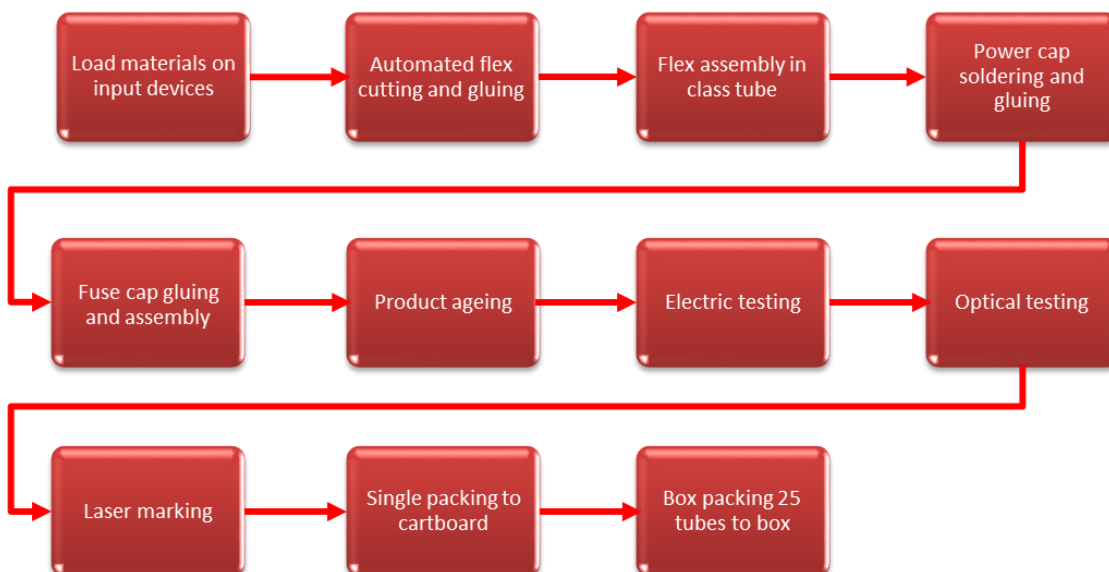
Picture 3: ANTPLant produces the highest quality LED tube products

Micro-factory functionality for G4 and E3 type LED tubes

ANTPlant operation flow chart G4



ANTPlant operation flow chart E3



Picture 4: ANTPlant automated operation Flow Charts

ANTPlant Q&A :

Q: What is unique in the ANTPlant micro-factory concept?

A: The end-product to be manufactured (G4, E3) is designed at the same time with the automation process. This means that the product fits perfectly to the process and no compromises in the process or product design are needed.

Q: Why will ANT Plant produce better quality than competing solutions?

A: Thanks to the fully automated process, there are no human errors in the products. There is 100% aging for the end products and every single product is tested and test results are saved to the data base. If failures appeared later, it is possible to come back to serialized test results and analyze possible causes for failures.

Q: Are the parts traceable?

A: Yes, there is a traceability for critical components and the required product specific data can be found based on the end-product's serial number. The critical components are the driver and the LED strip (including LEDs).

Q: What does 24/7 remote support include?

A: There is always Engineer on call for 24/7 support. In case deeper analysis is needed, a remote contact to the factory will be established for trouble shooting and determining the root cause of the problem.

Q: Is ANTPlant future-proof? How can the product and process be updated, when there are changes required in the end product?

A: Based on the analysis of history data, the most frequently needed updates or upgrades are required in the Power and/or LEDs. These changes can be managed easily, thanks to the intelligent line control system, where process parameters, markings and tests, can be updated remotely. All changes are made under mutual agreement between the ANTPlant owner and the plant vendor, EID Tech, services team.

Q: There is a need for different lengths, different color temperatures etc. in the market. Can ANT Plant accommodate all the different product variances? What is the manufacturing process changeover time between the products?

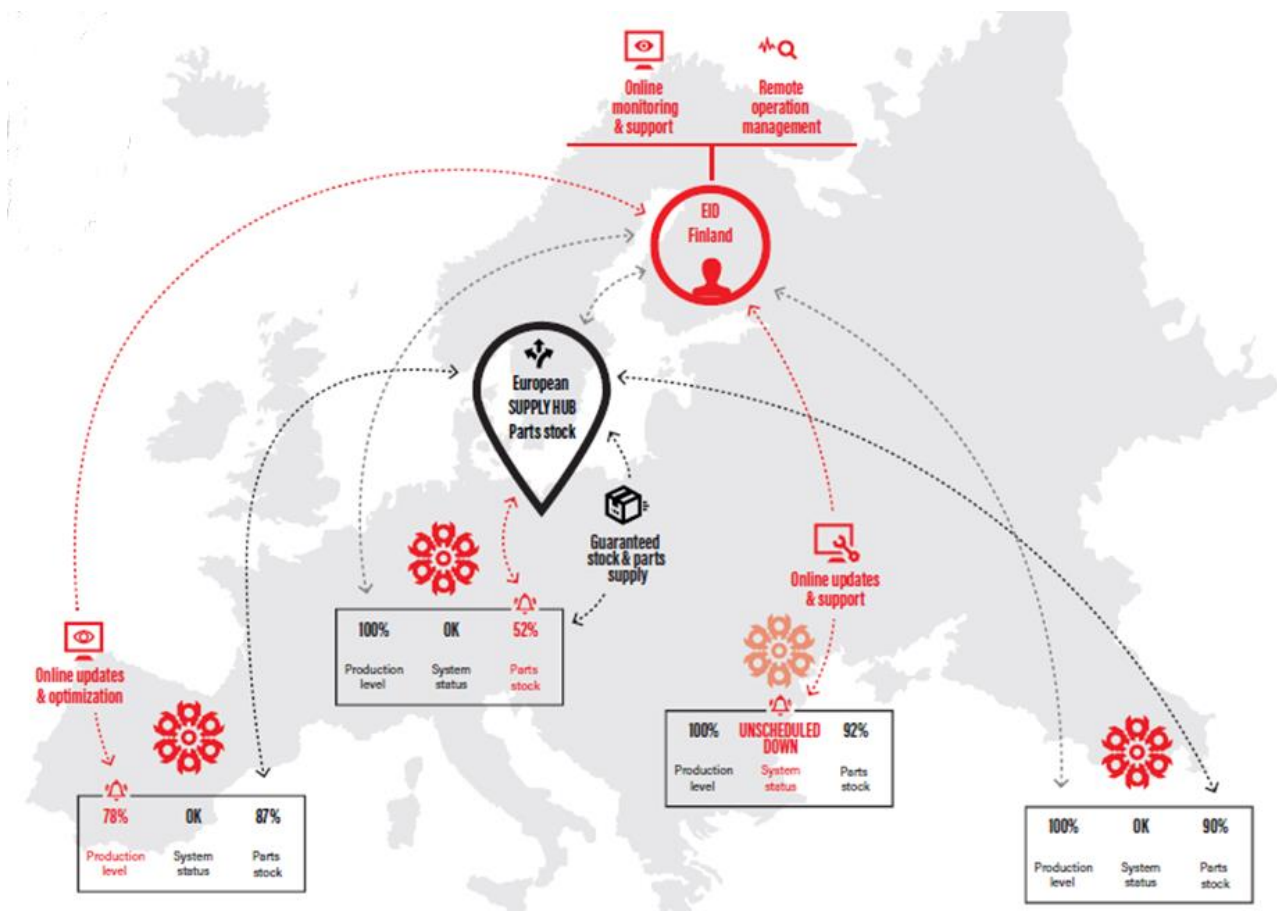
A: The process changeover time, for example for different color temperature, is less than 1 min. The new product information is just updated through the Graphical User interface and the correct color of LED strips are loaded. For changing the tube length, it takes less than 10 minutes to change LED strip "gripper" materials that will be fed to the process.

Q: U.S. based materials HUB is offered as a service. What is the benefit of that service for the ANT Plant owner.

A: There are several advantages in using the local materials HUB:

- Materials are sourced from pre-certified suppliers, to secure:
 - o Reliability of the supplier
 - o Best possible quality, minimizing errors in the process
 - o Compatibility with the automated manufacturing process
 - o Traceability and quality control per part

- Large volume purchases
 - o Securing competitive parts pricing also for smaller regional players vs. large international competitors
- Short forecast window
 - o Good availability means the local inventory and working capital needs are minimized
 - o Flexibility in operations, for example between switching different product models



Picture 4: Materials HUB - secures optimized logistics for production materials & parts.

End-Product Specifications:

- G4 - T8 LED Tube:
 - o lengths of 1.5ft, 2ft, 3ft, 4ft and 5ft
 - o variety of color temperatures
 - o ability to achieve high luminous efficacy and long lifetime: typically, 128 lm/w and 125,000 hours

- o optimized 120° light distribution
 - o made of anodized aluminum, end caps of fire resistant PC-plastic
 - o leading total cost of ownership in the industry
 - o wide operating temperature and high tolerance to vibration
 - o meets requirements in demanding industrial applications
 - o compatible with LED tube standards EN62776, CE, UL
- E3 – T8 LED tube:
- o lengths of 1.5ft, 2ft, 3ft, 4ft and 5ft
 - o variety of colour temperatures
 - o ability to achieve high luminous efficacy and long lifetime: typically, 130 lm/w and 64,000 hours
 - o wide 240° light distribution
 - o made of glass, end caps of fire resistant PC-plastic
 - o environmentally friendly
 - o meets requirements in a wide variety of commercial applications
 - o compatible with LED tube standards EN62776, CE, UL

Conclusion

As discussed in this white paper, the new micro-factory technology for LED Tube manufacturing industry has demonstrated that it can reduce manufacturing costs, to a level that is competitive with Asian imports, while substantially increasing the quality of the LED lighting product - up to 125k hour life span.

As LED lighting products continue becoming more standardized and price competition intensifies, the pressures to lower manufacturing costs in the USA will continue to increase. Micro-factory technology increases productivity and facility utilization levels, it minimizes human errors and reduces the machine downtime. It therefore offers the LED tube manufacturing companies an attractive, cost-effective opportunity to future-proof their operations, and to stay competitive for the longer term, even with increasing pressure from low-cost imports from Asia.

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