

Development of High Performance Spectrometer

Richard DISTL*, Taro SASADA**

要旨

LED業界において光学特性計測用基準分光器として広く成功を取めたCASシリーズの開発の歴史、またそれを生み出したInstrument Systems社の会社運営の基本思想について、過去、現在そしてKonica Minoltaと歩む将来についての思いを創始者であり現CEOであるリチャード・ディストゥル氏のインタビューとして述べる。

Abstract

The CAS series spectrometer achieved extraordinary success for the measurement of the optical properties in the LED industry. Here the history of its development and the management philosophy of the company in the past, present and the future with Konica Minolta are being described from an interview with the founder and current president Mr. Richard Distl.

1 Preamble

The history is always told nicely afterwards. And the success of our company is no exception but there must be something to pass over to the successors. By a chain of coincidence, Instrument Systems became a member of Konica Minolta group. It is our pleasure to share the key of our success to all stake holders and to wish continuous success of the entire group in the future. This article is made of by a dialogue between the current two managing directors of Instrument Systems and reflects the spirit of the founder and CEO Richard Distl and the opinion from Japanese Managing Director Taro Sasada.

2 At the 1st night

Instrument Systems was founded in 1986 when Mr. Distl was a student. He was the youngest recipient of the fund to promote technology start-up companies from Federal Government of Germany and he is a highly technical oriented entrepreneur. The first office was a corner of the living room of his parents' house. He was not able to make any profit for the first eight years and had to bear giving up a major share of the company to one of his business partner. Until this time, the philosophy of running a business was to make a good product and adjust the price to match the customer's price negotiation. Mr. Distl realized that he will never make a profit as far as he continue this way. So he decided to stop cutting price and keep the performance improved until it becomes an essential instrument for their usage. And the company started to make profit from then.

An important part of this decision was that all of the sales people objected to Mr. Distl because they assumed not to be able to sell the product with higher price. But he decided by his own believe and this

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believe was not made on the desk but the strong connection to the market field by Mr. Distl himself.

3 In the morning

3.1 Development of the 1st generation

When we developed the 1st CAS140, it was designed by a business partner. Around 1990, the construction of a spectrometer has been an aggregate of several components. It is like the set of organs on the table and occupies a large space. Mr. Distl thought this is not good for the customer and integrated all parts in one compact spectrometer. It's foot print was just 1/3 of the conventional modular spectrometer but still kept equivalent performance. Furthermore, he challenged to redesign the entire product including the test procedure to achieve more reliable performance. This again received a strong objection from entire company because it is easily foreseen a huge investment of time and risk but it has been a must to give up the old design and restructure everything to step up into the next stage.

3.2 More benefit for the customer – 2nd Generation CAS140B

The 2nd breakthrough was brought by a close relationship to the customer.

Our CAS140 was accepted by one of the large LED manufacturers and they told us that triggered measurement to capture a short pulse period and a wide dynamic range are necessary to achieve high testing throughput and precise measurement of various kinds of LEDs. We implemented triggering functions and optical density filters inside the spectrometer in very short development time. It is not a top technology but it gives to the customer a huge benefit. The picture of a LED testing station from that time is shown in Photo 1.



Photo 1 Usage of the CAS140B in a LED testing station.

3.3 Pursuing high accuracy

3.3.1 Improvement of sensitivity

One of the 3rd breakthroughs is brought by the innovation of our key component. A back-illuminated CCD is not a new technology nowadays but we are probably the first manufacturer who employed it in a spectrometer. The benefit of the back-illuminated CCD is the high sensitivity in the blue region and superior overall quantum efficiency. The conventional spectrometer using front illuminated CCD suffer a cut off wavelength at 420nm. This is a severe disadvantage when using the instrument to measure the color of light which is perceived by the human eye with a spectral responsivity from 380nm to 830nm. Hence, a part of the blue spectrum, i.e. 380nm to 420nm is missing when using front illuminated CCDs. The back illuminated CCD of the CAS140B & CAS140CT has an excellent sensitivity in the entire wavelength range. This is particularly important when testing white LEDs which are based on a blue chip and yellow phosphor.

3.3.2 Reducing stray light – CAS140CT

Another innovation is related to the optical design of the spectrograph which is the heart of every spectrometer. The previous CAS140B model was based on a simple design using a holographic concave grating that images the light directly onto the CCD sensor. When developing the CAS140CT we changed this to a complex crossed Czerny-Turner configuration where a plane grating is used along with separate concave mirrors to achieve the optical imaging onto the CCD sensor. The new optical design offers the advantage of much less stray light. Since it also required significant R&D efforts and development time, the majority of the team was against it. Mr. Distl, however, decided to start this project because he realized that the lower stray light drastically improves accuracy when measuring the color of LEDs. And he already believed at an early stage that LEDs will be the dominant light source in the future.

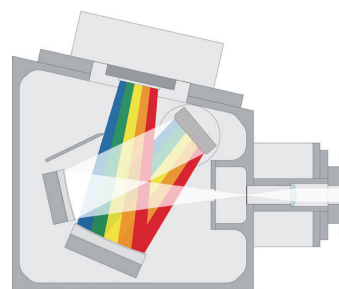


Fig. 1 Crossed-Czerny-Turner configuration of the CAS140CT.

3.4 Technology backbone of development success

3.4.1 Optical design – Innovative light guide fiber plug

To use a spectrometer in the practical way, you must prepare various accessories for each purpose of measurement. But in the conventional spectrometer, once the light guide is detached from the spectrograph, calibration data is lost and it was not possible to use multiple accessories for one spectrometer and simply exchanging them. We introduced a novel keyed fiber plug adaptor which can easily be exchanged while maintaining calibration. This unique optical design was created in the second year after founding the company and it is still the same today.

3.4.2 Metrologic foundations

Many spectrometers in the market only care about the wavelength accuracy and wavelength resolution but what distinguish us and others are the accuracy of the intensity axis. Our customer wants to define the brightness of the light or the exact color coordinates. Many national standardization laboratories are using our spectrometers and are satisfied with the level of accuracy we have achieved.

This can be done because we have a solid metrological foundation that closely works with manufacturing department.

3.4.3 Standardization activities

Instrument Systems participates in several technical committees including CIE. The purpose of it is to be involved in a scientific community.

From this activity,

- 1) We can learn what the world national metrology institute expects.
- 2) We can influence this community.
- 3) We can win the opportunities for future customers.

But it is necessary for this committee work that the participants from the company must be highly capable for technology of our own company and the common knowledge in the society. This person must be a good communicator as well. Presenting own ideas only is not enough.

4 Another night – Management Effort

4.1 Management in the different stage of company

In the first 10 years, there were only 4 people in R&D. CAS140CT was developed in parallel to other

projects by only 7 engineers in the complete R&D department. At that time the president was leading the company in a dominant way but now we have more than 100 employees and the style at the beginning is not appropriate any more. Now, the decision making procedure is passed to the management board members.

4.2 Create Champions

Mr. Distl is sure that management must make champions for every task. In other words, every task requires a responsible person who can take care of it better than anyone else.

Mr. Distl is the champion of organizing the company structure and he respects every individual of each department. There is no difference in the R&D or administration. They have the qualified talent to execute that particular job and integrating the superior performance of individuals maximize the company output. The difference of an excellent company and an ordinary company is the enthusiasm of those champions who enjoy and drive their responsible tasks.

4.3 Culture to respect minor opinions

We sometimes make the mistake to pursue a conclusion rapidly. But it is necessary to convince people from the belly. Our company has seen many cases that one of the participants in the meeting did not agree to the conclusion of the table and asked the opinion of the actual working person under him who knows the real situation. It turns out to achieve the right decision even though it was a minor opinion on the discussion table.

In our company we can say that there is a good culture to respect other opinions even though the number is not big.

5 Dawn to the future with Konica Minolta

5.1 Opinion of Taro Sasada

Richard Distl sold his company to Konica Minolta and he should have faced difficulty to make up his decision. Fortunately he says he does not regret his decision and this feeling is getting stronger day by day. As participant to the management from Konica Minolta, I have observed the penetration of Instrument Systems in the LED industry worldwide. I learned this success is brought by the good enrolment of customer, technology and standardization activities. I believe this acquisition will be a one of the landmark in our history.

5.2 Message from Richard Distl

I am always a scientist and engineer in my heart and I believe that a good technical background is the best qualification for any career in a technology driven company. However, besides technical creativity and engineering dedication, it is important to focus on the needs of customers and market requirements. To me, it was always the ultimate reward if customers appreciated our products.

Success is based on many elements similar to a great meal which is made up of different ingredients and spices. It is the right combination of technical expertise, customer orientation, as well as enthusiasm and bold decisions that creates the proper environment for excellent achievements.