PV fab managers' wish list: achieving an efficient supply chain

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Featuring insights from **Sovello AG**, **Solland Solar**, **Scheuten Solar**, **Deutsche Cell**, **Solarwatt** and **ersol Solar Energy**

ABSTRACT

The PV industry has seen some incredible growth in the last five to eight years. This growth is essential in order to fulfill the challenging targets this industry has set itself to ensure it becomes an economical viable alternative energy source. A negative result of this growth, however, is the inefficient supply chain, where there is a lack of balance between demand and supply. The industry is going from one bottleneck to another. What is the impact of such inefficiencies on the supplier/manufacturer relationship? In this article, we collect information from short interviews of a number of fab managers in the wafer, cell and module domain, and try to answer this question.

Introduction

The relation between customer and supplier goes through different phases: lead prospection, contract negotiation, delivery, installation, interfacing, debugging, modifications, buy-off, maintenance, and eventually the removal of obsolete equipment to restart the cycle. The most challenging of these phases currently seems to be delivery, installation, commissioning and maintenance, which topics will be further developed throughout this paper. This does not suggest that the other phases are problem-free, but they interfere less today with the efficiency of the manufacturers.

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Where are the challenges situated? Most manufacturers refer to maintenance services as the issue that most urgently requires collective fixing, closely followed by the need for standards. Challenges are also present in the need for consistent quality management of some material supplies and the need for much shorter lead times. This is especially true for ramp-up of the production and to get to stable manufacturing processes, if that state is ever reached. Each of these complaints is discussed in turn in the coming sections.

Maintenance services

Many of the people active in the PV industry today come from other industries, particularly the semiconductor industry. This industry, which holds many similarities to the PV industry from a technology perspective, generated some steps that brought so much added value

to the product that an outage had to be avoided at all costs. This expression has to be taken literally. In the photovoltaics industry, however, it is a different story. Huge volumes of material move through the production line, but the added value available from the processes is limited.

This difference is the main reason why some of the services that are normally available in the semiconductor industry are out of reach for the PV industry, such as 24/7 support by the supplier on site. But does that mean that no support needs to be provided? Equipment suppliers were reluctant until recently to be creative in alternative ways such as, for example, having a hotline and remote support, which would immediately solve more than 95% of all problems. This is all dependent on a support system being available, such as staff of the PV manufacturer that are well trained in the required skill set. But this set-up as a solution in itself presents the next challenge, namely, training of the production engineers and experts of the manufacturer's technologies. It all too often happens that the staff are not trained to the level that the customer would want.

An additional demand is the need to get insight into all information regarding machines that are custom made, or machines that were developed in collaboration with the equipment maker. "Why should we not have access to the source code of the control of equipment if we have paid for the development of the equipment?" asked Mr. Baumheuer of Sovello, indicating a clear unbalance in the relation between customer and supplier.

As a facility manager, if it happens that you are not able, for whatever reason, to have your own people well trained, the problem is further compounded if you do not have access to trained representatives of the supplier company. If it is a case that this absence of trained staff is due a lack on the part of your supplier, it is unlikely that a crisis at your facility will be met with a fast and effective intervention. "It's often the case that the same people are responsible for the installation and maintenance of the systems, with the result that sometimes an engineer comes straight from an installation at a competitor in order to help you fix an urgent problem in your production line," said Mr. Koerselman of Solland. This lack of experienced, sufficiently trained technical staff is causing bottlenecks in the organisations of the suppliers, in turn resulting in projects interfering with each other unnecessarily.

Maintenance is also related to the availability of spare parts at a reasonable cost. Today this cost is perceived as being higher than needed, as every supplier uses its own types of motors, valves, and other spare parts. The fast succession of new versions of the same equipment also contributes further to this problem. It has been discussed that a potential solution to this problem would be to establish a form of 'pool' of spare parts, but this suggestion has never been taken up and developed by any of the concerned parties. This idea could potentially reduce the costs associated with expensive components such as vacuum pumps, for example. The introduction of standardization would be a significant factor in reducing the cost of ownership in this case.

Standards

Streamlining the manufacturing process is especially difficult if each equipment supplier has its own individual interface for getting material in and out of the machine. "If we could agree on the height and the direction (horizontal or vertical) of flow of the wafers or panels in or out of a machine, and on the carriers to be used, this would be a significant improvement," indicated Mr. Stock of ersol.

Standardization can also help in less obvious situations in a fab, such as with the position, look and feel of an operator terminal. Consistency in this regard can prevent mistakes and consequently time-wasting, as well as reduce the training time of tool operators. Evidence to support this claim is close at hand: most workers today are familiar with the look and feel of the Mac and Windows platforms, which, had the companies not standardized the appearance and workability of the programs, would have ended up as a mess of interfaces for different programs.

> "Standards are sorely needed in relation to materials, their properties and measurement."

Another area that needs standardisation in order to bring about an improvement in discussions between suppliers and manufacturers are measurement procedures of supplies, the performance of the equipment (e.g. MTBF, MTTR,...), and the overall economic performance of the system (cost of ownership). A common sentiment in this regard is that usage numbers of gases and chemicals of the different machines are often over-estimated, making it difficult for the PV manufacturer to plan its logistics in preparation of the ramp-up of the new equipment. As cost of ownership will become a significant sales argument when shortage of equipment is resolved in the future, it would be beneficial for the equipment makers to provide much more accurate data.

Standards are sorely needed in relation to materials, their properties and measurement. These include basic properties of these materials such as the dimensions of the glass, screens for screen printing, types of pastes, etc. "If we had less quality variation on screens for screen printing, it would improve efficiencies in the order of percentages," said Dr. Schitthelm of Deutsche Cell. Another example was given by Dr. Prünte of Scheuten Solar: "If we could agree on specific measurement methods and characteristics of the basic materials that are needed for production, we would be able to reduce buffer stocks significantly, and we would be able to trust the quality checks of suppliers without the need to redo the same tests".

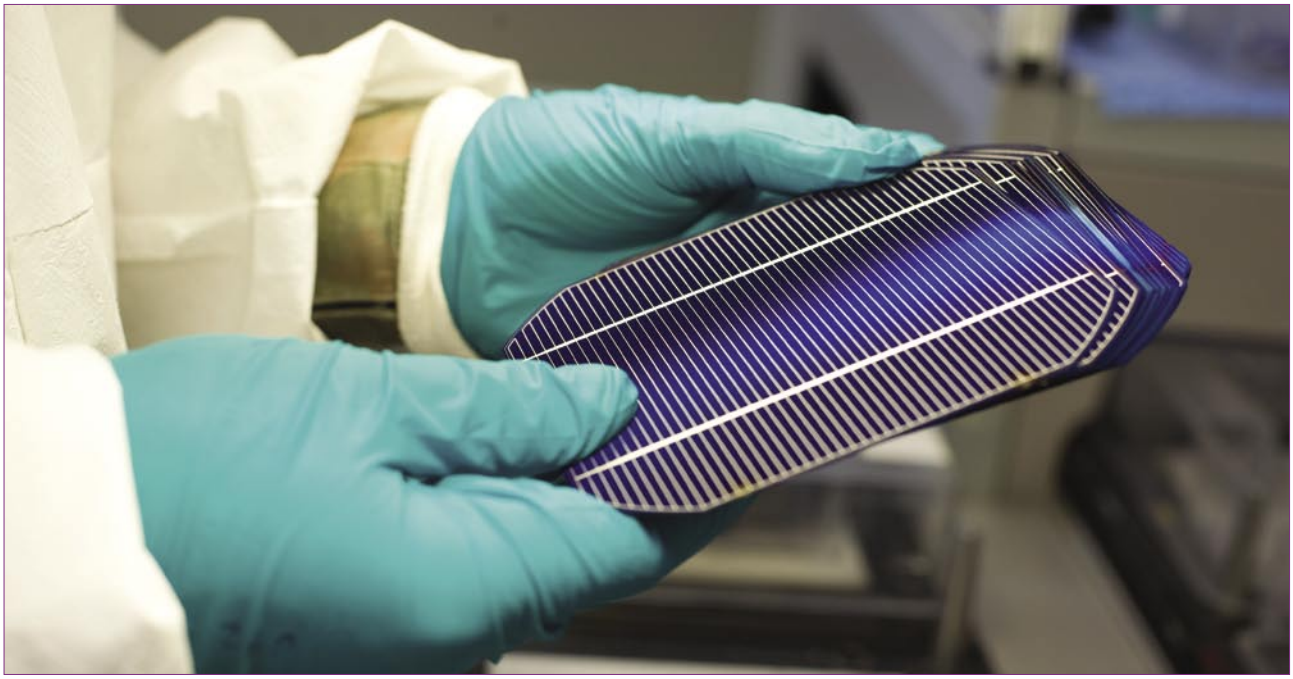
PV manufacturers often do not have access to information regarding their process window, hence the quality variations acceptance criteria of their supplies are also unknown. To compensate, the manufacturers often over-spec their supplies, and as a result receive an inefficient trade-off between supply cost and output improvement. As quantities of certain gases and chemicals required for PV manufacturing are currently low relative to other industries, there is still reluctance on the part of the materials manufacturers to invest in specific PV-grade chemicals, as there is no consensus among manufacturers as to what the standard quality levels should be.

Equipment lead- and ramp-up times

Given the strong growth of the PV industry, many suppliers have had problems keeping up with growth, some finding themselves unable to grow at the same pace as their order book. Research has shown that it is almost impossible to grow an organisation by more than 30% per annum without causing significant stress. Even if this were something that could be achieved without unnecessary hassle, there would still be a huge difficulty in finding staff with the required levels of experience to fill the newly-expanded organisation.

Standard overshooting of delivery lead times were the natural result of this inability to keep up with industry growth. But another, potentially more serious result was that people became rushed to try and keep up with the order books; as quite often happens in the harsh business world, people were forced to do first, and think later. Too little attention was paid to the all-important quality assurance in the manufacturing process, meaning that, in turn, too much time was lost in correcting errors after installation, absorbing resources that were scheduled to be spent on the next customer. Having experienced staff and quality assurance systems in place is vital in this industry. An organisation that lacks these elements runs the risk of being classed as sub-par.

Other examples clearly illustrate how fluidly a process such as installation and plant set-up can run. A supplier of thin-film equipment, starting from a green-field installation, succeeded in installing and ramping production within 15 months.



Courtesy of SolarWorld AG.

Suppliers that have their roots in other industries such as the car manufacturing industries are much less susceptible to these long delays: "Suppliers that also work for the car industry are often just in time with their equipment, installing and bringing them in to service almost without you noticing," said Mr. Schomann of Solarwatt.

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These companies were able to source from their experienced staff to service the PV industry, and they were used to very strict order fulfillment processes with well-established procedures for quality assurance. It will be interesting to see how speedy a knowledge transfer will be possible between both industries in order to obtain equivalent quality levels in the PV industry. Given the sluggish market for the car industry, this could happen faster than many would hope for.

Another element that requires attention is the build-up of process know-how on the part of equipment suppliers. This would help in two areas. Quite often it is not clear who owns certain IP when equipment improvements are developed in collaboration between an equipment supplier and a PV manufacturer, and it often takes too much time for an equipment supplier to ramp-up and stabilize the production on a new installation to an operational level. The first element, ownership of new developments, has been an element of frustration for the PV manufacturers, who invested resources and know-how to improve a specific equipment, but then saw 'their' improvements also implemented on the machines of their competitors, without any compensation for their input. Were the equipment supplier to have better know-how of the processes involved, they would be able to arrive at these improvements themselves without help from the PV manufacturers. This scenario would also prevent leakage of knowledge from one PV manufacturer to another.

Making this idea a reality, we would see huge improvements in new installation ramp-ups.

Another likely outcome would be a more stable process after ramping, less susceptible to system outages, and as a result, less dependent on support activities. And so we find that the issue has come full-circle – support facilities and sufficient access to trained technical staff are vital to prevent the supply bottlenecks we are currently experiencing in the industry.

Conclusion

As the current economic situation allows the market to stabilize a little, it is a good time to prepare for the next rush when grid parity is reached in more and more regions. It is also a perfect opportunity to correct any dysfunction in the supply chain. Several problems could be addressed by increasing the number of new process experts entering the industry, bringing fresh ideas for both the equipment and materials suppliers, as well as for the PV manufacturers. For this to become a reality, the education system needs to be stimulated to increase the amount and output of its photovoltaics-based courses, without sacrificing on the quality of the people.

Furthermore, the industry needs to invest in discussions on standards. This cannot be carried out by third parties; it must be done by the industry itself, with organisations such as the PV Group, the International SEMI Standards Program and standards group Deutsches Institut für Normung eV (DIN) actively supporting such initiatives. As long as the situation remains the same, with unresolved standards and resources issues, all parties should communicate to bridge the gap. Expectations of both parties must remain realistic, however, taking the lead from other industries' benchmarks. The semiconductor and FPD industries, the automotive and telecommunications industries – the solutions are there for the taking for the PV manufacturing industry.

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