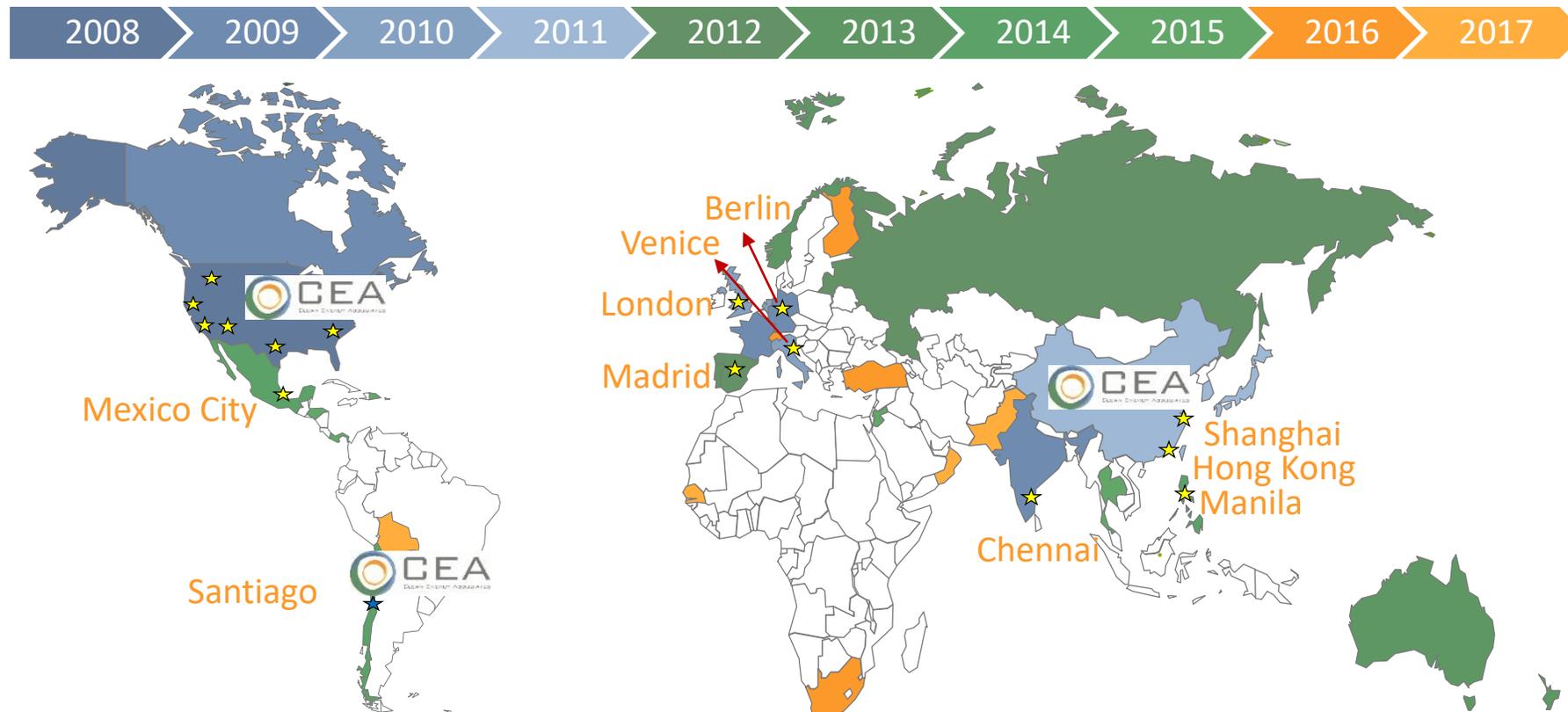


# Quantifying Risk: Benchmarking of Suppliers based on Risk Scoring of Quality Assurance Monitoring Data

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# COLLECTING MASSES OF RELIABLE DATA

CEA has completed 16 GWs of solar projects since 2008, with client engagements in 30 countries and presence in 10 countries. Over 9 GW of on-site Quality Assurance assignments were performed during this period. Thousands of data points collected over years, backed by deep knowledge of risk mitigation, produce powerful statistics.



# THE 3 MAIN QUALITY ASSURANCE ACTIVITIES

CEA performs quality assurance work before, during and after the production of PV modules, conducting three (3) main activities. Each defect or finding is assigned a risk score. Total scores are normalized per project or location, so that they can be compared.

## Factory Audit (FA)

- A team of engineers audits a factory location using a 1,000+ point checklist
- Every finding is recorded and classified according to its risk potential

## Inline Production Monitoring (IPM)

- A team of engineers continuously monitors all stations of a factory location during the production of an order, using a 260+ point checklist
- Every finding is recorded and classified according to its risk potential

## Pre-Shipment Inspection (PSI)

- A team of engineers performs visual, EL and IV inspections to a sample lot of modules, according to a list of vetted quality criteria
- Every finding is recorded and classified according to its risk potential

# RISK SCORING AND GRADING

A tree-shaped EL microcrack has higher risk potential than a backsheet dent, and this in turn is riskier than a frame scratch defect. In CEA's scoring system, the EL defect will receive a higher risk score than the other defects to reflect this difference.

**HIGH RISK**



**MEDIUM RISK**



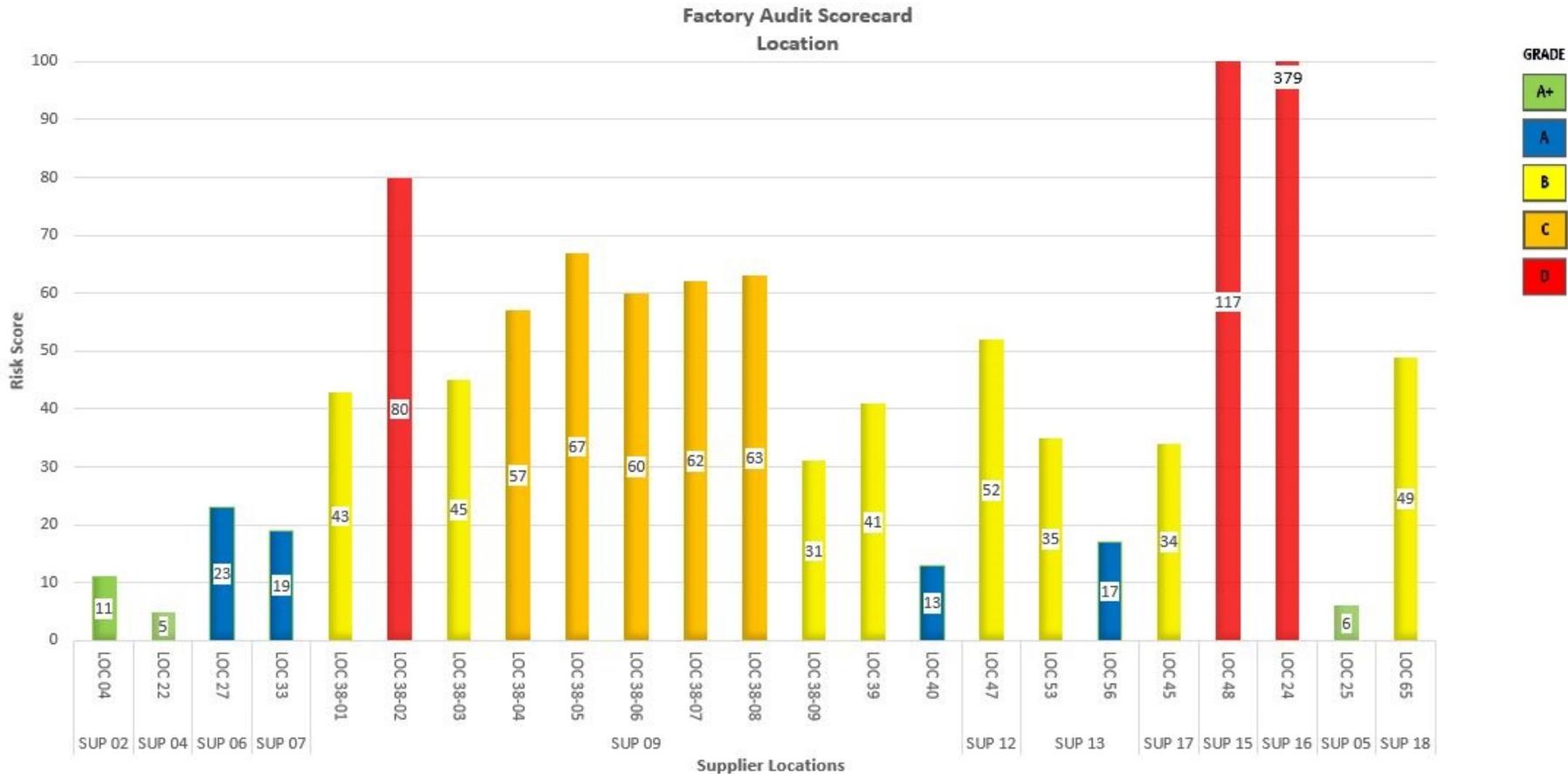
**LOW RISK**



Grade	Description	Risk analysis
A+	World Class location/supplier	Very low quality risk
A	Good location/supplier	Low quality risk
B	Average location/supplier	Average quality risk
C	Basic location/supplier	Increased quality risk
D	Risky location/supplier	Very high quality risk

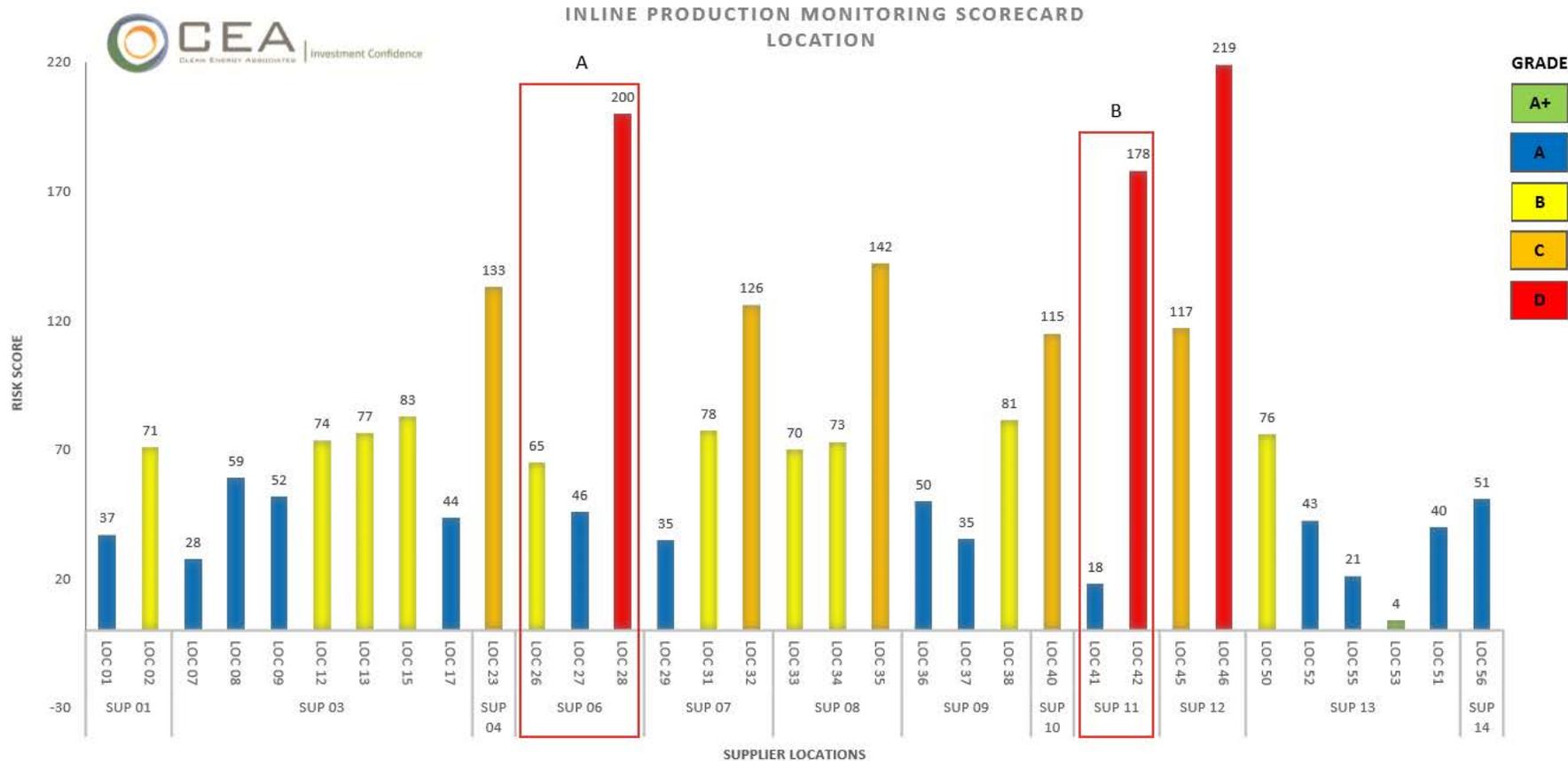
# FACTORY AUDIT SCORECARD

Supplier 09 (SUP 09), was audited in various locations, and we can also see individual scores for workshops 1 – 9 of Location 38 (LOC 38). In the chart, we can see that Supplier 09 has an A grade in location 39 ('C'), which is, interestingly enough, an overseas OEM location not owned by the supplier. Even in the same location 38, grades can vary widely, with workshop 38-02 ('A') having an alarming D grade, but workshop 38-09 having an average B grade ('B'). Location 47 is a BNEF tier supplier, but the D grade, accompanied by a very high score, means that serious improvements should be applied before beginning production.



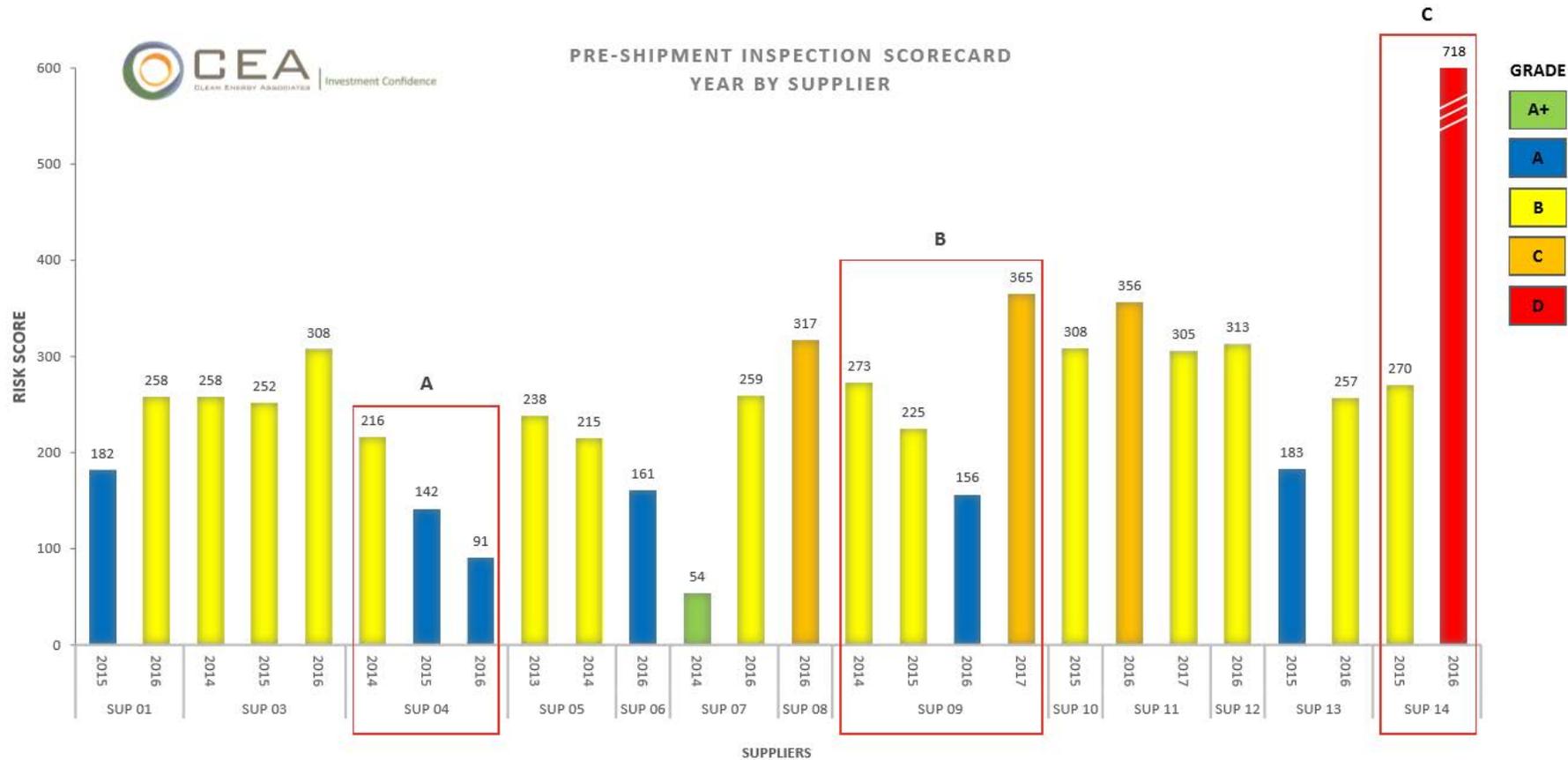
# INLINE PRODUCTION MONITORING SCORECARD

Supplier 06's location grades range from a good A to a high risk D grade ('A'). It's interesting to note that location 28 does not have the high degree of automation of the other two locations. For supplier 11 ('B'), there is a dramatic difference in grading. Location 41, an OEM location, has a good A score, but location 42, despite being the supplier's own location, has a very risky D grade.



# PRE-SHIPMENT INSPECTION SCORECARD

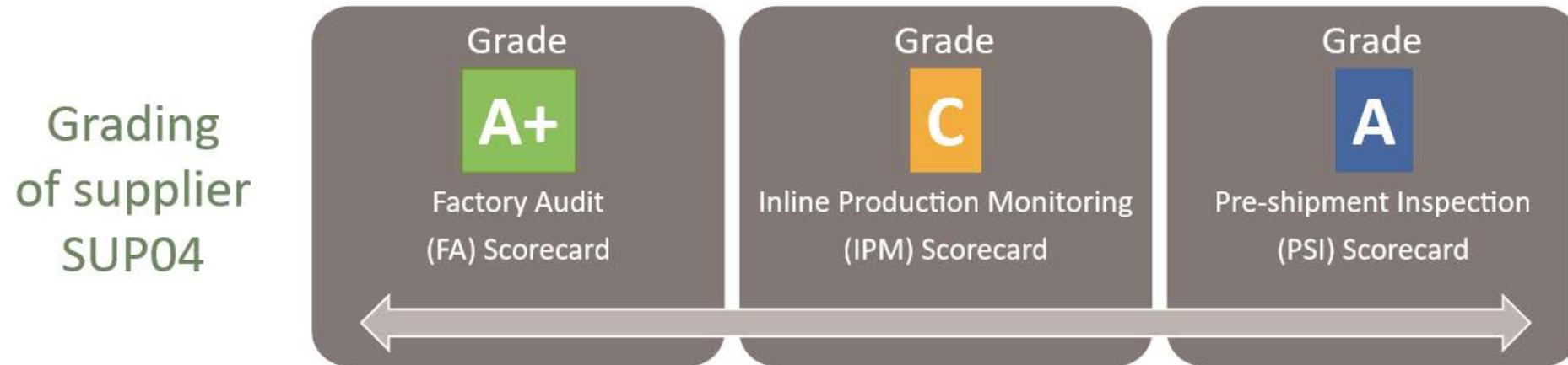
Supplier 04 ('A') shows a yearly improvement trend, moving from a B grade to an A grade within three years, which is a very positive result, consistent with industry goals. On the other hand, supplier 09 ('B'), showed an improvement from B grade to an A grade from 2014 to 2016, but then plunged to a C grade in 2017. Supplier 09 is experiencing very high demand in Q1 and this creates a lot of pressure on the production lines. However, since this grade is based on Q1 projects, it will be interesting to monitor the supplier's progress over the course of 2017. Supplier 14 had an average B grade in 2015, but jumped to a very high risk score and a D grade in 2016. This supplier was plagued by financial issues in 2016, and this seriously – and visibly – affected its ability to produce high quality PV modules.



# OVERALL SCORECARD

The three different facets of CEA's quality assurance oversight complement each other, as they focus on different areas of risk. A Factory Audit is a snapshot, and is therefore not fully representative of the ability of a supplier to produce good quality modules. A good FA score is a great starting point, but problems may arise in production. Such production problems will reflect in a bad IPM score. However, the same project may have a good PSI score, because the supplier redirects the lower grade modules to other clients and doesn't submit them for PSI. The 3 different scores of Supplier 04 underline this case.

The three (3) pillars of quality assurance





THANK YOU