SW Test Workshop
Semiconductor Wafer Test Workshop

TELeMetrics™

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TELeMetrics™

- Provides a secure connection from TEL probers to TEL servers for sharing log, utilization, and performance data
- Facilitates analysis and interpretation of this data
- Delivers data to the customer in a user friendly interface
- Improves the efficiency and performance of TEL equipment

Prober

TELeMetrics platform

Analysis applications

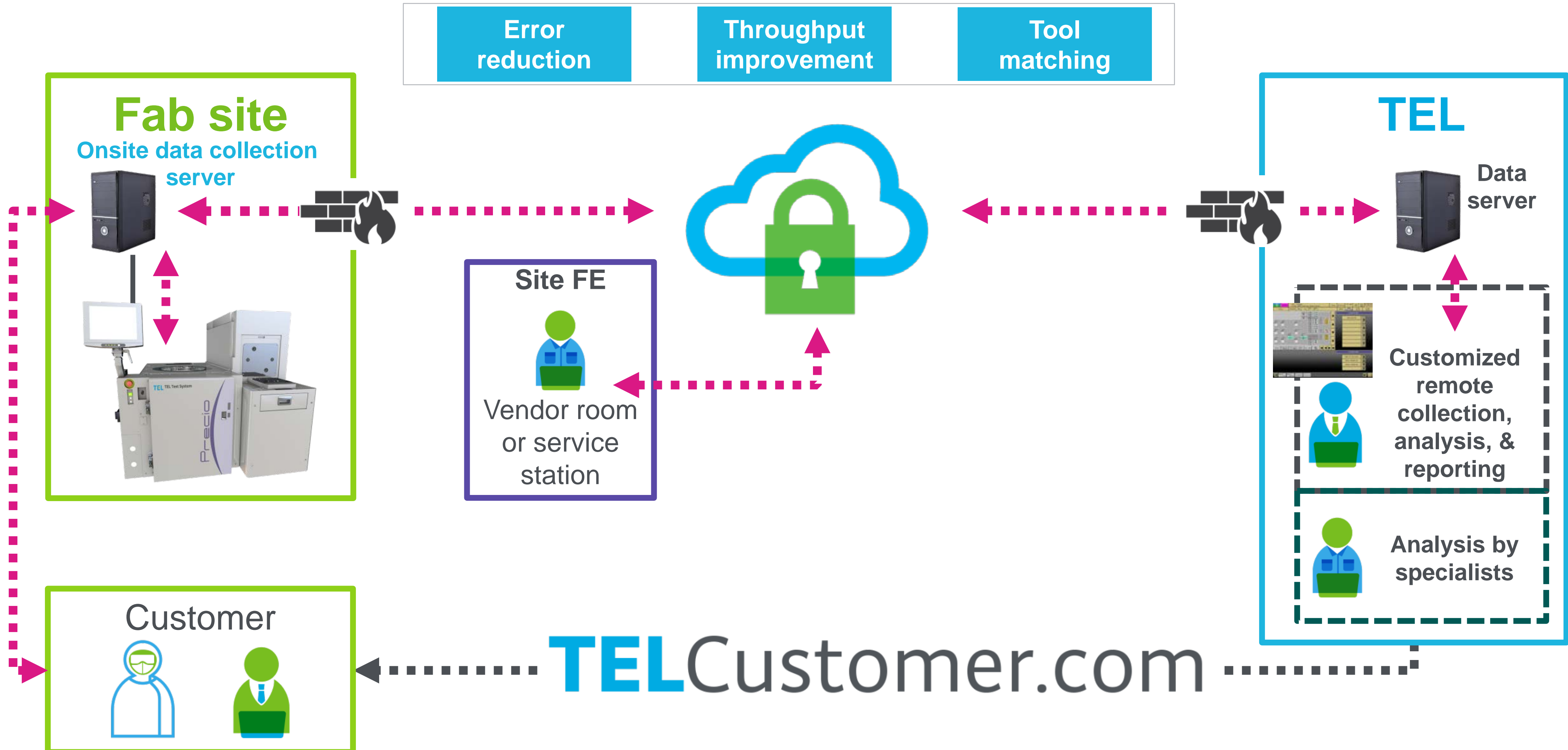
Customer services

TELeMetrics™

Product

Connection overview

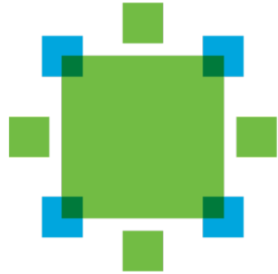
TELeMetrics™



Security first

	TELeMetrics™	Web based	VPN
SSL data encryption	☑	☑	☑
No firewall configuration needed	☑	☑	
Outbound communications	☑	☑	
End user control	☑	very limited	
Central control at customer IT	☑		
Internal credentials hidden	☑		☑
Customer security policy manager	☑		
Granular user permission at specific action and device level	☑		
Specific action level audit log at customer	☑		
Specific action level audit log at support	☑		
Customer pre-approved remote activities	☑		

Benefits



Improves intelligence

- Monitor tool utilization
- View alarm logs
- View event history
- Gather tool performance data
- Query tool parameters
- Backup process log data

Saves time

- Rapid TEL response
- Remote access
- More efficient troubleshooting
- Cross tool recipe comparison
- Automated notifications
- Enhanced tool capabilities

Saves money

- Availability improvement
- Throughput optimization
- PM optimization
- Tool matching
- Affordable support contracts

Error and assist reduction

Three main problems with collecting and charting errors and assists from the logs:

1. Duplicate entries for the same event
   - Example: Operator selects “Retry” multiple times for the same “Probe Macro Assist”
     - One event related to multiple log entries
     - Each log entry treated as a separate event
     - Incorrect interpretation skews data
2. Errors/assists generated during Maintenance should not be tracked
3. Errors/assists should be “normalized” by product volume
   - Errors/assists rise and fall with product volume
   - Example: Number of assists vs ratio of assists to wafer count
     - 600 assists per 30K wafers is better than 300 assists per 10k wafers
     - Tracking only the number of assists indicates the opposite conclusion
     - Ideal: Compare week-to-week performance after accounting for product volume variation

Error and assist reduction continued…

To address the problems of duplicate entries and the maintenance:

- TEL software counts errors/assists only between Lot Start and Lot End
- Duplications filtered out by counting only “unique” errors/assists per wafer.

To address normalization problem:

- Filtered data used to implement a rate of occurrence
- Referred to as the “Error Rate”
- Error rate = (Errors and Assists / Wafers) * 100

Error rate calculation allows accurate judgement of:

- Week-to-week performance
- Prober-to-prober performance
- Wafer file-to-wafer file performance

The following slide will shows the results of Error Rate calculation.

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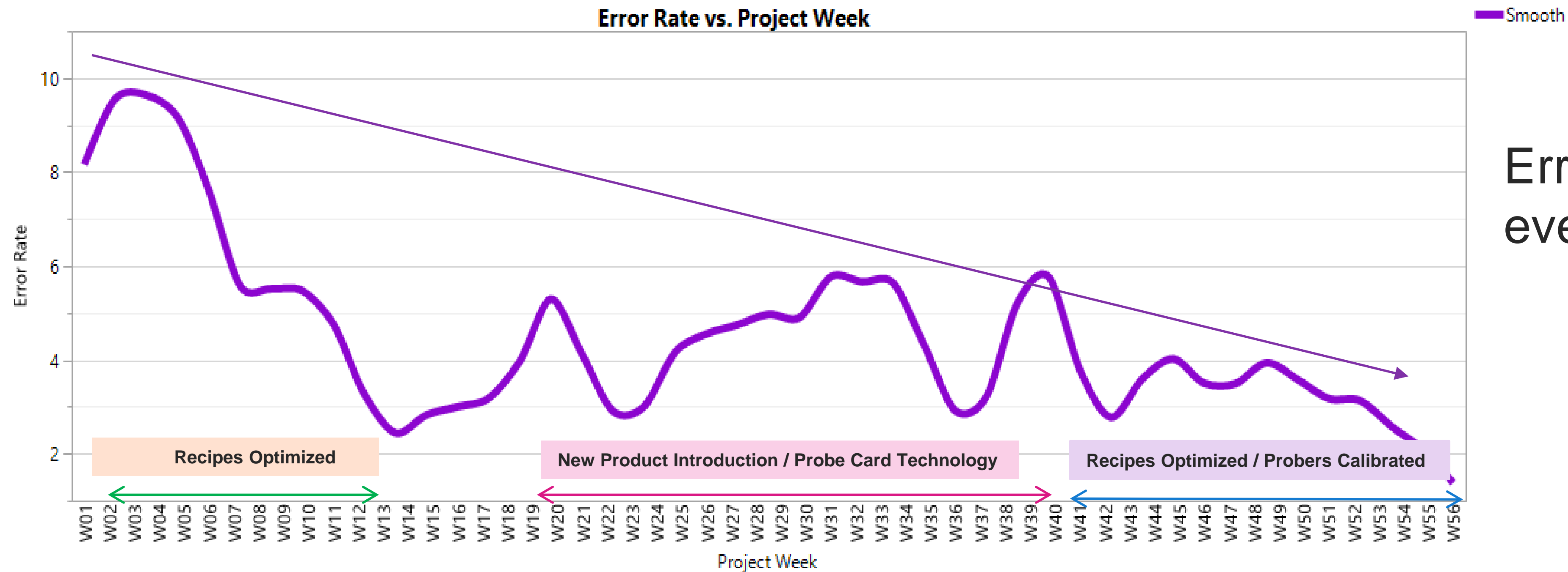
Real world error/assist reduction (~100 test cells)



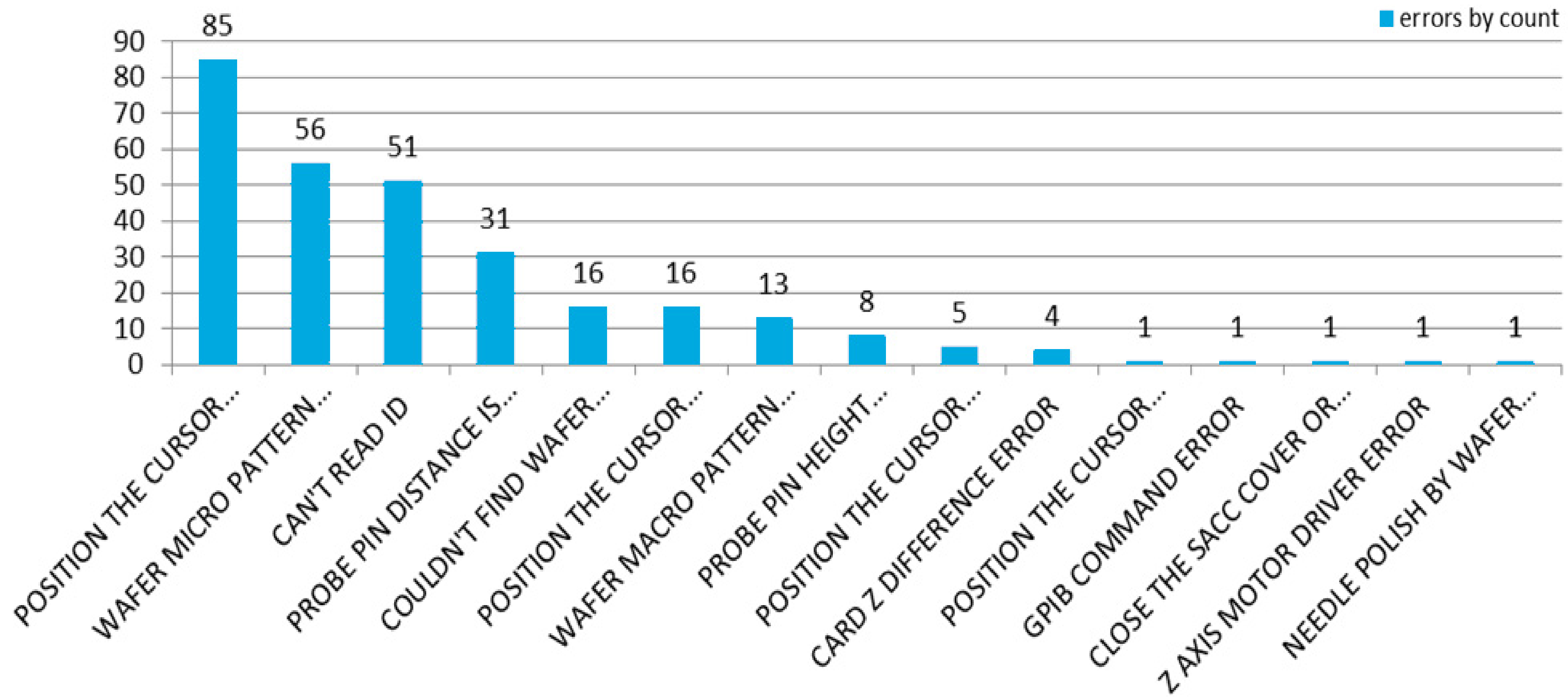
Error rate =
events per 100 wafers

- At trial start, customer Error Rate of **~8,** with ~350 errors/assists/wk
- After one year, customer Error Rate was < **1.5** with ~275 errors/assists with increased loads (>4x the wafers per week volume)

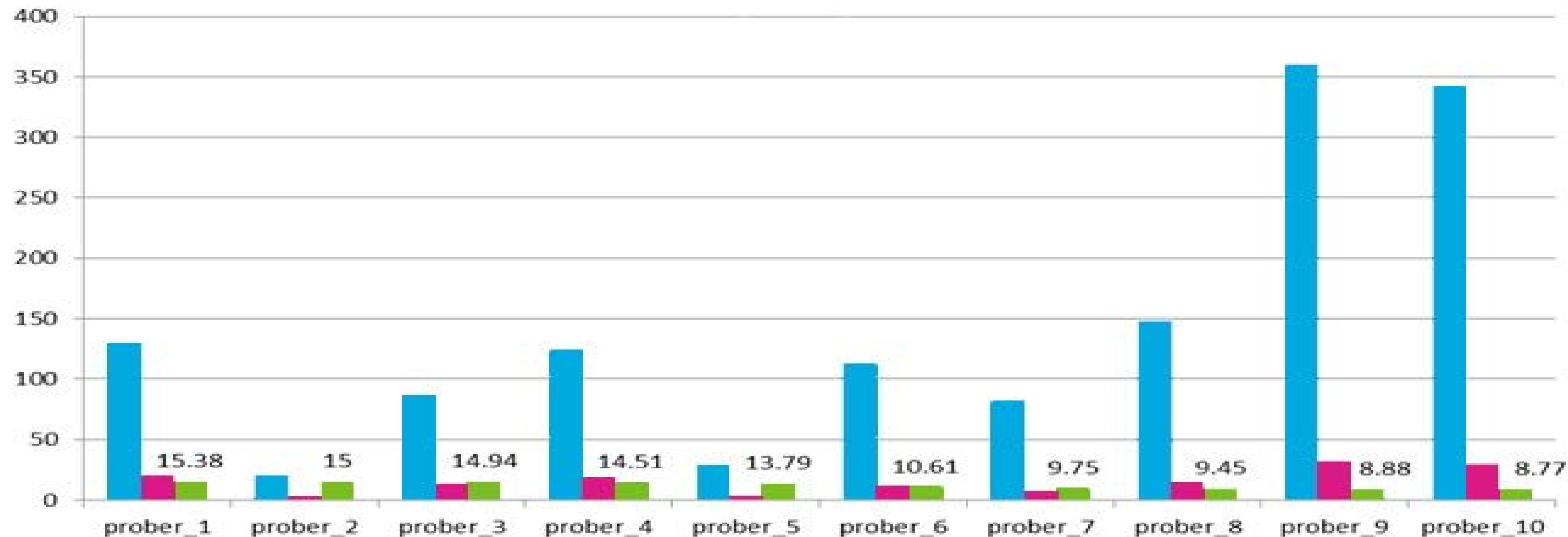
Drilling down

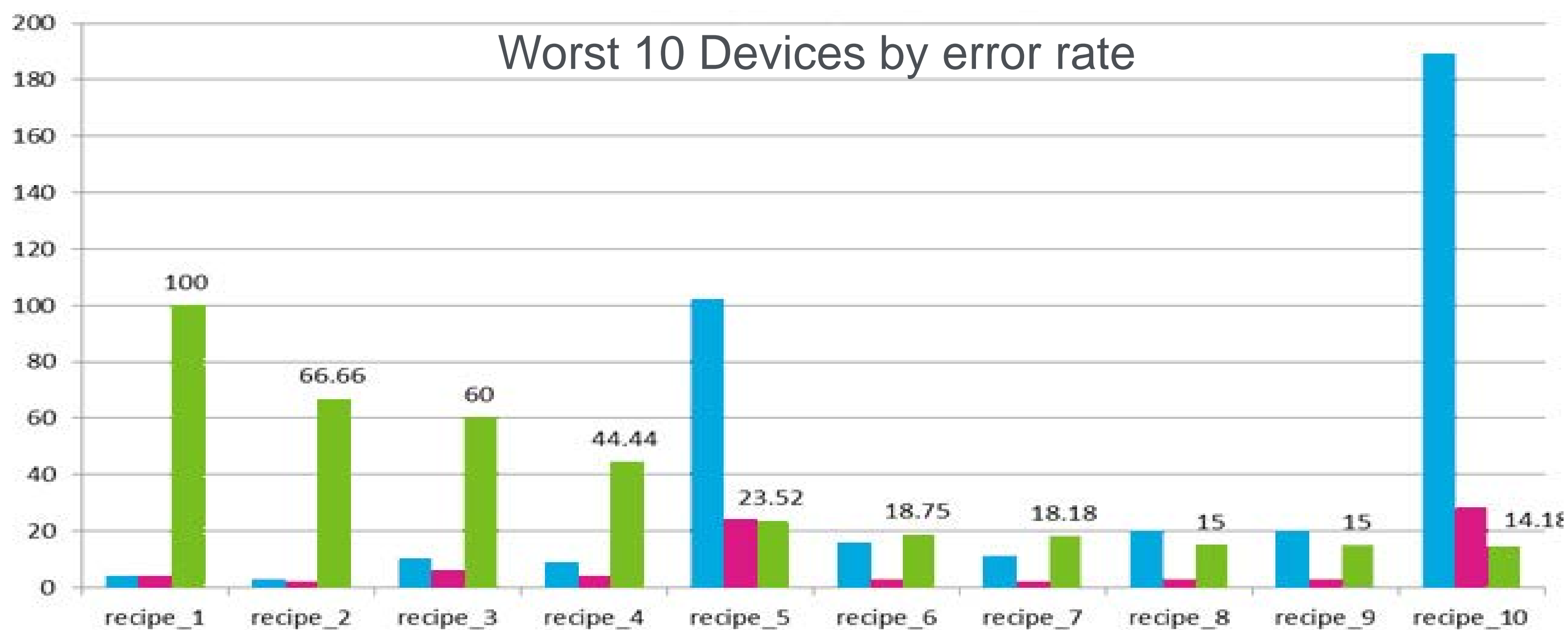
- Overall progress shows major achievements
- "Drilling down" into data provides the detail needed for targeted action
- The current error/assist drill down capabilities include:
  - Top errors/assist per week by type
  - Pareto analysis of errors/assists by prober or recipe
  - Comparing the same recipe across several probers
  - Comparing the same prober running several recipes
  - Calculating time within an Error State
  - Calculating the most expensive errors and assists by type (time)
  - Breakdown of errors/assists by prober/recipe

Weekly count of errors/assists



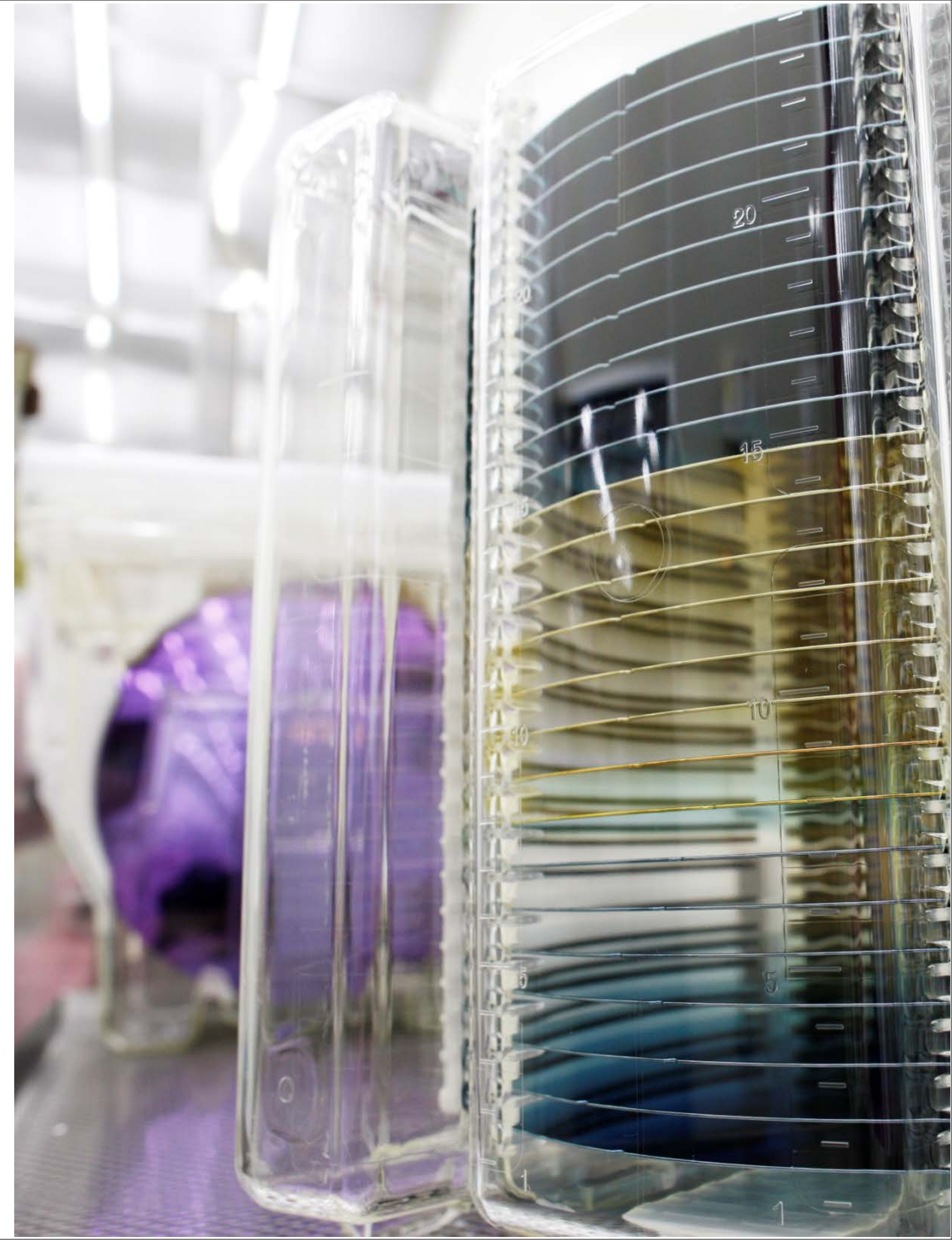
Weekly breakdown by prober and recipe





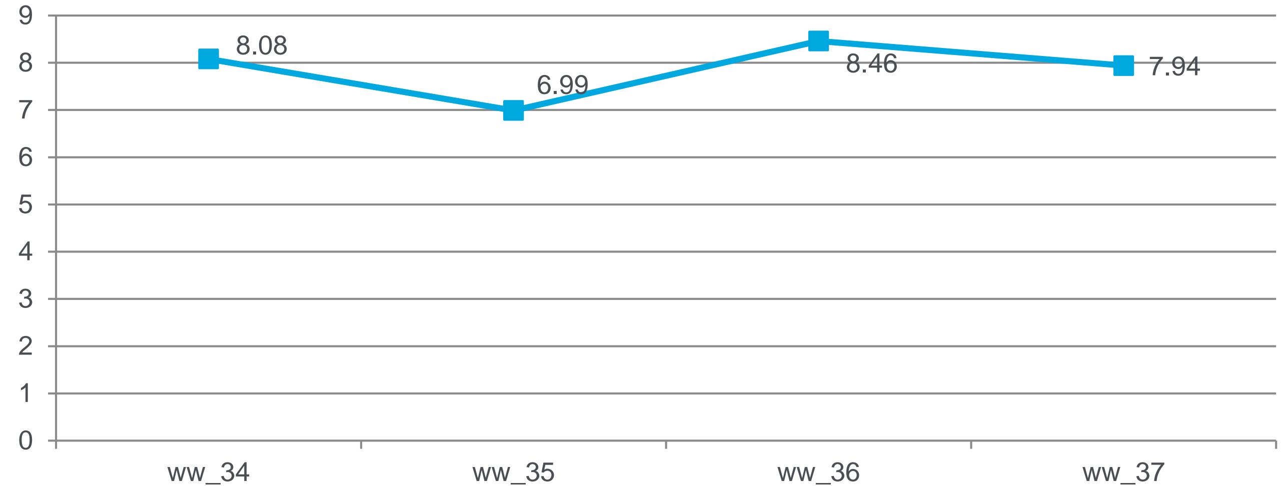
Event profiling overview

- Reducing errors/assists is an obvious goal
  - Errors/assists require operator intervention
  - Wait time = lost production time
- Other operational improvements are less obvious
  - Many settings and variables affect operation
  - Not all problems result in tool alarms
- The best way to measure operational efficiency is to profile each operation (measure time in state).
- Three major events to start profiling based on Customer Need.
  - Probe alignment
  - Wafer alignment
  - Probe cleaning
- Key point: we are only showing “Normal” operating behavior.
  - Wafers with error/assist events are removed from the sample
  - Time from that particular event is not counted

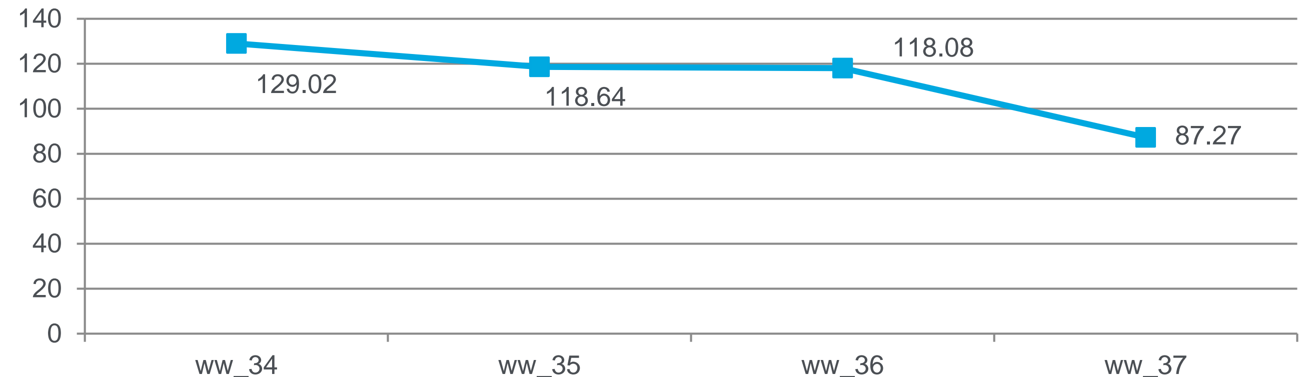


Time lost to errors/assists

Average error event (minutes)
This is the average amount of time in minutes it takes to return to a productive state after an error or assist. Operator response time is included within this value.



Total time in error state (hours)
This is the total amount of time in hours spent within an error or assist for the week.



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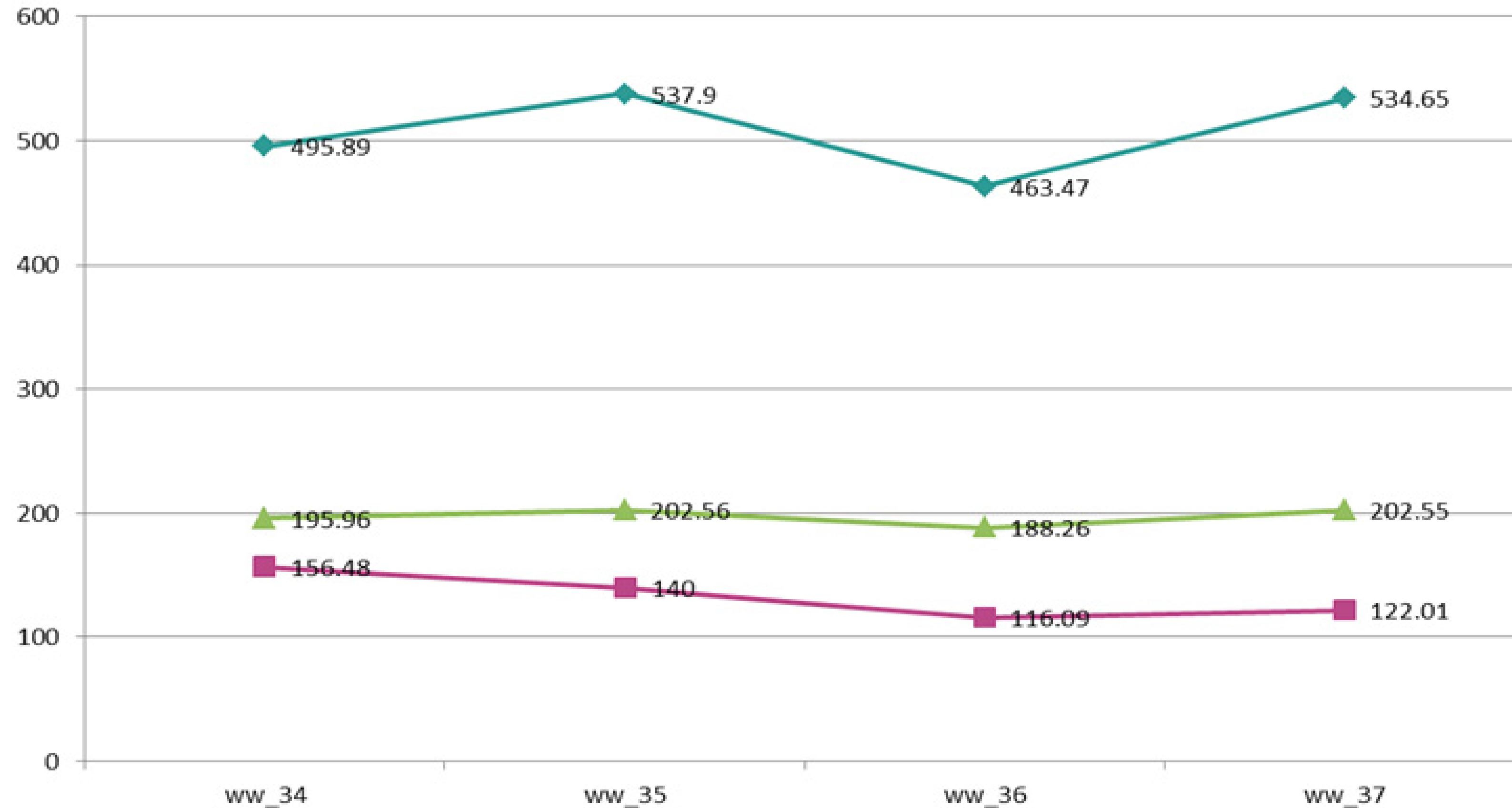
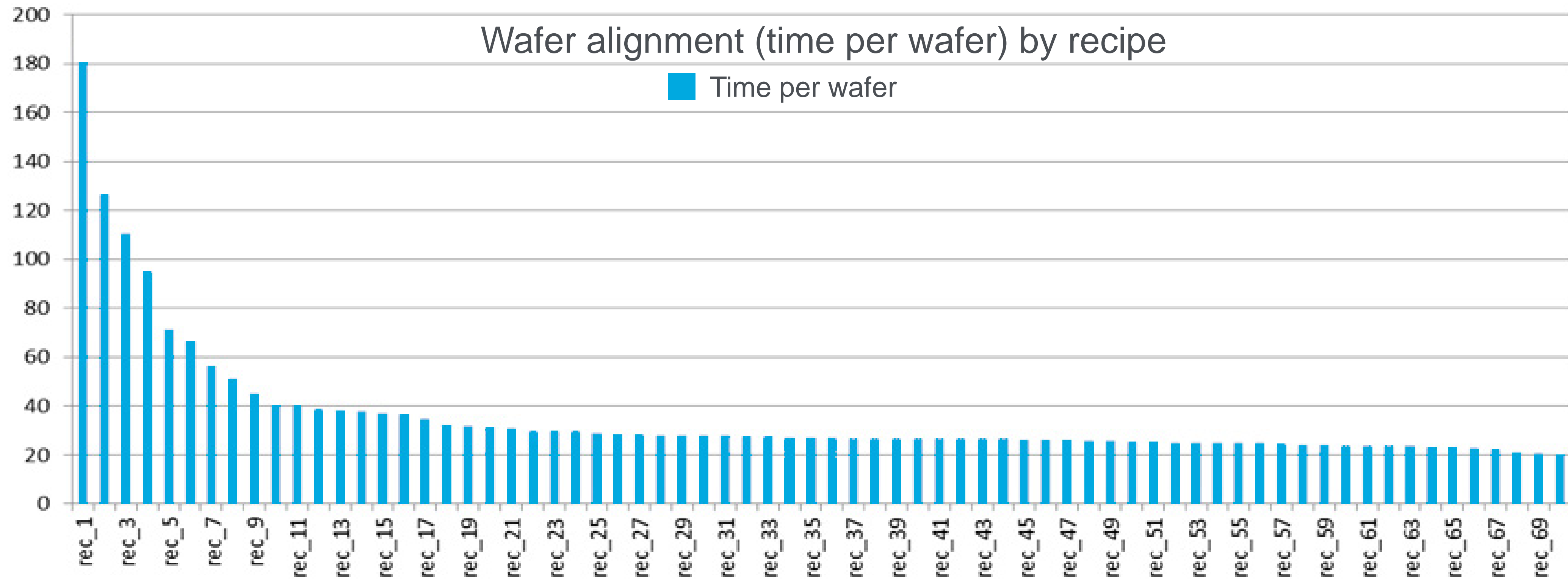
Total time for each event (hours)



Note: This data is **not** normalized. Values rise and fall with production volume.

Drilling down on wafer alignments



This chart shows the wafer alignment time per wafer by recipe

- Some recipes require more wafer alignment time than others
- Increased time indicates potential problems
- Investigate for potential improvement

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Real world results

- Using TELeMetrics facilitates "data driven" results
- Analysis pinpoints specific areas for improvement
- Customer change by percentage after one year:

Error reduction:	**136% decrease**
Wafer alignment time:	**46% decrease**
Probe alignment time:	**52% decrease**
Cleaning time:	**77% decrease**

Total savings: Over 600 production hours per week!

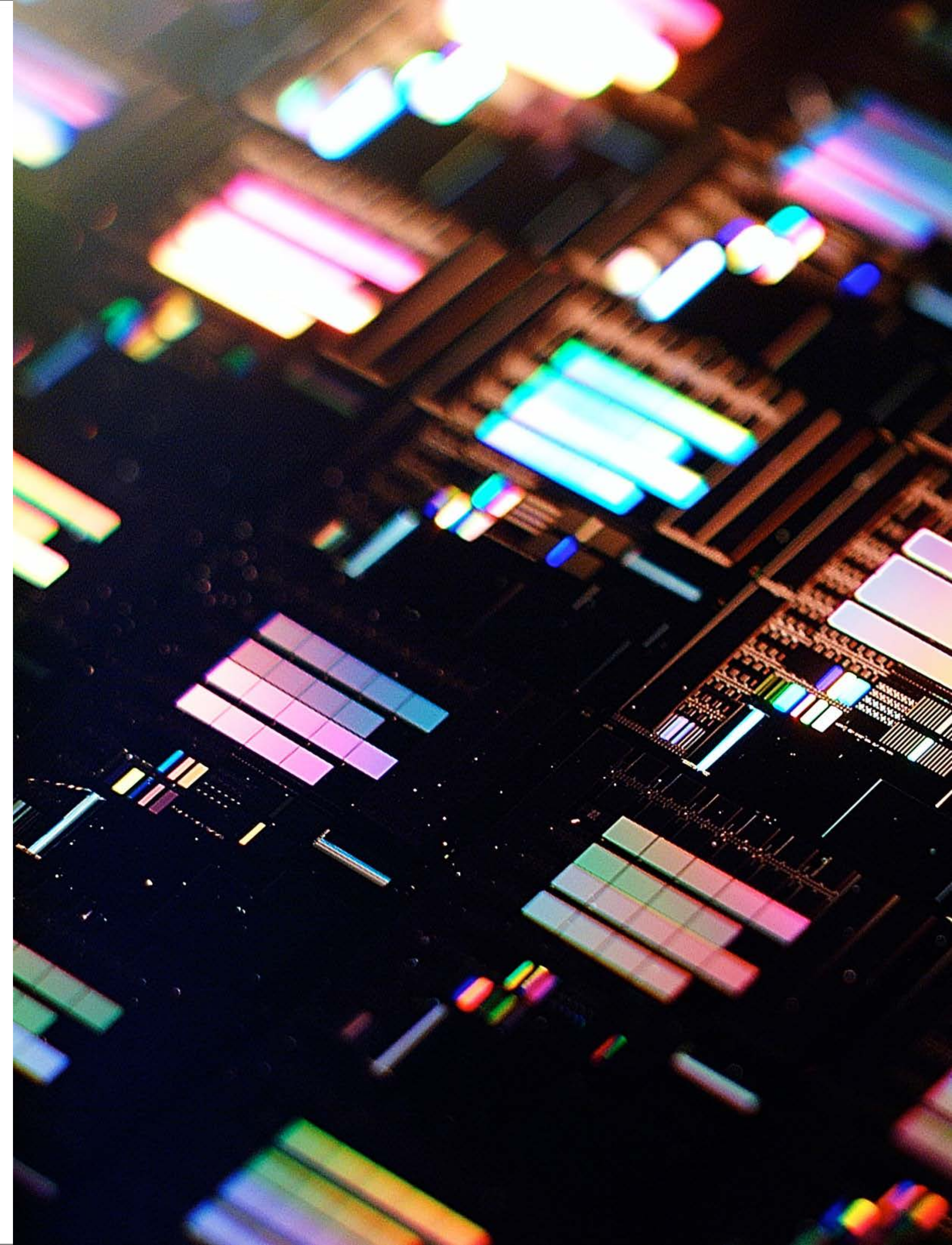
Under development/ Future capabilities

Currently under development:

- Parameter comparison for tool/recipe matching
- Interactive web interface

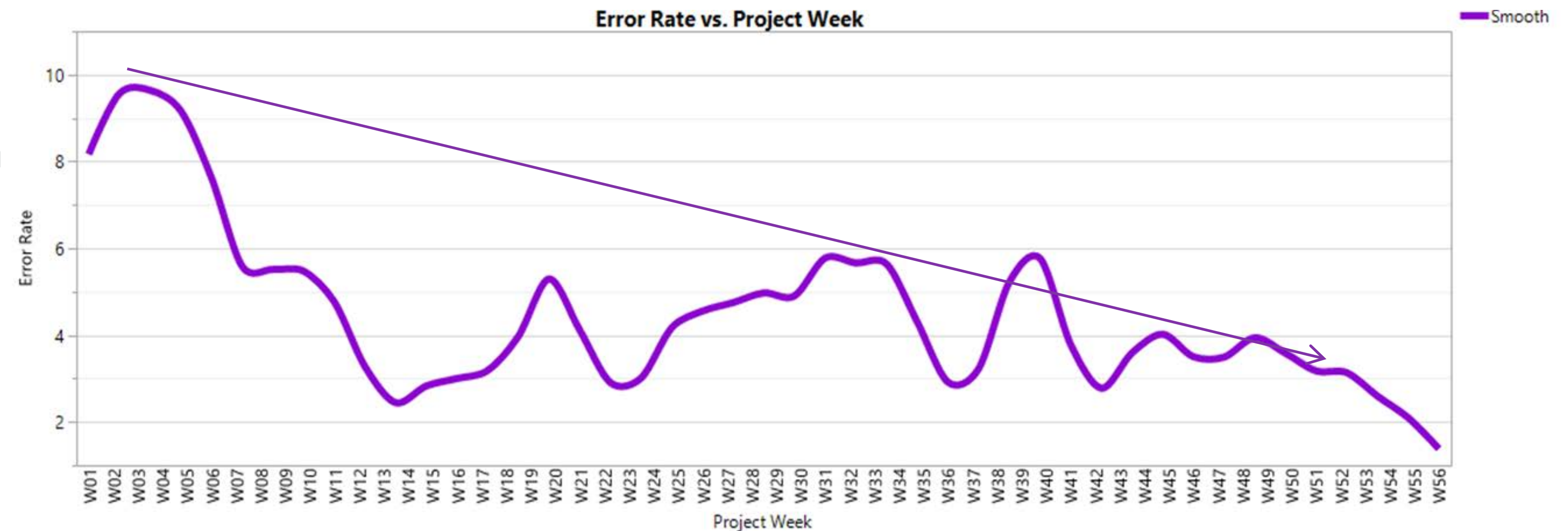
Future capabilities:

- Expand event profiling for all other events
- Predictive maintenance
- Automated troubleshooting algorithms

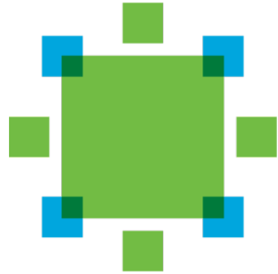


Conclusion

- TELeMetrics provides the data necessary to improve both prober and wafer file (recipe) performance.
- Being "data driven" means having data that is:
  - Accurate
  - Relevant to your problem domain
- Small changes add up
  - A single small change can save or cost many hours of production time per week
  - This system gives deeper visibility into your process
- With TELeMetrics, we can
  - Monitor your equipment
  - Recommend a course of action
  - Measure the results



Q & A



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