Appendix A: Metrics

This appendix lists all the metrics that are generated by XL, along with their units of measure and descriptions. Some metrics are directly measured by XL, while others are derived through calculations. When metrics are derived the calculation is shown as part of the description.

Metrics and dimensions are fundamental to how XL tracks production information. Metrics are numeric values that measure a quantitative characteristic of production, such as Good Count, OEE, or Labor Efficiency.

Counts

Core Counters

Metric	Units	Description
In Count	Pieces	Number of pieces that have entered the manufacturing process.
Good Count	Pieces	Number of good pieces that have been manufactured.
Reject Count	Pieces	Number of reject pieces that have been manufactured.
End of Line Count	Pieces	Typically used to count product at the end of the line. Product might be pieces, boxes, or pallets.

Additional Counters

Metric	Units	Description
Total Count	Pieces	Total number of pieces that have been manufactured. Calculated as Good Count + Reject Count.
Startup Rejects	Pieces	Number of reject pieces that have been manufactured during and immediately after a changeover.
Production Rejects	Pieces	Number of reject pieces that have been manufactured during steady-state production (after startup). Calculated as Reject Count - Startup Rejects.
WIP Count	Pieces	Number of pieces between the In Count sensor and Good Count sensor. Calculated as In Count - Good Count.

Count Percentages

Metric	Units	Description
Percent Good	Percent	Percentage of manufactured pieces that are good. Identical to Quality metric. Calculated as Good Count / Total Count.
Percent Reject	Percent	Percent of manufactured pieces that are reject. Calculated as Reject Count / Total Count.

Cycles

Number of Cycles

Metric	Units	Description
Run Cycles	Cycles	Number of "normal" cycles – cycles that are shorter than the small stop threshold.
Small Stops	Cycles	Number of "longer" cycles – cycles that are longer than the small stop threshold.
Partial Cycles	Cycles	Number of "boundary" cycles – cycles that are on the boundaries of run events. Each run event has one partial cycle. Whereas Run Cycles and Small Stops are measured from input to input, each partial cycle includes time from the start of the run event to the first input plus time from the last input to the end of the run event.
Total Cycles	Cycles	Total number of cycles. Calculated as Run Cycles + Small Stops + Partial Cycles.
Equipment Cycles	Cycles	Total number of cycles across ALL production states. All other cycle metrics are ONLY measured during run events. This metric is particularly useful for cycle-based work center care programs.

Cycle Loss

Metric	Units	Description
Run Cycle Lost Time	Seconds	Time in excess of ICT for Run Cycles (waste). If this number is negative the ICT is set too high.
Partial Cycle Lost Time	Seconds	Time in excess of ICT for Partial Cycles (waste).
Cycle Lost Time	Seconds	Time in excess of ICT for Run Cycles and Partial Cycles (waste). One of the Six Big Losses. Calculated as Run Cycle Lost Time + Partial Cycle Lost Time.
Small Stop Lost Time	Seconds	Time in excess of ICT for Small Stops (waste). One of the Six Big Losses.

Cycle Times

Metric	Units	Description
Ideal Cycle Time	Seconds	Theoretical fastest possible time to complete one cycle for the currently running part. Configured on a part-by-part basis.
Ideal Time	Seconds	Theoretical fastest possible time that it should have taken to complete all cycles. Used to calculate other metrics and not usually of direct interest to users.
Current Cycle Time	Seconds	Time spent so far in the current cycle. Restarts at zero with every new cycle.
Previous Cycle Time	Seconds	Time it took to complete the most recent cycle.
Total Cycle Time	Seconds	Accumulated time for all cycles. Equals Run Time. Calculated as Ideal Time + Run Cycle Lost Time + Partial Cycle Lost Time + Small Stop Lost Time.

Average Cycle Times

Metric	Units	Description
Avg. Cycle Time	Seconds	Average time for a cycle. Includes all cycles during run time. Calculated as Total Cycle Time / Total Cycles.
Avg. Ideal Cycle Time	Seconds	Theoretical fastest possible time for one cycle as averaged across a time period. Calculated as Ideal Time / Total Cycles.
Avg. Run Cycle Time	Seconds	Average time for each run cycle. Does not include small stops or partial cycles (i.e., it is analogous to the speed of your process when it is running). Calculated as Avg. Ideal Cycle Time + Run Cycle Lost Time / Run Cycles.
Avg. Small Stop Time	Seconds	Average time for each small stop. Calculated as Avg. Ideal Cycle Time + Small Stop Lost Time / Small Stops.

Labor

Team Size

Metric	Units	Description
Current Team Size	People	Number of people currently working at the work center. Used to generate labor time metrics. Note that labor time is accumulated unless production is "not scheduled".
Team Size	People	Average number of people working at the work center. Calculated as Total Labor / Production Time.

Labor per Piece

Metric	Units	Description
Current Target Labor per Piece	Seconds	Expected labor time to manufacture one good piece. Configured on a part-by-part basis.
Target Labor per Piece	Seconds	Expected labor time to manufacture one good piece as averaged across a time period. Calculated as Earned Labor / Good Count.
Labor per Good Piece	Seconds	Actual labor time to manufacture one good piece. Calculated as Total Labor / Good Count.
Labor per Piece	Seconds	Actual labor time to manufacture one piece. Calculated as Total Labor / Total Count.

Pieces per Labor Hour

Metric	Units	Description
Good Pieces per Labor Hour	Pieces	Good pieces manufactured per hour of labor time. Calculated as Good Count / Total Labor Hours.
Pieces per Labor Hour	Pieces	Pieces manufactured per hour of labor time. Calculated as Total Count / Total Labor Hours.

Labor Efficiency

Metric	Units	Description
Earned Labor	Seconds	Labor time "earned" by manufacturing good pieces. Each time a good piece is manufactured the Current Target Labor per Piece is added to Earned Labor.
Lost Labor	Seconds	Labor time "lost" by taking longer than expected to manufacture good pieces. If this number is negative, pieces are taking less than the target labor time to manufacture. Calculated as Total Labor - Earned Labor.
Total Labor	Seconds	The total of labor time on this work center. Note that labor time is accumulated unless production is "not scheduled". The accumulated amount of labor time on this Work Center during Production Time. Each second of Production Time is multiplied by Current Team Size to generate this metric. Total Labor is comprised of two parts - Earned Labor (time "earned" by producing good pieces) and Lost Labor.
Labor Efficiency	Percent	How actual labor time compares to the target, expressed as a percentage. This is the preferred metric for comparisons as it is normalized. In other words, 100% is meeting expectations and better than 100% is exceeding expectations. Calculated as Earned Labor / Total Labor.

OEE

Core OEE

Metric	Units	Description
Availability	Percent	Percentage of planned production time where the process is running. 100% Availability means the process is always running during planned production time. Calculated as Run Time / Production Time.
Performance	Percent	Percentage that compares the theoretical maximum speed (based on ideal cycle time) to the actual speed (based on accumulated run time). 100% Performance means when the process is running it is running as fast as possible. Calculated as Ideal Time / Run Time.
Quality	Percent	Percentage of manufactured pieces that meet quality standards. 100% Quality means there are no rejects. Calculated as Good Count / Total Count.
OEE	Percent	Percentage of planned production time that is fully productive. 100% OEE means perfect production (always running, as fast as possible, manufacturing only good pieces). Calculated as Availability × Performance × Quality.

OEE Loss Percentages

Metric	Units	Description
Availability Loss	Percent	Percentage of planned production time lost to the process not running. Accounts for planned and unplanned stops. Calculated as 100% - Availability.
Performance Loss	Percent	Percentage of planned production time lost to running slower than the theoretical maximum speed. Accounts for cycles longer than the ideal cycle time. Calculated as (100% - Performance) × Availability.
Quality Loss	Percent	Percentage of planned production time lost to manufacturing pieces that do not meet quality standards. Accounts for defects (including parts that need rework). Calculated as (100% - Quality) × Availability × Performance.
OEE Loss	Percent	Percentage of planned production time that is not productive. Calculated as 100% - OEE.

OEE Lost Times

Metric	Units	Description
Availability Lost Time	Seconds	Planned production time lost to the process not running. Calculated as Availability Loss × Production Time.
Performance Lost Time	Seconds	Planned production time lost to the process running slower than the theoretical maximum speed. Calculated as Performance Loss × Production Time.
Quality Lost Time	Seconds	Planned production time lost to manufacturing pieces that do not meet quality standards. Calculated as Quality Loss × Production Time.
OEE Lost Time	Seconds	Planned production time lost to all sources. Calculated as Production Time - Fully Productive Time.
Fully Productive Time	Seconds	Represents perfect production (i.e., the time it would have taken to manufacture only good pieces as fast as possible). Calculated as Percent Good x Ideal Time.

Planning

Metric	Units	Description
Goal Count	Pieces	Production goal for the current part run in terms of good pieces.
Good Count Left	Pieces	Number of good pieces remaining to reach the production goal for the current part run. Calculated as Goal Count - Good Count.
Percent Done	Percent	Progress towards production goal for the current part run. Calculated as Good Count / Goal Count.

Production Times

Impact Times

Metric	Units	Description
Run Time	Seconds	Time the process has been in the run state (e.g., running).
Down Time	Seconds	Time the process has been in the unplanned stop state (identical to Unplanned Stop Time metric).
Planned Stop Time	Seconds	Time the process has been in the planned stop state (e.g., changeover).
Not Scheduled Time	Seconds	Time the process has been in the not scheduled state (e.g., no production).

Combined Times

Metric	Units	Description
Manufacturing Time	Seconds	Time the process is expected to be running. Calculated as Run Time + Down Time.
Production Time	Seconds	Time the process is scheduled for production. Calculated as Manufacturing Time + Planned Stop Time.
All Time	Seconds	Accounts for all time. Calculated as Production Time + Not Scheduled Time.

Impact Percentages

Metric	Units	Description
Percent Run	Percent	Percentage of production time that the process has been running. Calculated as Run Time / Production Time.
Percent Down	Percent	Percentage of production time that the process has been in an unplanned stop (identical to Percent Unplanned Stop metric). Calculated as Down Time / Production Time.
Percent Planned Stop	Percent	Percentage of production time that the process has been in a planned stop. Calculated as Planned Stop Time / Production Time.

Last Impact Event Times

Metric	Units	Description
Last Run Time	Seconds	Duration of the most recent (or current) run event.
Last Down Time	Seconds	Duration of the most recent (or current) unplanned stop event (identical to Last Unplanned Stop Time metric).
Last Planned Stop Time	Seconds	Duration of the most recent (or current) planned stop event.
Last Not Scheduled Time	Seconds	Duration of the most recent (or current) not scheduled event.

General Events

Metric	Units	Description
Duration	Seconds	Duration of a given event (e.g., a shift, part run, or production state).
Start Time	Date Time	Date and time a given event started.
End Time	Date Time	Date and time a given event ended.

Production State Events

Metric	Units	Description
Elapsed Time	Seconds	Time accumulated thus far in the current production state (e.g., changeover time).
Target Time	Seconds	Expected time of the current production state (e.g., changeover target).
Remaining Time	Seconds	Expected time until the current production state ends (e.g., remaining time for a changeover). Calculated as Target Time - Elapsed Time.
Remaining Percent	Percent	Percentage of time expected to be remaining for the current production state (e.g., percent remaining for a changeover). Calculated as Remaining Time / Target Time.

Mean/Quality Times

Metric	Units	Description
MTBF	Seconds	How long on average the process runs before it is stopped by a fault (Mean Time Between Failures). Calculated as Run Time / Down Events.
MTTR	Seconds	How long on average it takes to get the process running once it is stopped by a fault (Mean Time to Repair). Calculated as Down Time / Down Events.

Days

Metric	Units	Description
Calendar Day	Days	Identifies the calendar day of an event (calendar day changes at midnight).
Production Day	Days	Identifies the production day of an event (production day changes on shift boundaries).

Six Big Losses

Six Big Losses Times

Metric	Units	Description
Down Lost Time	Seconds	Production time lost to down events (identical to Down Time and Unplanned Stop Lost Time metrics).
Planned Stop Lost Time	Seconds	Production time lost to planned stop events (identical to the Planned Stop Time metric).
Cycle Lost Time	Seconds	Production time lost to cycles longer than the ideal cycle time and shorter than the small stop threshold. Only time in excess of the ICT is considered lost. Calculated as Run Cycle Lost Time + Partial Cycle Lost Time.
Small Stop Lost Time	Seconds	Production time lost to cycles equal to or longer than the small stop threshold. Only time in excess of the ICT is considered lost.
Startup Reject Lost Time	Seconds	Production time lost to manufacturing rejects during startup. Calculated as Startup Reject Loss × Production Time.
Production Reject Lost Time	Seconds	Production time lost manufacturing rejects during steady-state production. Calculated as Production Reject Loss × Production Time.

Six Big Losses Percentages

Metric	Units	Description
Down Loss	Percent	Percentage of production time lost to down events (identical to Unplanned Stop Loss metric). Calculated as Down Lost Time / Production Time.
Planned Stop Loss	Percent	Percentage of production time lost to planned stop events. Calculated as Planned Stop Lost Time / Production Time.
Cycle Loss	Percent	Percentage of production time lost to cycles longer than ideal cycle time and shorter than the small stop threshold. Only time in excess of the ICT is considered lost. Calculated as Cycle Lost Time / Production Time.
Small Stop Loss	Percent	Percentage of production time lost to cycles equal to or longer than the small stop threshold. Only time in excess of the ICT is considered lost. Calculated as Small Stop Lost Time / Production Time.
Startup Reject Loss	Percent	Percentage of production time lost manufacturing rejects during startup. Calculated as Startup Rejects / Total Count × Availability × Performance.
Production Reject Loss	Percent	Percentage of production time lost manufacturing rejects during steady-state production. Calculated as Production Rejects / Total Count × Availability × Performance.

Speed

Metric	Units	Description
Current In Speed	PPH, PPM	Speed parts are currently entering the manufacturing process.
Current Good Speed	PPH, PPM	Speed good parts are currently being manufactured.
Current Reject Speed	PPH, PPM	Speed reject parts are currently being manufactured.
Current Total Speed	PPH, PPM	Speed parts are currently being manufactured.
Current End of Line Speed	PPH, PPM	Current speed measured at the end of the line.
In Speed	PPH, PPM	Speed that parts entered the manufacturing process, measured against Run Time. Calculated as In Count / Run Time x 60 (PPM) or In Count / Run Time x 3,600 (PPH).
Good Speed	PPH, PPM	Speed that good parts were manufactured, measured against Run Time. Calculated as Good Count / Run Time x 60 (PPM) or Good Count / Run Time x 3,600 (PPH).
Reject Speed	PPH, PPM	Speed that reject parts were manufactured, measured against Run Time. Calculated as Reject Count / Run Time x 60 (PPM) or Reject Count / Run Time x 3,600 (PPH).
Total Speed	PPH, PPM	Speed that parts were manufactured, measured against Run Time. Calculated as (Good Count + Reject Count) / Run Time x 60 (PPM) or (Good Count + Reject Count) / Run Time x 3,600 (PPH).
End of Line Speed	PPH, PPM	Speed at the end of the line, measured against Run Time. Calculated as End of Line Count / Run Time x 60 (PPM) or End of Line Count / Run Time x 3600 (PPH).

Rates

Metric	Units	Description
In Rate	PPH, PPM	Rate which parts entered the manufacturing process, measured against Manufacturing Time. Calculated as In Count / (Run Time + Down Time) x 60 (PPM) or In Count / (Run Time + Down Time) x 3,600 (PPH).
Good Rate	PPH, PPM	Rate which good parts were manufactured, measured against Manufacturing Time. Calculated as Good Count / (Run Time + Down Time) x 60 (PPM) or Good Count / (Run Time + Down Time) x 3,600 (PPH).
Reject Rate	PPH, PPM	Rate which reject parts were manufactured, measured against Manufacturing Time. Calculated as Reject Count / (Run Time + Down Time) x 60 (PPM) or Reject Count / (Run Time + Down Time) x 3,600 (PPH).
Total Rate	PPH, PPM	Rate which parts were manufactured, measured against Manufacturing Time. Calculated as (Good Count + Reject Count) / (Run Time + Down Time) x 60 (PPM) or (Good Count + Reject Count) / (Run Time + Down Time) x 3,600 (PPH).
End of Line Rate	PPH, PPM	Rate at the end of line, measured against Manufacturing Time. Calculated as End of Line Count / (Run Time + Down Time) x 60 (PPM) or End of Line Count / (Run Time + Down Time) x 3,600 (PPH).
Target Rate	PPH, PPM	Target Rate of the process during manufacturing (generated from Takt Time). Calculated as Target Count / (Run Time + Down Time) x 60 (PPM) or Target Count / (Run Time + Down Time) x 3,600 (PPH).
Rate Efficiency	Percent	Ratio of actual good parts to expected good parts (identical to Efficiency metric).

Target

Takt Time

Metric	Units	Description
Takt Time	Seconds	Expected pace of manufacturing for the currently running part. Set on a part-by-part basis (as a cycle time). Includes "budgeted" losses for down time, cycles, and rejects. Does NOT include time where production is not expected to be running (breaks, meetings, changeovers, and planned maintenance). Drives the target counter and efficiency calculations.
Avg. Takt Time	Seconds	Average takt time across any time period. Calculated as Manufacturing Time / Target Cycles.
Pace Timer	Seconds	Paces production by takt time. Each cycle the value starts at the takt time and counts down.

Targets

Metric	Units	Description
Target Count	Pieces	Real-time target for good pieces. Each time the takt time elapses the target count increases. Often shown on the scoreboard together with good count to show operators where they are at as compared to expectations.
Target Cycles	Cycles	Increments each time the takt time elapses. Used to calculate other metrics and not usually of direct interest to users.

Efficiency and Variance

Metric	Units	Description
Efficiency	Percent	How production is doing as compared to expectations. 100% or higher means your team is "winning". Calculated as Good Count / Target Count.
Percent Variance	Percent	How far ahead or below expectations production is doing (as a percentage). Calculated as (Good Count - Target Count) / Target Count.
Time Variance	Seconds	How far ahead or below expectations production is doing (in terms of time). Calculated as Percent Variance × Manufacturing Time.
Count Variance	Pieces	How far ahead or below expectations production is doing (in terms of pieces). Calculated as Good Count - Target Count.

TEEP

Core TEEP

Metric	Units	Description
TEEP	Percent	Percentage of ALL time that is truly productive. Often used for capacity planning. Calculated as OEE × Utilization.
Utilization	Percent	Percentage of ALL time that is used for production. Calculated as Production Time / All Time.
Schedule Loss	Percent	Percentage of ALL time that is NOT used for production. Calculated as 100% - Utilization.
Production Loss	Percent	Percentage of ALL time that is taken up by lost production time (OEE Lost Time). Primarily used when presenting information from the perspective of all time (100%) being the sum of time not scheduled for production (Schedule Loss), time that is scheduled and productive (TEEP) and time that is scheduled and not productive (Production Loss). Can be calculated as OEE Lost Time / All Time OR 100% - Schedule Loss - TEEP.

TEEP Lost Times

Metric	Units	Description
Schedule Lost Time	Seconds	Time lost to not being used for production. Calculated as Schedule Loss × All Time
Production Lost Time	Seconds	Time lost to all sources of lost productivity during planned production time (this is simply another name for OEE Lost Time – a name which aligns with the Production Loss metric).
Hidden Factory Time	Seconds	Untapped capacity of your manufacturing process. The maximum amount of additional production that can be unlocked without capital investment. Fully utilizing this time means around-the-clock perfect production – manufacturing only good pieces, as fast as possible, with no downtime, every hour of every day. Calculated as OEE Lost Time + Schedule Lost Time.