

📄 Table of Contents

1. Introduction — What is the KPI Dashboard?
2. Quick Start (2 minutes)
3. Interface Overview
4. Importing Data — XLSX from the Simulator
5. Quality Specifications — Targets & Tolerances
6. KPI Cards — 6 Key Performance Indicators
7. Chart Selector Sidebar
8. Charts Library — All Chart Types Explained
9. Pareto — Defect Analysis
10. SPC Control Charts
11. DOE Applications — Reading Multi-Run Data
12. Practical Tips & Exploration

1. Introduction

What is the KPI Dashboard?

The **KEEPLEAN KPI Dashboard** is a data analysis and visualization tool designed to analyse the experimental results exported from the **Injection Molding Process Simulator**. After running experiments in the simulator, you export the data as an Excel (.xlsx) file and import it into the dashboard to explore charts, KPIs, Pareto defect analysis and SPC control charts.

The dashboard is entirely browser-based — no installation required. It accepts any .xlsx file produced by the KEEPLEAN simulator and renders interactive charts instantly.

🎯 Learning Objectives:

- Visualise process parameter trends across multiple experimental runs
- Calculate and monitor 6 key performance indicators at a glance
- Identify the most frequent defects using Pareto analysis
- Detect out-of-control signals with SPC X-bar control charts
- Compare SP (Setpoint) vs PV (Process Value) for each controller
- Connect simulation results to real industrial data analysis methods

Dashboard Capabilities

Feature	Description
 XLSX Import	Drag & drop or click to import any .xlsx file from the simulator — auto-detects specs
 Demo Mode	Built-in 16-run DOE 2 ⁴ dataset — explore the dashboard immediately without any file
 6 KPI Cards	Total Runs · Conformity % · Mean Weight · Mean Flatness · NOK Count · Weight σ
 14 Chart Types	Quality, Process (SP/PV), Speed, Overlays, Defect Pareto, SPC X-bar — all toggleable
 Pareto Defects	Sorted bar chart + cumulative % line — identifies top defect causes instantly
 SPC Charts	X-bar control charts for Weight and Flatness with UCL/LCL/USL/LSL control limits
 Spec Editor	Edit weight target, tolerance and flatness max directly in the dashboard
 Live Refresh	All charts and KPIs update instantly when you change specs or toggle chart visibility

The DOE Connection:

This dashboard is designed to complement a **DOE experiment** run in the simulator. Import your 8 or 16 runs, then use the charts to visually identify which factors most affect Quality outputs — exactly as you would in Minitab or JMP, but directly in the browser.

2. Quick Start (2 Minutes)

🌟 Follow these steps to explore the dashboard in under 2 minutes:

1 Open the Dashboard

Open **KEEPLEAN_KPI_Dashboard_v3.html** in your browser. No installation required. Google Chrome or Firefox recommended.

2 Load the Demo Dataset

Click the **↵ Démo 16 runs** button in the top import bar. The dashboard instantly loads a pre-built DOE 2⁴ dataset (16 runs, 4 factors). All charts and KPIs populate automatically.

3 Explore the KPI Strip

Read the 6 KPI cards below the import bar: Total Runs · Conformity % · Mean Weight · Mean Flatness · NOK Count · Weight σ . These update whenever data changes.

4 Toggle Charts On/Off

In the left sidebar, click any checkbox to show or hide a chart. Try enabling **Baril SP vs PV** to overlay setpoint and process value on the same chart.

5 Read the Pareto Chart

The **Défauts par type** chart is always visible by default. Identify the tallest bar — that is your most frequent defect type across all runs.

6 Activate SPC Charts

In the sidebar under **Cartes SPC**, enable **X-bar Poids**. A control chart appears with UCL, LCL, and individual run points colour-coded by conformity.

7 Import Your Own Data

In the Injection Simulator, click **📄 Export Excel**. Then drag the .xlsx file anywhere on the dashboard page. Your charts refresh immediately with your own experimental data.

Expected Results with Demo Data:

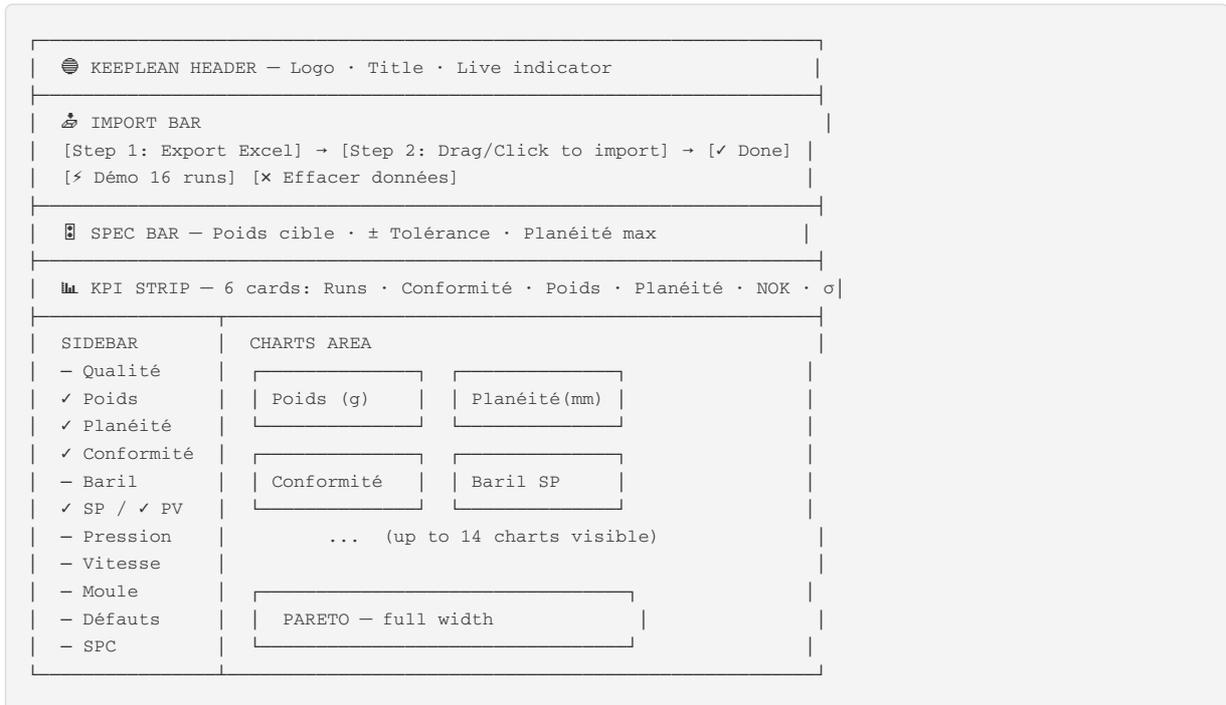
Conformity: ~75% · Mean Weight: ~48.5 g · Mean Flatness: ~0.19 mm

Dominant defect: *Warpage* (linked to flatness out-of-spec runs)

Results are deterministic for the demo dataset — your experimental results will vary.

3. Interface Overview

Layout — Top to Bottom



Key Display Elements

Element	Location	Purpose
Header	Very top	KEEPLEAN branding, live dot blinking indicator
Import Bar	Below header	3-step workflow: Export → Drag → Analyse
Spec Bar	Below import bar	Edit quality specifications — all charts refresh on change
KPI Strip	Below spec bar	6 real-time KPI cards summarising all loaded runs
Sidebar	Left panel	Toggle chart visibility by parameter group
Charts Grid	Right panel	2-column responsive grid of all selected charts
Pareto Chart	Full width	Defect frequency sorted by occurrence with cumulative %
Toast Notifications	Bottom centre	Confirms file load success or errors
Drag Overlay	Full screen	Visual drop target that appears when you drag a file over the page

4. Importing Data — XLSX from the Simulator

The 3-Step Workflow

The import bar at the top of the dashboard displays a **3-step guided workflow**:



Step	What to Do	Status Indicator
Step 1	In the simulator, run your experiment. Results appear in the table.	— (no tracking)
Step 2	Click Export Excel in the simulator. A .xlsx file downloads to your device.	Step shows ✓ green when file is ready
Step 3	Drag the .xlsx file anywhere on the dashboard page, or click Glisser / Cliquer and select the file.	Blue border → green ✓ when loaded

Import Methods

- **Drag & Drop anywhere:** Drag the .xlsx file from Windows Explorer / macOS Finder directly over the browser window. A large drop overlay appears in cyan — release to import.
- **Click the drop zone:** Click the **Glisser / Cliquer** button in the import bar → a file picker dialog opens.
- **Demo Dataset:** Click **Démo 16 runs** to load a pre-built DOE 2⁴ dataset without any file.

Auto-Detection of Specifications

If the exported .xlsx file contains a second sheet named **Summary** (automatically added by the simulator), the dashboard reads the Weight target and Flatness max from that sheet and fills the Spec Bar fields automatically. When this happens, the badge appears.

Manual Spec Override:

Even when specs are auto-detected, you can always overwrite the values in the Spec Bar fields manually. All charts and KPIs will refresh immediately. This is useful when you want to test "what if" scenarios with different tolerance windows.

Clearing Data

Click **Effacer données** to remove all loaded runs and reset the dashboard to its empty state. This does not clear the spec bar values — they remain for your next import.

Accepted Formats:

Only **.xlsx** and **.xls** files are accepted. CSV files are not supported. If you try to drop an unsupported file type, a red error toast notification will appear at the bottom of the screen.

5. Quality Specifications – Targets & Tolerances

The **Spec Bar** below the import bar controls how the dashboard interprets conformity. Three values are editable:

Field	Label	Default	Meaning
Poids cible	Weight Target	48 g	Nominal weight value the part should achieve
± Tolérance	Weight Tolerance	± 1 g	Acceptable deviation from target (bilateral tolerance)
Planéité max	Flatness Max	0.20 mm	Maximum acceptable flatness deviation (unilateral spec)

How Conformity is Calculated:

A run is marked **OK** only if *both* conditions are met simultaneously:

- Weight is within $\text{Target} \pm \text{Tolerance}$ (e.g., 47–49 g with target 48 ± 1)
- Flatness is below Planéité max (e.g., < 0.20 mm)

If either condition fails, the run is **NOK**.

When you change any spec value, all KPI cards, charts and the Pareto chart recalculate and redraw in real time — no need to re-import the data.

🔍 DOE Exploration — Sensitivity to Specs:

Try tightening the tolerance (e.g., ± 0.5 g instead of ± 1 g) and observe how conformity drops and the NOK count rises. This demonstrates **process capability** concepts: a process that is capable at ± 1 g tolerance may not be capable at ± 0.5 g.

6. KPI Cards — 6 Key Performance Indicators

The **KPI Strip** below the Spec Bar displays 6 summary metrics calculated across all loaded runs. Each card has a coloured left border and updates automatically whenever data or specs change.

<p> Total Runs</p> <p>Count of all imported runs. Blue border.</p>
<p> Conformité</p> <p>% of runs where both Weight and Flatness are in spec. Green border.</p>
<p> Poids moyen</p> <p>Mean part weight across all runs in grams. Orange border.</p>
<p> Planéité moy.</p> <p>Mean flatness across all runs in mm. Yellow border.</p>
<p> Runs NOK</p> <p>Count of non-conforming runs. Red border — turns brighter as NOK increases.</p>
<p> Variabilité</p> <p>Standard deviation of Weight across all runs. Purple border.</p>

Colour Coding

KPI	Green (Good)	Yellow (Warning)	Red (Bad)
Conformité	≥ 80%	50-79%	< 50%
Poids moyen	Within Target ± Tol	Near boundary	Outside spec
Planéité moy.	< Planéité max	Near limit	Exceeds max
Runs NOK	0 NOK	1-3 NOK	4+ NOK

σ Weight — What it Tells You:

The standard deviation of weight is a direct indicator of **process capability**. A low σ means consistent results run-to-run. High σ means high variability — which may be caused by poorly tuned PID controllers, or strong interaction effects between process factors. For a capable process with ± 1 g tolerance, σ should be well below 0.33 g (to achieve $C_p \geq 1$).

7. Chart Selector Sidebar

The left sidebar lets you **toggle individual charts on and off**. Each item has a checkbox with a coloured dot matching its chart line colour. Only active (checked) charts are displayed in the main area.

Sidebar Groups

Qualité

- Poids (g)
- Planéité (mm)
- Conformité run/run

Baril (A)

- Baril SP (°C)
- Baril PV (°C)
- Baril SP vs PV

Pression (B)

- Pression SP (bar)
- Pression PV (bar)
- Pression SP vs PV

Vitesse (C)

- Vitesse eff. (mm/s)

Moule (D)

- Moule SP (°C)
- Moule PV (°C)
- Moule SP vs PV

Défauts · SPC

- Défauts par type (Pareto)
- X-bar Poids
- X-bar Planéité

Utility Buttons

Button	Effect
Tout cocher	Enables all charts at once — up to 14 charts displayed
Tout décocher	Hides all charts — useful to start fresh and select only what you need

Recommended Workflow:

Start with all charts checked (Tout cocher) to get a full overview. Then uncheck groups you don't need for your analysis. For a focused DOE analysis, keep: Qualité + the specific factor you're studying + Pareto.

8. Charts Library – All Chart Types Explained

Quality Charts

Chart	X Axis	Y Axis	What to Look For
Poids (g)	Run #	Weight (g)	Trend up or down. Points outside target \pm tolerance band. High scatter = high variability.
Planéité (mm)	Run #	Flatness (mm)	Any point above the flatness max spec line. Systematic trends linked to parameter changes.
Conformité run/run	Run #	Cumulative conformity %	The line should trend upward toward 100%. A flat or declining line = systematic process problem.

Process Parameter Charts

For each of the 4 process factors (A Barrel, B Pressure, C Speed, D Mold), three chart variants are available:

Chart Type	Content	When to Use
SP (Setpoint) only	Single line — the commanded value for each run	Verify the DOE design — confirm factors were set at the correct levels
PV (Process Value) only	Single line — the actual value measured during the run	Assess process stability — look for consistent values, no drift
SP vs PV overlay	Two lines on the same chart — SP in solid, PV in dashed	Assess controller tracking — the smaller the gap between SP and PV, the better the PID tuning

Reading SP vs PV Overlays:

Lines closely following each other → Well-tuned PID controller, low process noise.

Large, consistent gap (PV always above/below SP) → Controller has a steady-state error — consider adjusting K_i .

PV oscillating around SP → Controller is unstable — K_p or K_i is too high.

Speed Chart

The **Vitesse eff. (mm/s)** chart plots the *effective injection speed* — the weighted average of S1, S2 and S3 — for each run. Use this to verify speed was consistent across replicates or was varied as a DOE factor.

9. Pareto – Defect Analysis

The **Pareto chart** is displayed full-width at the bottom of the chart grid, always visible when **Défauts par type** is checked in the sidebar. It is the primary tool for **root-cause prioritisation**.

How the Pareto Chart Works



Element	Description
Blue bars	Defect count per type — sorted from highest to lowest (Pareto order)
Left Y axis	Count (number of occurrences across all runs)
Red line	Cumulative percentage — reaches 100% at the last bar
Right Y axis	Cumulative % scale (0-100%)
Tooltip	Hover over a bar: shows exact count and % of runs affected

The 9 Defect Types

Defect	Triggering Condition in Simulator	Key Factors
Short Shot	Pressure PV < 1100 bar	B ↓ Pressure too low
Silver Streak	Speed > 95 mm/s eff.	C ↑ Speed too high
Jetting	Speed > 95 mm/s eff.	C ↑ Speed too high
Weld Line	Mold PV < 56°C	D ↓ Mold temp too low
Flash	Pressure PV > 1350 bar	B ↑ Pressure too high
Bubble / Void	Mold PV < 56°C	D ↓ Mold temp too low
Sink Mark	Weight out of spec (weight > target) & NOK	Packing insufficient
Warpage	Flatness out of spec (flatOK = NOK)	Flatness > max spec
Sticking	Mold PV < 53°C AND Pressure > 1300 bar	D ↓ + B ↑ combination

⚠ Reading the Pareto — Vital Few vs Useful Many:

The Pareto principle states that **~80% of defects come from ~20% of causes**. Focus on the bars to the left of the point where the red cumulative line crosses 80%. These are your "Vital Few" defect types to address first. Defects to the right of the 80% line are the "Useful Many" — lower priority.

🔗 **Using Pareto for Root Cause Analysis:**

If **Warpage** dominates the Pareto, examine your Flatness chart and Moule PV chart. If **Flash** is high, check Pression PV — it is likely exceeding 1350 bar in many runs. The Pareto gives you the "what" — the process charts give you the "why."

10. SPC Control Charts

The dashboard provides two **SPC X-bar control charts** — one for Weight and one for Flatness. Enable them from the *Cartes SPC* group in the sidebar. These charts apply classic Statistical Process Control methodology to your experimental data.

X-bar Poids

Weight (g) per run with control limits. $UCL = \bar{X} + 3\sigma$ · $LCL = \bar{X} - 3\sigma$. Spec limits USL/LSL shown separately.

X-bar Planéité

Flatness (mm) per run with UCL and USL (specification limit). Only upper limits apply for flatness.

Control Limit Lines

Line	Label	Calculation	Meaning
—	\bar{X}	Mean of all run values	Process average — the centreline
---	UCL	$\bar{X} + 3\sigma$	Upper Control Limit — statistical boundary. Points above → out of control
---	LCL	$\bar{X} - 3\sigma$ (min 0)	Lower Control Limit — points below → out of control
---	USL	Target + Tolerance	Upper Specification Limit — customer requirement
---	LSL	Target – Tolerance	Lower Specification Limit — customer requirement

Point Colour Coding

Point Colour	Meaning
 Green	Within control limits — process is in statistical control for this run
 Red	Outside control limits (UCL or LCL) — out-of-control signal, investigate cause
 Orange	Within control limits but outside spec (between UCL and USL, or between LCL and LSL)

Control Limits vs Specification Limits — Key Difference:

Control limits (UCL/LCL) are derived from the data itself ($\pm 3\sigma$). They indicate whether the *process is statistically stable*.

Specification limits (USL/LSL) come from the product requirements (Target \pm Tolerance). They indicate whether the *product meets the customer requirement*.

A process can be *in control* but *out of spec* (stable but centred wrong), or *out of control* but still *within spec* (unstable but acceptable). Both cases require different corrective actions.

🔍 **Process Capability from the SPC Chart:**

Look at the distance between USL and LSL versus UCL and LCL. If the spec limits are *wider* than the control limits, the process is capable ($C_p > 1$). If the spec limits are *narrower*, capability is poor — too much variability for the required precision. This is the foundation of **Cp / Cpk analysis**.

11. DOE Applications — Reading Multi-Run Data

The DOE 2⁴ Demo Dataset

The built-in demo dataset is a **full factorial DOE 2⁴** with 4 factors and 16 runs (no replication):

Factor	Symbol	Low Level (-)	High Level (+)	Units
Barrel Temperature	A	250	270	°C
Injection Pressure	B	1000	1400	bar
Injection Speed (eff.)	C	90 (low)	100 (high)	mm/s
Mold Temperature	D	50	80	°C

Reading the DOE Charts

A Main Effect of Pressure — Weight Chart

In the Poids chart, compare runs 1-4 (B=1000 bar) vs runs 5-8 (B=1400 bar). Higher pressure should produce heavier parts. If the weight line is clearly higher at specific run numbers, that is the main effect of B visible in the time-series chart.

B Mold Temperature Effect — Flatness & Defects

Compare runs where D=50°C vs D=80°C. Lower mold temperature (50°C) should produce more Weld Line and Sticking defects in the Pareto. Enable the Moule PV chart to confirm the actual temperature achieved.

C SP vs PV Consistency Check

Enable all three "overlay" charts (Baril SP vs PV, Pression SP vs PV, Moule SP vs PV). If the PV lines closely follow the SP lines across all 16 runs, the PID controllers were well tuned during the experiment — your data is reliable. Systematic deviations indicate controller issues.

D Export for Minitab Analysis

The .xlsx file exported from the simulator contains all columns needed for **Minitab DOE analysis**: Open Minitab → Stat → DOE → Factorial → Analyze Factorial Design. Use Weight and Flatness as responses, A/B/C/D as factors. The dashboard visuals complement — not replace — rigorous statistical analysis.

Run Order in the Dashboard:

The dashboard plots data in **run order** (x-axis = Run #). This is intentional — time-series plots reveal *time effects* (drift, warm-up) that factor-based plots hide. If you see a systematic upward or downward trend across all 16 runs regardless of factor settings, suspect a *lurking variable* (e.g., ambient temperature change, material lot change).

12. Practical Tips & Exploration

Suggested Exploration Exercises

A Spec Sensitivity Analysis

Load the demo data. Change **Planéité max** from 0.20 to 0.15 mm. How does conformity change? How does the NOK KPI card change colour? Which runs flip from OK to NOK? This shows how a tighter customer spec impacts your yield.

B Pareto Root Cause Drill-Down

Load the demo data. Identify the top 2 defects in the Pareto. For each defect, find its trigger condition in the defect table above. Then enable the corresponding process chart (e.g., Pression PV for Flash, Moule PV for Weld Line) and identify which runs triggered that defect.

C SPC vs Specs Comparison

Enable X-bar Poids. Observe where UCL/LCL fall relative to USL/LSL. Is the process capable (spec limits wider than control limits)? Now tighten the tolerance to ± 0.5 g. Observe how USL/LSL move inward — are any green points now outside the new spec limits?

D Run Your Own DOE

In the simulator, run a 2^2 full factorial (Pressure and Mold Temp only) with 3 replicates per corner = 12 runs. Export and import into the dashboard. Compare the Pareto with the demo dataset Pareto — does the distribution of defect types change? Why?

E PID Impact Study

Run 8 cycles in the simulator with **poor PID settings** ($K_p = 0.5$, $K_i = 0.1$, $K_d = 0$ on Pressure). Export and import into the dashboard. Observe σ Poids — it should be higher than with well-tuned PIDs. Then overlay Pression SP vs PV — you'll see a larger gap and more scatter.

Common Mistakes to Avoid

Mistake	Consequence	Solution
Importing a CSV instead of .xlsx	Error toast — dashboard only accepts XLSX	Use  Export Excel in the simulator (not CSV export)
Changing specs after visual analysis	Charts redraw — previously noted points may change OK/NOK status	Fix specs before starting analysis — or note that specs changed
Confusing control limits with spec limits	Wrong conclusions about process capability	UCL/LCL = statistical (from data). USL/LSL = from customer requirement

Only reading the Pareto count — ignoring % scale	1 defect in 16 runs (6%) looks same as 1 in 4 runs (25%)	Always read "% of runs" from the tooltip — hover each bar
Enabling all 14 charts simultaneously	Cluttered view — hard to read	Use Tout cocher for overview, then uncheck groups for focused analysis
Forgetting to clear data before a new experiment	Old and new runs mixed — wrong statistics	Click × Effacer données before importing a new file

Quick Reference Card

Objective	Chart(s) to Use	What to Look For
Overall quality overview	KPI strip + Poids + Planéité	Conformity %, mean vs target, scatter
Find most impactful defect	Pareto — Défauts par type	Tallest bar(s) to the left of 80% cumulative line
Check controller performance	SP vs PV overlays (Baril, Pression, Moule)	Gap between SP and PV lines, oscillation
Assess process variability	X-bar Poids (SPC)	σ , UCL/LCL width vs USL/LSL width
Identify DOE factor effect	Quality chart coloured by run	Pattern aligned with factor level changes across runs
Confirm DOE factor levels set correctly	SP charts (Baril SP, Pression SP, etc.)	Stepped pattern matching the DOE design matrix
Detect time drift or lurking variable	Any time-series chart	Systematic upward or downward trend across all runs

🔍 The Analytical Challenge:

The dashboard shows you *what happened* — KPIs, charts, and the Pareto tell you which runs failed and which defects appeared most. The deeper challenge is explaining *why* — connecting each defect and quality deviation to its root cause in the process parameters. That connection, from data to insight to corrective action, is the core skill of a **Six Sigma practitioner** and the ultimate goal of this educational tool.