Having Fun with SPC Using JMP[®] Scripting Language

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Introduction

- Statistical Process Control (SPC) is widely used at The Dow Chemical Company to investigate the process stability.
- JMP scripts are utilized to automate the statistical monitoring process.
- JMP scripts significantly reduce the data analysis time.

Example 1 Tracking Extruder Data

Background

• Aspen InforPlus. 21 ® (IP.21) was used to collect and store extrusion process data in a manufacturing plant at The Dow Chemical Company.

Example 2 Monitor Multi-Step Process Using Tab Box Background

- A complex manufacturing process at The Dow Chemical Company includes seven steps with at least 10 process variables in each step.
- The process needs to be frequently monitored to ensure control.

Multi-Step Process



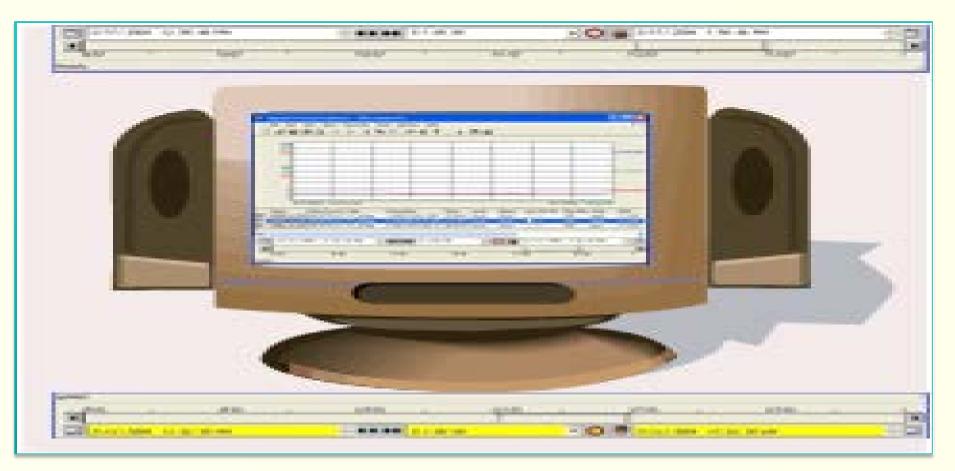
Step 6 11 variables

15 variables

- The process data was tracked daily because the product quality is strongly dependent on the deformation during extrusion.
 - IP.21Import DataDataDataDatabaseinto JMPManagementVisualization
 - Tracking the extruder data **daily** following the above 4 steps ???



JMP Script Workflow



| Connections | | |
|------------------------|-------------------------------|---|
| | Connect | Script 2 - JMP Pro |
| | Disconnect | File Edit Tables DOE Analyze Graph Tools View Window Help |
| | Refresh Connections | 🗄 🚰 🥁 🛃 👗 🖺 🧱 🗮 🔀 📄 EngineeringErrorsAndOm 💌 🆆 |
| Schemas - Tables | | Open Database("DSN=Extrusion Project;", /*Database name*/ "SELECT NAME, cast(ts as char format 'YYYY/MM/DD HH:MI:SS') as DateTime, VALUE FROM HISTORY WHERE (NAME='ABB_EX1001' or NAME='ABB_EX1002' or NAME='ABB_EX1003' or |
| Include in Table List: | ews 🔲 System Tables 📝 Synonym | NAME='ABB_EX1004' or) AND TS BETWEEN '21-Jan-11 09:56' AND '21-Jan-11 13:33' |

Step 1 : InfoPlus.21 Data Base

- Collect and store process data
- IP.21 tags used as data base storage references

Step 2: Import Data into JMP



Step 3

17 variables

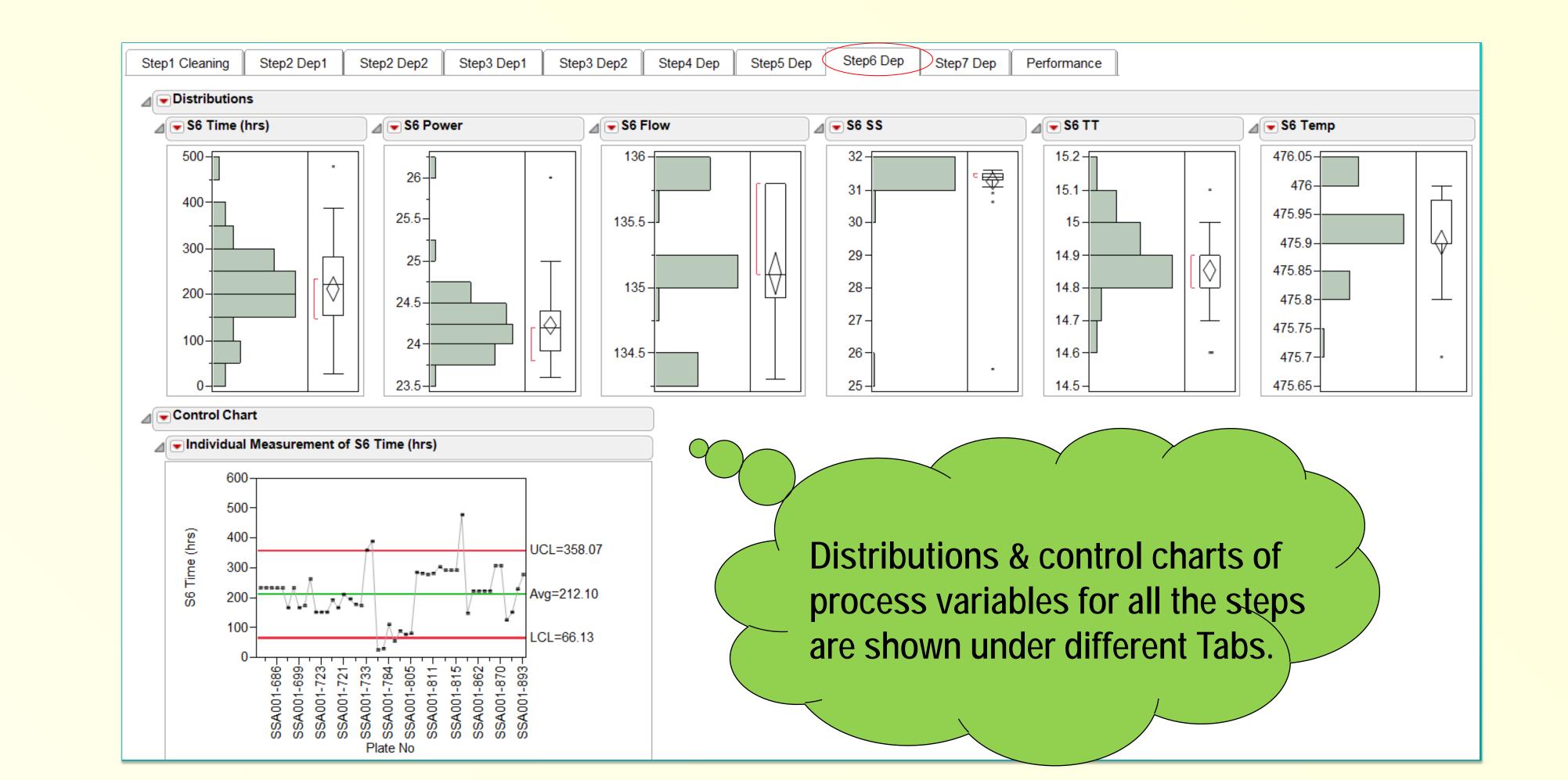
Plot Distributions and Control Charts for All the Variables in Each Step Weekly. Help!!!



Step 215 variables1

Step 1 10 variables

Advantage of Tab Box



| /*Data Management*/ | |
|---|------------------|
| /*Create data filter column to delete intended-stop data*/ | |
| RawDt << Newcolumn (| |
| "Data Filter", | |
| Character, | |
| Nominal, | |
| Formula (If(Row() == 1, 0, 0.75 < :Speed <= 3 & 0.5 < | :Position |
| [Row(), Empty()] - :Position[Row() - 1, Empty()] <= 3, 1, 0)) | |
|); | |
| | |
| | |
| /*Identify different paste loadings*/ | |
| ProcessDt << Newcolumn(| |
| "Loading", | |
| Character, | |
| Nominal, | |
| <pre>Formula (If(Row() == 1, 1, :Time for Each Run[Row(), H</pre> | |
| <pre>for Each Run[Row() - 1, Empty()] == 1, :Loading[Row() - 1, Empty()],</pre> | :Loading[Row() - |
| 1, Empty()] + 1)) | |
|); | |
| | |
| | |
| /*Create Part Number*/ | |
| ProcessDt << <u>Newcolumn(</u> | |
| "Part", | |
| Numeric, | |
| Continuous, | |
| Formula (Row()/20) | |
|); | |
| [| |

Connect to IP.21 database

- Select key process variables
- Directly import data into JMP

Step 3: Data Management

- Filter out intended-stop data
- Identify different batch loadings
- Create part numbers

Step 4: Data Visualization

- Monitor extrusion speed w/ run charts
- Investigate correlations by overlay plots



The Tab Box scripting logic allows for simultaneous viewing of over a hundred variables for quick identification of a sudden change or problem anywhere in the multi-step process.

Conclusion

Monitoring manufacturing processes is often long-term, on-going and requires





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repeated work.

- JMP Scripting Language is used to automate the SPC process, thus significantly reducing the analysis time.
- Statistical graphics provide a better understanding of variation in the process.