The Minitab Blog

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在一個專案檔中發現如何在鍛造製程中降低成本並提高品質

Evan McLaughlin 17 September, 2020

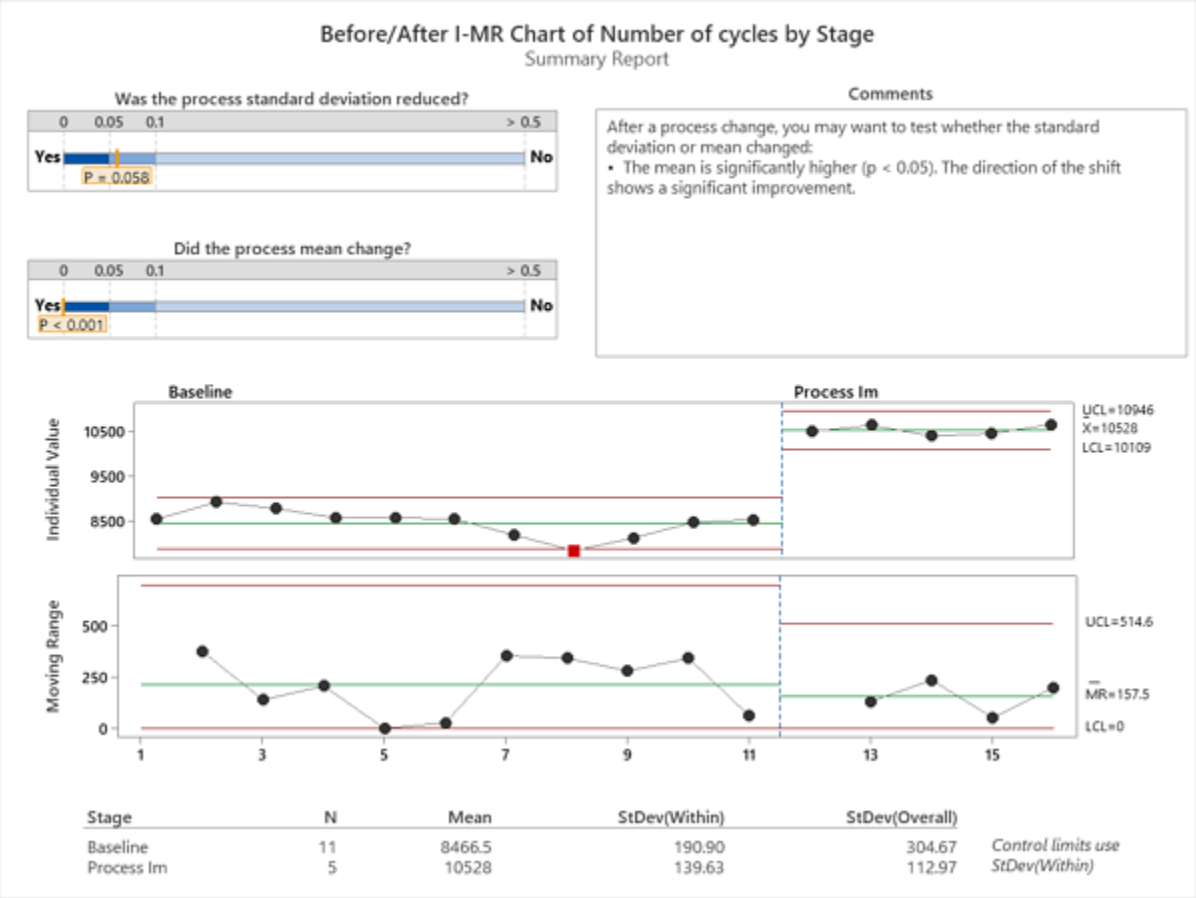
對於鋼鐵的堅固性和可靠性無需爭論，它是製作持久耐用產品的首選材料。但是，當您的產品是由如此堅固的材料製成時，您甚至需要更強大的工具來製造產品本身，更不用說需要對您的數據有很強的掌握力，並可以提供何時將需要維修或更換機器的可靠見解。

讓我們來看一家鍛造公司 - 我們將它稱為 Silver Dam International - 製程工程師 Bill 正在研究鍛模和固定裝置的性能，以同時實現...

- 提高鍛造曲軸的品質；和
- 降低客戶成本

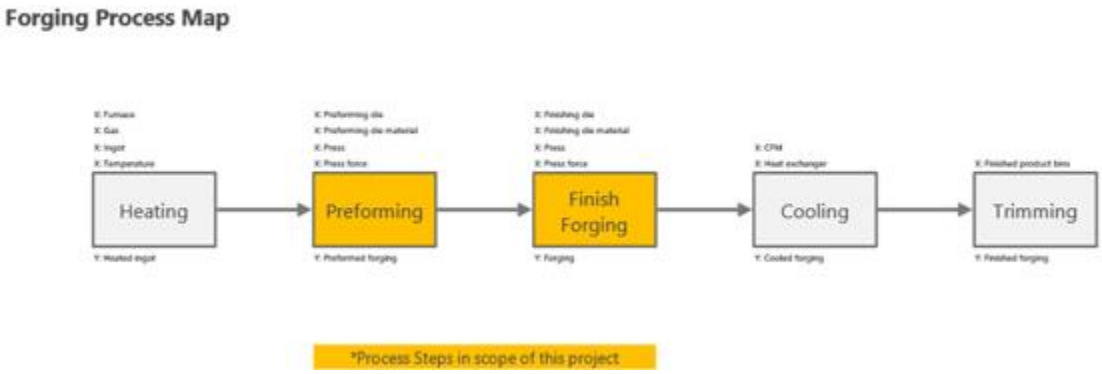
利用管制圖確定基準

首先，Bill 讓他的團隊在 Minitab 的管制圖中繪製平均循環次數，以確定基準：



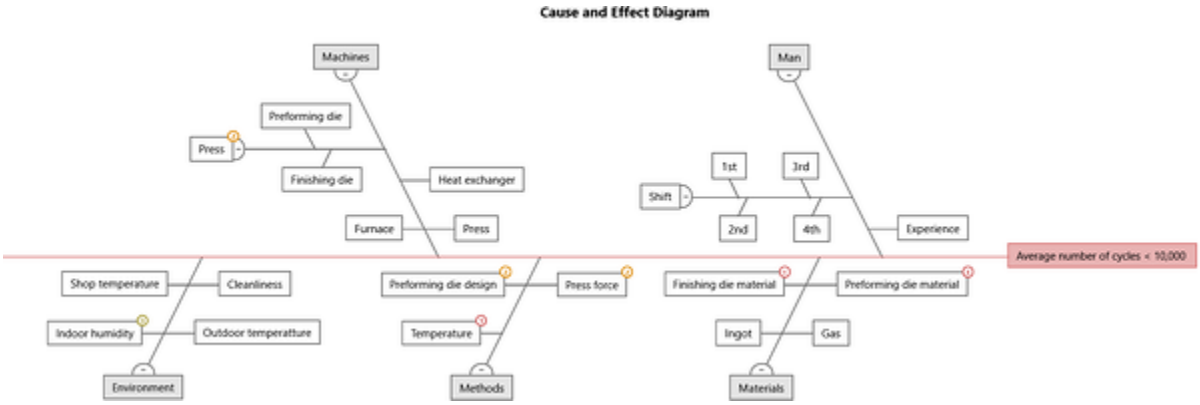
繪製流程圖

一旦該基準建立後，他們可以在 Minitab Workspace 中建立一個流程圖，確定主要製程步驟、輸入和輸出，啟發改善的機會。



腦力激盪因果關係

接著，團隊可以製作一個簡單的因果圖 (Cause and Effect Diagram) 也稱為魚骨圖 (Fishbone) 來集思廣益潛在的錯誤原因：



最後，制定了 FMEA 和控制計劃幫助規劃改善路徑

Bill 和團隊在 Workspace 中完成了失效模式和效應分析 (FMEA)，評估風險並確定緩解機會。他們已經在控制計劃 (Control Plan) 中記錄了規格限制、檢查頻率和應變計劃，確保對製程的持續改進。

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FMEA

																Revised Metrics			
Step #	Process Map - Activity	Key Process Input	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN	Actions Recommended	Responsibility	Target End Date	Actions Taken	Actual End Date	SEV	OCC	DET	RPN
1	Process Map - Preforming	Preforming die	Premature wear	Reduced forging die life	7	Incorrect material die selection	6	Corporate materials selection guidelines	7	294	Review guidelines	Engineering	3/23/2020	Guidelines updated with input from corporate materials engineering team	4/15/2020	7	4	4	112
2			Plastic deformation	Micro cracking leading to severe failure	8	Incorrect heat treatment	6	SPC	3	144						8	6	3	144
3			Thermal fatigue	Micro cracking leading to severe failure	8	Incorrect temperature calibration	5	PM schedule	5	200	Update PM procedure	Maintenance	4/15/2020	PM schedule updated	4/13/2020	8	3	3	72
4		Preforming die material	Plastic deformation	Die deformation	9	Excessive pressure applied	6	SPC	3	162	Review historical SPC data	Manufacturing	4/30/2020	SPC data shows special causes of variation to be further investigated	4/30/2020	9	5	3	135
5				Material slip behavior	7	Poor die design	5	Engineering design guidelines	6	210	Review guidelines	Engineering	4/30/2020	Guidelines updated with input from corporate engineering team	4/15/2020	7	3	4	84
6				Low yield strenght	6	Incorrect machine calibration	7	PM schedule	7	294	Update PM procedure	Maintenance	4/15/2020	PM schedule updated	4/13/2020	6	7	4	168
7		Press force	Incomplete stroke	Finished product out of spec	6	Incorrect machine setup	7	Machine setup checklist	3	126						6	7	3	126
8			Inadequate force - too low	Unfilled cavities	6	Incorrect machine setup	7	Machine setup checklist	3	126						6	7	3	126
9			Inadequate force - too high	Over flush	8	Incorrect machine setup	8	Machine setup checklist	3	192	Review machine setup checklist	Manufacturing	5/30/2020	Check list expanded to include step by step setup and video	6/1/2020	8	4	3	96
10	Process Map - Finish Forging	Finishing die	Premature wear	Reduced forging die life	7	Inadequate lubrication	6	PM schedule	5	210	Update PM procedure	Maintenance	5/30/2020	PM schedule updated		7	3	3	63
11			Plastic deformation	Micro cracking leading to severe failure	8	Excessive pressure applied	5	None	9	360	Conduct DOE and implement process parameters	CI team	6/1/2020	Factorial DOE completed, scheduling CCD to investigate curvature	6/15/2020	8	4	5	160
12			Thermal fatigue	Micro cracking leading to severe failure	8	Incorrect temperature settings	5	Machine setup checklist	3	120						8	5	3	120
13		Finishing die material	Plastic deformation	Material slip behavior	7	Excessive pressure applied	6	None	9	378	Develop materials engineering test	Engineering	6/30/2020	Guidelines updated with input from corporate materials engineering team	6/15/2020	7	6	5	210
14			Erosive wear	Reduced forging die life	7	Poor die maintenance	8	None	9	504	Conduct DOE and implement process parameters	CI team	6/1/2020	Factorial DOE completed, scheduling CCD to investigate curvature	6/15/2020	7	4	5	140
15		Press force	Inadequate force - too high	Unfilled cavities	6	Incorrect machine setup	7	Machine setup checklist	3	126						6	7	3	126
16			Inadequate force - too high	Over flush	8	Incorrect machine setup	5	Machine setup checklist	3	120						8	5	3	120

視覺化一切

鍛模是一種工具，必須有足夠的強度迫使金屬變為所需形狀而不會缺損或破碎，但在對有如此多變數的製程進行全面評估時，您需要不同種類的工具和強度：您的數據分析和專案軟體。

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Bill 和他的團隊在 Silver Dam International 使用各種解決問題的工具，全面視覺化影響鍛造製程的關鍵因素。團隊利用了他們收集的數據並且在 Minitab 統計軟體中進行分析，發現了基準指標和改善流程的機會，他們可以輕鬆地點擊滑鼠右鍵，將其匯入 Minitab Workspace。他們可以在其中的流程圖 (Process Map) 中視覺化流程，透過魚骨圖 (Fishbone) 和整體計劃集思廣益、腦力激盪如何解決浪費，並使用 FMEA 和控制計劃 (Control Plan) 文件檔處理最關鍵的流程輸入。

利用具有共同目的的一系列工具相輔相成，可以幫助您實現成功的願景！

免費試用 Minitab 統計軟體 和 Minitab Workspace 30 天

下載 Minitab Workspace 試用

下載 Minitab 統計軟體試用

感謝 Minitab 解決方案架構師 Antonio Vargas 在此案例方面的研究和技術支援！

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