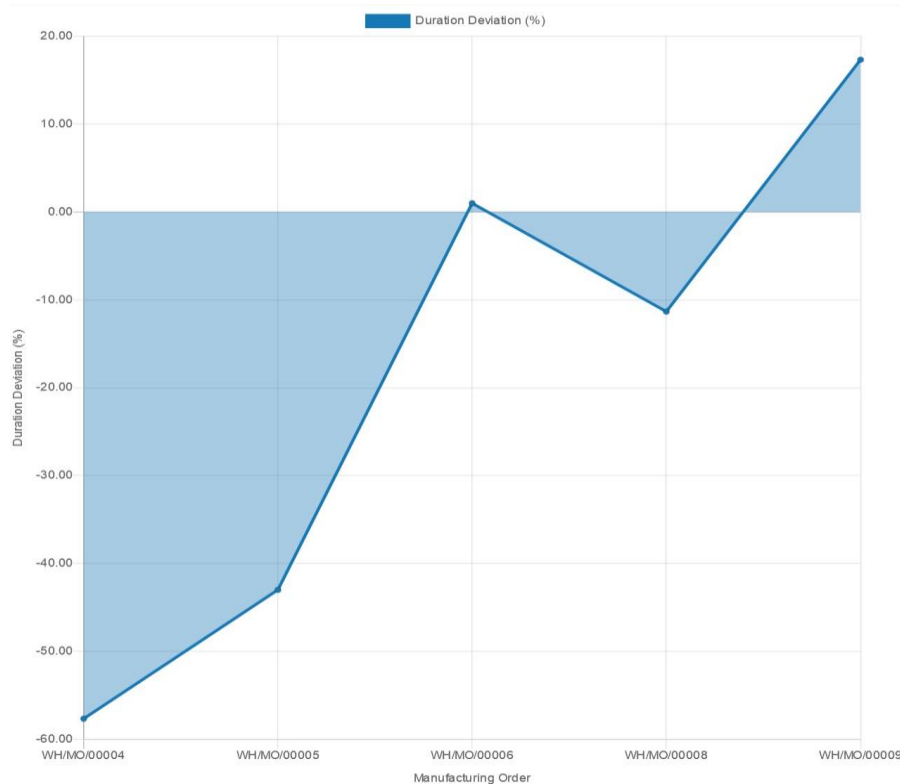


**Figure 67 Real duration regarding work orders**

圖表 67：工作訂單的實際持續時間

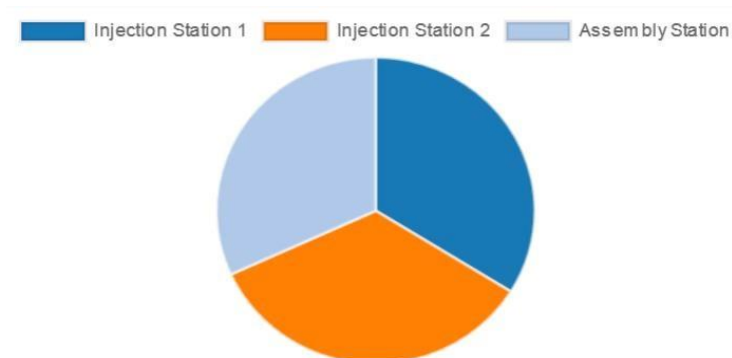
Something worth mentioning here is that whenever Odoo mentions quantity or duration it is referring to amount per workorder summed (the system does not care if the operations are being carried in parallel). So, on our simulation, making 50 units using 3 operations that should take 30 seconds each the estimated “duration” to be recorded ideally here is 75 minutes per MO.

值得一提的是，每當 Odoo 提及數量或持續時間時，它指的是每個工作訂單總和的數量（系統不在乎操作是否同時進行）。因此，在我們的模擬中，使用 3 個應該每個需要 30 秒的操作來製造 50 個單位，理想情況下應記錄的“持續時間”是每個 MO 75 分鐘。



**Figure 68 Duration variation regarding work orders**

圖表 68：工作訂單的持續時間變化



**Figure 69 Overall equipment effectiveness**

圖表 69：整體設備效能

The astute reader will notice that all the data mentioned so far is derived from the time to completion of the operations been carried out, the related amount to the MO and the workcenter utilized. Even so it is impressive how much information can be drawn especially considering that it is all generated automatically.

細心的讀者會注意到，到目前為止提到的所有數據都是來自正在進行的操作完成所需的時間，與 MO 相關的數量以及使用的工作中心。即便如此，令人印象深刻的是，可以獲得多少信息，尤其考慮到這一切都是自動生成的。

## 6. CHAPTER

# ODOOS ACOMPLISHMENTS REGARDING PLM AND MES

This chapter aims to summarize the strengths and weaknesses of the Odoo software focusing on the questions raised on section 4.2. It will also comment Odoo functionalities or lack thereof noticed throughout the simulation also taking the questions into account.

有關 PLM 和 MES 方面的 Odoo 的成就

本章旨在總結 Odoo 軟件的優點和缺點，重點關注第 4.2 節提出的問題。它還將評論在模擬過程中觀察到的 Odoo 功能或缺失，同時考慮這些問題。

### 6.1. How does the software deals with items?

Overall, the Odoo software presents the user with a wide variety of digital items that can be used to represent several aspects of manufacturing as well as other aspects of business. This is mainly due to the way the Odoo ERP functionality uses items to track the pull and push actions throughout its use, that is also how automation is achieved in the software.

#### 6.1 軟體如何處理物品？

整體而言，Odoo 軟體向使用者提供了各種數位物品，可以用來代表製造的多個方面，以及業務的其他方面。這主要是由於 Odoo ERP 功能使用物品來追蹤其使用過程中的拉動和推動動作，這也是軟體實現自動化的方式。

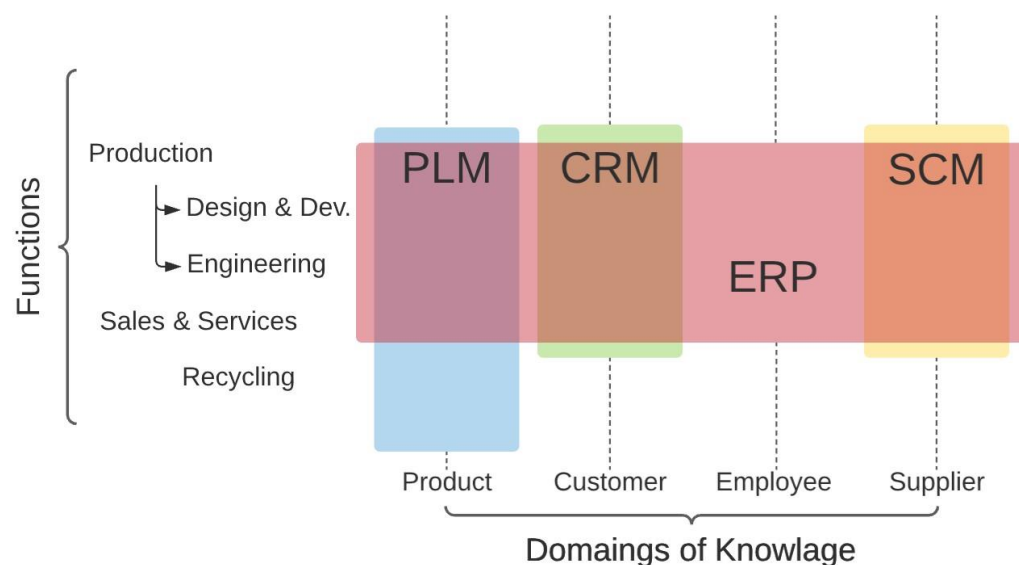
#### 6.1.1. Are all aspects of the product lifecycle represented?

One of the disadvantages of being derived from a ERP system is that it focus on the primary scope of ERP (Figure 2) ,that is, production and sales. The Items in Odoo reflect that. For instance, the development part of the life cycle during the simulation, although the representation was possible it certainly felt like a stretch of functionalities made for the production phase rather than development is self

(Figure 70). When developing prototypes for instance many of the steps like creating an ECO just to carry files in the beginning and going through many steps every time an adjustment in the prototype was made felt too bureaucratic or too much of a workaround.

#### 6.1.1 產品生命週期的所有方面是否都有所代表？

從 ERP 系統衍生出來的一個缺點是它專注於 ERP 的主要範圍（見圖 2），即生產和銷售。Odoo 中的物品反映了這一點。例如，在模擬中的開發部分，雖然表示是可能的，但確實感覺像是針對生產階段而不是開發本身的功能的拉伸（見圖 70）。例如，當開發原型時，許多步驟，如創建 ECO 以便在開始時攜帶文件並在每次調整原型時進行許多步驟，都感覺太過於官僚主義或太過於繞彎。



**Figure 70 Diagram representing Odoo scope of ERP**

圖 70：代表 Odoo ERP 範圍的圖表

#### 6.1.2. How well are each of those items represented?

Representation levels of the items vary depending on how the item is used. A good example of that is the material focus of product items. In the sense that everything is considered a product with very little distinction between prototypes or raw materials. The representation of product items or BOM items is very high with a lot of metadata and useful connections to other items. However, even within the manufacturing application there are some items that lack attention. Operations for instance are items that could benefit greatly from more upload capabilities like 3D printing or CNC files. As automation is becoming more widespread in production it is no longer enough to have only PDF or slide instructions. Additionally, other items do not have the ability of holding files not even with the use of ECOs

#### 6.1.2. 每個物品的代表程度如何？

物品的代表程度取決於該物品的使用方式。一個很好的例子是產品物品的材料焦點。在這方面，一切都被視為產品，幾乎沒有區別原型或原材料。產品項目或 BOM 項目的代表性非常高，具有大量的元數據和與其他項目的有用連接。然而，即使在製造應用程序中，也有一些缺乏關注的項目。例如，操作是一種可以從更多上傳功能中獲益的項目，例如 3D 打印或 CNC 文件。隨著自動化在生產中變得越來越普遍，僅僅擁有 PDF 或幻燈片說明已不再足夠。此外，其他項目甚至沒有保存文件的能力，即使使用 ECO 也不行。

## **6.2. How easy it is to create a brand-new product?**

Product creation is one of the most straightforward procedures in Odoo, it really comes down to using either the Inventory application or the Manufacturing application to create a new Product and then fill in its metadata.

### **6.2. 創建全新產品有多容易？**

在 Odoo 中，產品創建是最簡單的程序之一，基本上只需要使用庫存應用程序或製造應用程序來創建新產品，然後填寫其元數據即可。

### **6.2.1. How is the product depicted?**

The product depiction is clear and concise, the product item allows for an image to be uploaded to the item and used as an icon. The ERP nature of the product items in Odoo means that the metadata is reasonably bias toward information that is used to manage storage and inventory (Weight, Volume, Quantity etc.) but the item also allows for written description as well as providing links to the BOMs and ECOs related to the product.

#### **6.2.1. 產品如何被描述？**

產品的描述清晰簡潔，產品項目允許上傳圖像並用作圖示。Odoo 中產品項目的 ERP 性質意味著元數據相當偏向於用於管理儲存和庫存的信息（重量、體積、數量等），但該項目還允許書面描述，並提供與產品相關的 BOMs 和 ECOs 的鏈接。

### **6.2.2. How does the product integrate and reference relevant files?**

There is surely a reasonable attempt in allowing the most valuable items (Product and BOMs) to be able to manage and reference relevant files. However, Odoo does not implement much more than the bare minimum as far as file management goes. The most it can do is allow for files to be uploaded and download manually. This means that whenever someone makes a change in a file it needs to be manually uploaded in ECO. Integration with most files is inexistent except for operation items because the instruction files can be opened and interacted within Odoo during the

production.

#### 6.2.2. 產品如何整合和參考相關文件？

Odoo 確實試圖允許最有價值的項目（產品和 BOM）能夠管理和參考相關文件。然而，就文件管理而言，Odoo 並未實施更多的功能。它最多只能允許手動上傳和下載文件。這意味著每當有人更改文件時，都需要手動將其上傳到 ECO 中。與大多數文件的集成不存在，除了操作項目，因為製作過程中的指示文件可以在 Odoo 中打開並進行交互。

#### 6.2.3. Does changing one affects the other?

It does not, files are mostly dealt by Odoo as paperwork for later reference. Anything added file wise that could entail a change in the product or BOM metadata will require someone to be aware of the change and update the information manually.

#### 6.2.3. 更改一個是否會影響另一個？

不會，文件在大多數情況下被 Odoo 視為以供日後參考的文書工作。任何添加的文件內容，可能導致產品或 BOM 元數據的更改，都需要有人意識到此更改並手動更新信息。

### 6.3. How easy it is to create a brand-new production process?

As mentioned before the item the best represents the process is the bill of materials. This item class requires an existing product to be associated with, other than the BOM is no harder to create than a product item.

#### 6.3. 創建新生產流程有多容易？

如前所述，最能代表流程的項目是材料清單。這個項目類別需要與現有產品關聯，除此之外，創建 BOM 並不比產品項目更難。

#### 6.3.1. How the process is depicted?

The process is depicted in the BOM as a list of components (other product items) and operations that are carried out in a specific order to produce a number of end products. This representation seems to sit well with the production procedure. Metadata is kept to a minimum but there is still the capability to offer a text description.

#### 6.3.1. 流程如何被描述？

流程在 BOM 中被描述為一系列組件（其他產品項目）和按特定順序進行的操作，以生產一定數量的最終產品。這種表示似乎與生產程序很相符。元數據保持最低限度，但仍具有提供文本描述的能力。

### **6.3.2. How does the process integrate and reference the product it produces?**

The integration between the BOM and the product items is by far the most well done in Odoo. Changes made in the BOM affect production and are directly linked to the product. Whenever metadata changes are possible and said aspect is represented in the product item as well the change of one is inherited by the other.

#### **6.3.2. 流程如何整合並參考其生產的產品？**

在 Odoo 中，BOM 和產品項目之間的整合是最出色的。對 BOM 所做的更改會影響生產，並直接與產品相關聯。每當元數據的更改是可能的，並且該方面在產品項目中也有所表示時，其中一個的變化會被另一個所繼承。

### **6.3.3. Does changing one affects the other?**

As far as inventory and manufacturing is concerned integration is and referencing is well implemented. Production results flawlessly in the resulting changes in inventory and the navigation path of the GUI is very well optimized. It does not take more than 3 or 4 clicks to get from one product to another or to navigate to other relevant items.

#### **6.3.3. 更改一個是否會影響另一個？**

就庫存和製造而言，整合和參考是良好實施的。生產會無縫地導致庫存的變化，並且 GUI 的導航路徑非常優化。從一個產品轉到另一個產品或導航到其他相關項目不需要超過 3 或 4 次點擊。

### **6.4. How easy is to improve an existing product/ production process?**

As mentioned previously, all improvements in Odoo are performed using engineering change orders. These are applied to product items or bill of materials. Creating ECOs is quite easy and organized, the ECO is an item on itself that symbolizes a signal given to create change, once effective, it symbolizes an increment on the product or process.

#### **6.4. 改善現有產品/生產流程有多容易？**

如前所述，Odoo 中的所有改進都是使用工程變更訂單進行的。這些變更應用於產品項目或材料清單。創建 ECO 相當容易且有組織，ECO 本身就是一個項目，代表著創建變更的信號，一旦生效，就代表著對產品或流程的增量。

#### 6.4.1. How easy it is to update its metadata

It is easy to update any metadata regarding any item in Odoo; however, it is wise to point out that since the ECOs are separate items that are just point by products or BOMs many of the changes are not automatic and require manual intervention. I.e. an ECO will not change the text description of the product for instance. If the new update were to require a change on that description it would require a manual intervention from the user in the product item. Doing that is easy, but it is an extra task that will not be tracked by the ECO.

##### 6.4.1. 更新其元數據有多容易？

在 Odoo 中更新任何項目的任何元數據都很容易；然而，值得指出的是，由於 ECO 是獨立的項目，只是通過產品或 BOM 指向，許多更改都不是自動的，需要手動干預。例如，ECO 不會更改產品的文本描述。例如，如果新的更新需要更改該描述，則需要用戶在產品項目中進行手動干預。這樣做很容易，但這是一個額外的任務，不會被 ECO 跟踪。

#### 6.4.2. How easy it is to determine the effects of the change?

Odoo feedback of information is mainly done in a manufacturing order basis. The information available is clear and ECOs do not affect MOs that are already under way so the effects of an applied ECO would not be hard to notice. However, it is good to point out that in the way the performance information is displayed there is no indication of the product revision or the ECO applied. This means that the user would need to first figure when the ECO was applied, then navigate to the equivalent MO in the data to draw its conclusions. Although not a problem for recent changes this does becomes problematic if someone want to analyze effects of old changes.

##### 6.4.2. 確定變更的影響有多容易？

Odoo 主要是根據製造訂單提供信息反饋。可用的信息是清晰的，並且 ECO 不會影響已經進行中的 MO，因此應用 ECO 的影響不難注意到。然而，值得指出的是，在顯示性能信息的方式中，沒有指示產品修訂版或應用的 ECO。這意味著用戶首先需要弄清楚 ECO 應用的時間，然後導航到數據中相應的 MO 來得出結論。儘管對於最近的更改不是問題，但如果有人想分析舊更改的影響，這就變得棘手了。

#### 6.4.3. How does the software deals with different product revisions?

Version control is something well covered by the 1 to N relation between product/BOM and linked ECOs. Every product will have a tab containing all the ECOs applied to it in chronological order effectively working as a timeline representing the item evolution.



### 6.4.3. 軟體如何處理不同的產品修訂版？

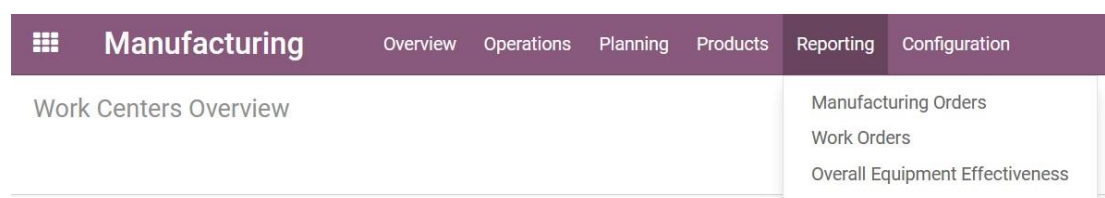
版本控制是由產品/材料清單和相關 ECO 之間的 1 對 N 關係很好地處理的。每個產品將擁有一個選項卡，其中包含按時間順序應用於該產品的所有 ECO，有效地充當了代表項目演變的時間軸。

## 6.5. How easy is to find data related to product or process?

Most of the data related to performance regarding production is concentrated under the reporting tab as mentioned in the previous chapter (Figure 71).

### 6.5. 尋找與產品或流程相關的數據有多容易？

大部分與生產相關的性能數據都集中在報告選項卡下，如前一章節所述（見圖 71）。



**Figure 71 GUI Options of data reporting**

圖 71 數據報告的 GUI 選項

This means that as far as performance is concerned it is quite easy to find the data. The previous chapter will show examples of possible information that are available within those tabs.

In addition to using this path the UI of the product item also has a tab that point to the monthly comparison of production volume regarding the product (Figure 72). Which would be more impressive if there was more than one month in the trial version of Odoo.

這意味著就性能而言，找到數據相當容易。前一章節將展示這些選項卡中可用的可能信息的示例。

除了使用這個路徑之外，產品項目的用戶界面還有一個選項卡，指向有關產品生產量的月度比較（見圖 72）。如果 Odoo 試用版本中有多於一個月的數據，這將會更加令人印象深刻。



Figure 72 Total quantity regarding MO from product item

圖 72 產品項目中關於製造訂單的總數量

### 6.5.2. How does Odoo generate performance data?

The astute reader will notice that all the data mentioned so far is derived from the time to completion of the operations been carried out, the related amount to the MO and the workcenter utilized. Even so it is impressive how much information can be drawn especially considering that it is all generated automatically.

6.5.2. Odoo 如何生成性能數據？ 敏銳的讀者會注意到，到目前為止提到的所有數據都是來自於操作完成所需的時間，與 MO 相關的數量以及所使用的工作中心。儘管如此，考慮到所有這些數據都是自動生成的，可以獲得多少信息仍然令人印象深刻。

### 6.5.3. How does the software present performance change as a result of a upgrade?

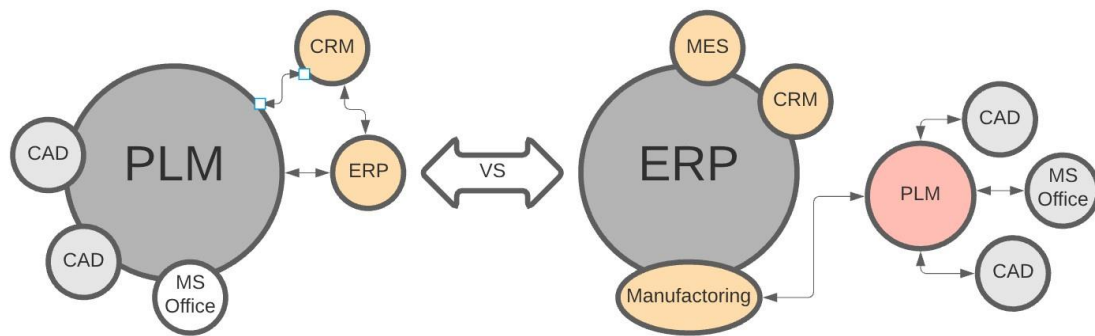
In order to identify the change, the user must identify the MOs following the change and see the difference based on that. Ideally it would be nice if the graphical information showed the revision of the product, but this is not present as of Odoo V13.

6.5.3. 軟體如何呈現由升級所導致的性能變化？ 為了識別變化，用戶必須在變化後識別 MOs 並基於此來查看差異。理想情況下，如果圖形信息顯示了產品的修訂版，那會很好，但截至 Odoo V13，這並不存在。

## CONCLUSION

In chapter 2 I referenced a diagram that represents a theoretical ideal of how the integration of PLM with other systems should be (Figure 74). In that diagram the reader can notice that ideally PLM would be the center of the system with other systems (Including ERP) attached to it. Different from said diagram the Odoo software takes ERP as the center with other systems attached to it. This work has shown that it is certainly possible to use Odoo for PLM and MES however it has also shown that the PLM and MES implementation presents some weaknesses.

在第二章中，我引用了一個圖表，代表了 PLM 與其他系統整合的理想情況（見圖 74）。在該圖表中，讀者可以注意到理想情況下，PLM 應該是系統的中心，其他系統（包括 ERP）附加在其上。與該圖表不同，Odoo 軟件將 ERP 作為中心，其他系統附加在其上。這份工作已經表明，確實可以使用 Odoo 進行 PLM 和 MES，但也表明 PLM 和 MES 的實施存在一些弱點。



**Figure 74 Comparison to the left the adapted diagram as theorized by Saaksvuori, A. and Immonen, A. (2008), to the right Odoo take on how systems interact.**

The lack of file upload support on things like operation items, work centers or equipment is something of some concern especially considering 3D printing or CNC because access to the CAD files would prove helpful to the operators. Also, there is a gap in between the facets of product and tool when the company is taking upon themselves to develop and produce said tooling (similar situation founded when developing the molds in the simulation).

對於操作項目、工作中心或設備等缺乏文件上傳支持，尤其是考慮到 3D 打印或 CNC，這是一些令人關注的事情，因為對 CAD 文件的訪問對操作員會很有幫助。此外，在公司自行開發和生產工具時（類似模擬中開發模具時的情況），產品和工具之間存在差距。

In addition, although MES provide detailed graphical representation regarding the dataset that it has, it is limited to data derived from the time to completion of the operations been carried out. For instance, it would be very valuable if graphical representation regarding quality control was easily available as well.

此外，儘管 MES 提供了關於其數據集的詳細圖形表示，但它僅限於來自操作完成所需時間的數據。例如，如果關於質量控制的圖形表示也能輕鬆獲得，那將非常有價值。

All that said, applying ECOs to BOMs in Odoo is a procedure deserving of praise. The ECO holds the information until it is ready to be applied and then it updates the BOM automatically once the ECO is validated by responsible personnel. It might not look like something so important now because this simulation is dealing with very simple products, but it becomes exponentially more important as complexity increases. E.g. A car with thousands of parts and hundreds of nested BOMs would be considered a nightmare to control and keep track of change if a system like this was not present.

儘管如此，將 ECO 應用於 Odoo 中的 BOM 是值得稱讚的過程。ECO 保存信息，直到準備好應用，然後一旦 ECO 被負責人員驗證，它就會自動更新 BOM。現在可能看起來不那麼重要，因為這個模擬正在處理非常簡單的產品，但隨著複雜性的增加，它變得指數級地更加重要。例如，擁有成千上萬個零件和數百個嵌套 BOM 的汽車，如果沒有這樣的系統，將被認為是難以控制和跟蹤變更的噩夢。

This software is not perfect for PLM or MES implementation, but it does hold value in the sense of availability and integration with other systems. The functionality is there specially regarding product and process and the software has an extremely interesting integration with its natural ERP functionalities. All this makes up for a system that would suit better:

這個軟體並非完美的 PLM 或 MES 實施方案，但在可用性和與其他系統的整合方面確實具有價值。尤其是在產品和流程方面，功能性已經存在，而且該軟體與其天然的 ERP 功能有著非常有趣的整合。所有這些都構成了一個更適合的系統：

- ✦ Small business that could use PLM and MES in a smaller scale.
- ✦ Companies that deal with less manufacturing and more assembly or distribution taking advantage of the All in One nature of the software.

It is important to mention that the limitations of Odoo are not in the complexity of the product itself but in the complexity of the operations that surround its development. All things considered you could track a large and complex assembly if it includes only simple manufacturing operations or if more complex engineering tasks are done by suppliers. I.e. you could track the assembly of a motorcycle with ease in Odoo, but the PLM features are not polish enough to track the full evolution/development of its powertrain. It is certainly possible to do so but it would take too much time and effort from the engineering team to be considered worth it just for the sake of having an all in one solution with ERP features.

- 可以在較小規模中使用 PLM 和 MES 的小型企業。
- 面對較少的製造，更多的裝配或分銷，並利用軟體的一體化特性的公司。

重要的是要提到，Odoo 的限制不在於產品本身的複雜性，而在於圍繞其開發的操作的複雜性。綜合考慮所有因素，如果組裝過程只包含簡單的製造操作，或者更複雜的工程任務由供應商完成，那麼您可以追蹤大型和複雜的組件。換句話說，您可以輕鬆在 Odoo 中追蹤摩托車的組裝，但 PLM 功能不夠完善，無法追蹤其動力系統的全面演變/開發。這當然是可能的，但這將需要工程團隊花費大量的時間和精力，僅僅為了擁有一個具有 ERP 功能的一體化解決方案而被視為值得。

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