Comparison of financial results of companies with different production systems: a case study of lean manufacturing and industry 4.0

Comparação dos resultados financeiros de empresas com diferentes sistemas de produção: estudo de caso de fabricação enxuta e indústria 4.0

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Abstract

This research article aims to compare two companies, one in the commercial aviation segment (E) and the other in the cosmetic segment (N), considering the differences presented between them in relation to their production systems using lean manufacturing tools and perspective

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Comparison of financial results of companies with different production systems: a case study of lean manufacturing and industry 4.0. The methodology to be used is the Discounted Cash Flow (DCF), applying the method to the two companies and performing the analysis, discussion, and comparison of projections and enterprise value obtained for each one. In the end, company N obtained growth projections and enterprise value significantly higher than the results obtained by E, whose enterprise value presents a negative sign. The present research compared only two companies in one specific market segment. It is important to amplify the field of investigation for others and compare companies that belong to the same segment. As the implication, we have the fact that the figure of the COVID-19 pandemic period considered, and the answers from each company could be different to recover from the pandemic. This research work presents as originality the methodology of evaluating the financial impact of the companies which apply lean and Industry 4.0 tools in the open capital enterprise.

**Keywords:** Lean Manufacturing. Industry 4.0. Discounted Cash Flow. Valuation. COVID-19.

**Resumo**
Este artigo de pesquisa tem como objetivo comparar duas empresas, uma no segmento de aviação comercial (E) e outra no segmento de cosméticos (N), considerando as diferenças apresentadas entre elas em relação aos seus sistemas de produção utilizando ferramentas de fabricação enxuta e perspectiva sobre as tecnologias da indústria 4.0. A metodologia a ser usada é o Fluxo de Caixa Descontado (DCF), aplicando o método às duas empresas e realizando a análise, discussão e comparação de projeções e valor empresarial obtido para cada uma delas. Por fim, a empresa N obteve projeções de crescimento e valor empresarial significativamente superior aos resultados obtidos por E, cujo valor empresarial apresenta um sinal negativo. A presente pesquisa comparou apenas duas empresas em um segmento de mercado específico. É importante ampliar o campo de investigação para outros e comparar empresas que pertencem ao mesmo segmento. Como consequência, temos o fato de que o número do período de pandemia da Covid-19 considerado, e as respostas de cada empresa podem ser diferentes para se recuperar da pandemia. Este trabalho de pesquisa apresenta como originalidade a metodologia de avaliação do impacto financeiro das empresas que aplicam as ferramentas lean e Industry 4.0 na empresa de capital aberto.

Introduction

Seeking to optimize the production process, the application of technological advances resulting in profound transformations, often stimulated by socio-economic crises, the so-called Industrial Revolutions took place. Figure 1 presents the historic industrial revolutions with the features of each revolution (Dias, 2018).

![The Four Industrial Revolutions](image)

Figure 1. Industrial evolution from a time point of view.
Source: (Dias, 2018).

Industry 3.0 has as its philosophy the Toyota Production System (TPS), or Lean Manufacturing (LM), which originated in Japan after the defeat in World War II, culminating in a period marked by serious crises. In contrast to the Fordist model, used previously, toyotism adopted as main principles the management of quality and waste reduction, adopting new practices and tools of management and administration (Campos, 1992; Rangel, 2017).

Mangaroo-Pillay and Coetzee (2022), presented their research to investigate what design methods and design elements are utilized in creating Lean frameworks. Amrina et al. (2021), explore the complexity of developing a sustainable small and medium industry (SMI) through a conceptual model that integrates lean and green manufacturing principles. Martins et al. (2021), present an analyze the excellence and operational efficiency of Portuguese industrial companies through the measurement of lean practices implementation. Priyono and Idris (2018), analyze the challenges of lean manufacturing implementation in the remanufacturing industry.

Bohórquez and Herrera (2022), established an Industry 4.0 maturity model for manufacturing SMEs. This research presents the characteristics of the proposed model, which takes the elements and the scope of the fourth industrial revolution, as well as the dimensions and assessment scales of some maturity models already applied. Aguilar-Rodríguez et al.,
(2021), examined the relationship between social culture, Industry 4.0 technologies, and organizational performance in companies from emerging countries.

However, currently, there is a set of new technologies, both physical, such as additive manufacturing and new materials, and digital, such as the Internet of Things (IoT), big data, artificial intelligence (AI), cloud computing, and blockchain, making up the set of innovations of the fourth industrial revolution (Lima & Gomes, 2020). It is a global trend that has been gaining space in Brazil, but challenges such as high cost and lack of skilled labor and technical knowledge still represent obstacles to investments in these innovations (Cni, 2020). In this sense, this paper aims to compare the financial results of two companies that adhere to the production systems mentioned above: lean manufacturing and Industry 4.0, with the Brazilian Aeronautical Company (E) and The Cosmetics Company (N) representing the systems, respectively. To this end, the Discounted Cash Flow (DCF) methodology will be used during the years 2019 to 2021, employed for valuation and future projections of a company, whose results can be analyzed and associated with the respective system.

Theoretical Referential

In this section the scientific literature is reviewed to introduce the theoretical foundations of the themes Industry 4.0, Lean Manufacturing and Valuation. It is emphasized that this review did not exhaust the theme, but brought to evidence its most important elements for the development of this research and, consequently, enable readers the minimum bases for its understanding.

2.1 Industry 4.0

The 1st Industrial Revolution appeared at the end of the 18th century in Europe, bringing the facilities of mechanical production, especially with the creation of the steam engine, making the handmade manufacturing that existed until then obsolete. The 2nd Revolution is marked by the arrival of electricity and mass production, introducing assembly lines and the division of labor derived from Taylorism. The 3rd Revolution, also known as the Digital Revolution, started after World War II, and was characterized by the application of information systems that began to spread in the industry extremely quickly (Borlido, 2017; Tessarini; Saltorato, 2018).
The Fourth Revolution began in 2011 in Germany when the country's government presented during the Hannover Fair a series of technology-related strategies capable of transforming the organization of organizations on a global scale through the emergence of "smart factories" (Drath & Horch, 2014). Since then, academic, scientific, business, and political interest in the topic has been growing, this is since for the first time, an industrial revolution is being observed before it becomes concrete (Tessarini, 2018). Industry 4.0 is based on the diffusion of technologies applied to the production environment. Among them are Cyber-Physical Systems (CPS), the Internet of Things (IoT), the Internet of Services (IoS), autonomous vehicles, 3D printers, advanced robots, artificial intelligence, Big Data, nanomaterials and nanosensors (Schwab, 2016; Cni, 2016; Bcg, 2015). The use of these technologies enables greater product customization without losing the advantages of mass production (Lasi et al., 2014; Reis et al., 2021).

Today, statistics has made a significant contribution to the decision-making process because much of what is produced is based on quantitative methods, and statistics is one such area, especially in the spread of Industry 4.0 due to the enormous amount of data to be processed and manipulated. In the information and knowledge age, statistics uses mathematics to support business professionals, government and researchers (da Motta Reis et al., 2020; de Sousa Alvarenga et al., 2021; Gomes et al., 2022; Junior et al., 2023; Felipe C. Mazza et al., 2023; Felipe Cury Mazza et al., 2022; Mendonça et al., 2023; Menezes et al., 2023; Oliveira et al., 2023; Rezende et al., 2023; Santana et al., 2023; Veloso et al., 2023; Yamada et al., 2023).

2.2 Lean Manufacturing

Lean Manufacturing emerged in the year 1950, in Japan. After the Second World War, due to the lack of resources, the country did not have the conditions to make the high investments necessary to implement mass production, which characterized the system implemented by Henry Ford and General Motors. Besides that, Japan still faced a series of problems and challenges such as the limited domestic market and the demand for a wide variety of products, organized labor, and the existence of several vehicle manufacturers in the world interested in entering Japan, among others (Riani, 2006).

Thus, it was necessary to create a new managerial model, thus being born the Toyota Production System or Lean Manufacturing, developed by Taiichi Ohno and Eiji Toyoda from Toyota (Riani, 2006). After the visit of these professionals to the United States, where they
came into direct contact with the Ford model, they noticed that the Ford model was efficient, however, it generated a huge waste of resources. With this, the basis for the creation of the Toyota Production System emerged, which adopted as guiding principles manufacturing with quality and waste reduction (Campos, 1992).

Lean Manufacturing focuses on lean production, aiming to gradually eliminate all sources of waste in the production system, that is, the activities performed in a process that does not add value to the customer, and serve only to increase the cost of the product, operating so that the final product is produced in the right quantity and at the right time, according to customer demand (Ohno, 1997, 4). For this, several simple actions and approaches are taken so that the processes are executed perfectly, having as guiding principles the continuous improvement and the constant satisfaction of all involved in the process, making use of time strategically during the processes (Kamble; Gunasekaran; Dhone, 2020). For Ohno (1997) these wastes were divided into seven classic types of waste, also called losses, existing within a company, being Transportation, Inventory, Motion, Waiting, Overproduction, Overprocessing and Defects. An eighth waste was later added in the 1990s, being the non-utilized talent of workers (Skmoth, 2017). Figure 2 shows the eight categories of losses.

![Figure 2. The seven wastes](Source: Skhmot (2017)).

Waiting for waste consists of the time when no processing, transportation, or inspection is performed is originated by human idleness or idleness due to waiting time (Riani, 2006; Cittatini et al., 2017). The Kanban tool can minimize waiting loss (Rezende et al., 2013). The losses by defect are caused by failures during the process, in the manufacturing of
defective items for example, thus, one has two options the part is discarded, or it is reworked, which increases its production cost (Ikari et al., 2020).

Transport losses are caused by unnecessary displacements or temporary inventories, being a waste of time and resources, the transport and movement activities can be eliminated or reduced through the elaboration of an adequate physical arrangement (Riani, 2006). The excess movement performed by operators to perform an operation generates the so-called wastes of movement, and are usually caused by poorly designed layouts, and obstacles in the way that lead the operator to have to deviate to reach his destination (Rezende et al., 2013). The waste caused by excess inventory is related to excess raw material, in-process material, and finished products that can be seen as "idle money". Another loss caused by excess is the loss by overproduction, characterized by the production of a product beyond what is needed, resulting in unnecessary use of raw materials, labor, and transportation. The losses due to overprocessing consist of the inadequate use of machinery or equipment. Because of this, to minimize this waste, it is important to apply the methodologies of value engineering and analysis (Rezende Et Al., 2013; Riani, 2006).

2.3 Valuation

Valuation is considered by many to be the heart of corporate finance, defined as a technique to reduce the subjectivity of what is naturally subjective. The purpose of the valuer is to, through the application of a single theory or several combined ones, determine a value for the asset. Understanding what makes up the value of a given company and how to budget for it is of great importance for making correct decisions (Povoa, 2012; Prado; Teixeira; Ribeiro, 2011). Behara (2020) indicates two main methods for performing valuation for companies. The method based on the economic value added (EVA) is widely used for the stipulation of the rate of return of organizations, however, it does not admit the possibility of future forecasts with the calculations of the method. For this, the methods based on discounted cash flow (DCF) are used, which are of utmost importance in today's market, globally interconnected and under constant mutual influence (Gráf & Rowland, 2021).

Moreover, it is essential to analyze the effects caused by the plans drawn by managers, in the valuation process of the organization, for the shareholders and for the market in general. The increasing relevance given to shareholders, due to the strengthening of the stock market, has encouraged managers to give greater importance to the generation of value as a parameter of their company's performance (Freitas, 2015; Prado; Teixeira & Ribeiro, 2011). To perform
the valuation, it is necessary to define the valuation objectives, and then choose the valuation techniques to be used. Furthermore, it is necessary to perform the necessary research to obtain the data available by the company of all its resources, to know more deeply the object of valuation. Among the most used techniques to evaluate an asset is the Discounted Cash Flow Evaluation, methodology in which the company studied in this paper will be evaluated.

To minimize the risks within a company, it is necessary to evaluate the information concerning the internal and external condition to quantify a basic criterion that will represent the value of the company. Having the criterion, a strategy can be adopted to maximize the company's value in the market. Finally, to assess the value of the company the calculation based on the discounted cash flow mentioned above is used. The concepts used by this method are described below (Freitas, 2015). The discounted cash flow method consists of an evaluation methodology performed according to the forecast of future operational cash flows that will be realized. Through this technique, the company is evaluated as a sum of the present value of the total of the expected future cash flows, discounted by a certain interest rate that incorporates the possible risks submitted to the company (Fontalvo, 2018).

The cash flow available to all fund providers is known as Free Cash Flow to the Firm (FCFF), while the cash flow available to the firm's equity investors is called Free Cash Flow to the Shareholder (FCFE). For the valuation of a company, the FCFF model is widely used today. Based on the company's historical growth rate, as well as management discussion, a growth rate assumption is determined which, in union with a perpetual growth rate, commonly related to the gross domestic product (GDP) of the country in which the company is located, it is possible to make future forecasts and analyze the variability of the company's growth rate (Chase, 2006).

Some of the advantages in using this methodology are to recognize the value of money over time, considering the effect caused by the various economic variables on the bases of the company evaluated. In counterpoint to this, one of the disadvantages brought by this technique is the large amount of information needed to perform the valuation, given that the projection is made based on data about calculations of revenues, margins, future investments among other elements of the company (Lima, 2015). In the Cash Flow to Company model, the valuation is done in a global way, dealing not only with the rights of the shareholders but also of the creditors jointly, its calculation is done through the following formulation:
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| FCFF = EBIT x (1 - Tx) - Capital Expenditure + Depreciation - Working Capital Variation | (1) |

Where:

EBIT – Earning Before Interest and Taxes
Tx - Profit Taxes

The discount rate used in the FCFF model is the WACC: Weighted Average Cost of Capital or weighted average cost of capital, which consists of the weighted average of the overall cost of equity and third-party capital (Freitas, 2015; Silva, 2017).

Before performing the WACC calculation it is necessary to determine the value of the cost of equity capital (rs), obtained through CAPM: Capital Asset Pricing Model, this model can be defined as the opportunity cost of an investor when making an investment that presents a similar level of risk to the studied one. The rs is calculated using the following equation:

\[ r_s = R_f + \beta \times (R_m - R_f) \]  

(2)

Where

Rf represents the risk-free rate, (Rm-Rf) is the difference between the expected market return and the risk-free rate, and \( \beta \) is defined as the leveraged beta. This beta represents the remaining return of the market in which the asset is located, its use provides a better evaluation, since it encompasses dividends and taxes levied on the profit (Povoa, 2012; Gráf & Rowland, 2021).

Its formulation is given as follows:

\[ \beta = \beta_u \times [1 + (1 - \tau) \times (B/S)] \]  

(3)

With

\( \beta_u \) being the unlevered beta, which comprises only the companies in the analyzed sector, \( \tau \) representing the effective tax rate and (B/S) is the ratio of debt (B) to equity (S) at market value.

In addition to the cost of equity capital it is also necessary to calculate the cost of third-party capital, determined using the following formula:

\[ r_b = R_f + \text{Country Risk Premium} + \text{Rating Spread} \]  

(4)

Revista Gestão e Secretariado (GeSec), São Paulo, SP, v. 14, n. 12, 2023, p. 21340-21357.
Both the values of $r_s$ and $r_b$ are initially obtained in dollars and then converted into Real. To perform this currency conversion, the equation below is applied.

$$R_{sBrasil} = \frac{(1 + Inflation_{Brasil}) \times (1 + R_{sUSA})}{(1 + Inflation_{USA})}$$  \hspace{1cm} (5)$$

By obtaining the value of the cost of equity capital together with the cost of third-party capital it is possible to determine the WACC through the following equation:

$$WACC = \frac{B}{B+S} \times r_b \times (1 - T_c) + \frac{S}{B+S} \times r_s$$  \hspace{1cm} (6)$$

Where:

- $\frac{B}{B+S}$ - Percentage of third-party capital in the capital structure;
- $r_b$ - Cost of third-party capital;
- $T_c$ - Effective tax rate;
- $\frac{S}{B+S}$ - Percentage of equity capital in the capital structure;
- $r_s$ - Cost of equity capital, calculated by CAPM;

Finally, the firm value based on the FCFF model, which represents the present value of the firm’s future cash flows is determined by the equation (Silva, 2017):

$$Enterprise\ Value = \sum_{t=1}^{t=n} \frac{FCFF_t}{(1 + WACC)^t} + \frac{FCFF_{n+1}}{(WACC - g_n)} \left(\frac{1}{(1 + WACC)^n} - \frac{1}{(1 + WACC)^{n+1}}\right)$$  \hspace{1cm} (7)$$

With:

- FCFF$_t$ - Free cash flow for the company in the period $t$;
- $g_n$ - Growth rate after terminal year (terminal value);
- WACC - Weighted average cost of capital

**Research Method**

The data was collected by accessing the financial reports made available by the companies themselves, which, since they are publicly traded, usually disclose them in the
Investor Relations (IR) section of their own websites. The data of interest for the development are: Net revenue; Cost of goods sold (CMV); Expenses; Depreciation; Financial income (expense); and Income tax and social contribution.

These were analyzed using the FCD method, to obtain other indicators and a projection until 2026. The Excel software was used to compile the data collected and to apply the method and obtain the results. Furthermore, for the calculations, the real profit tax regime was considered in both cases.

**Results and Discussions**

From the data cited above, calculations were made for gross profit, EBITDA, EBIT, and net profit. In addition, some indicators were also calculated: revenue growth, gross margin, operating margin, and net margin. Then it was possible to apply the DCF methodology described above.

**4.1 Valuation of The Company E**

The financial data collected and calculated for E are shown in Table 1 below:

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Revenue</td>
<td>21802</td>
<td>19641</td>
<td>22669</td>
</tr>
<tr>
<td>Growth</td>
<td>-9.9%</td>
<td>15.4%</td>
<td></td>
</tr>
<tr>
<td>CMV</td>
<td>-18637</td>
<td>-17234</td>
<td>-19130</td>
</tr>
<tr>
<td>Gross Earn</td>
<td>3165</td>
<td>2407</td>
<td>3539</td>
</tr>
<tr>
<td>Gross Margin</td>
<td>14.5%</td>
<td>12.3%</td>
<td>15.6%</td>
</tr>
<tr>
<td>Expenses</td>
<td>-2735</td>
<td>-2584</td>
<td>-1430</td>
</tr>
<tr>
<td>EBITDA</td>
<td>431</td>
<td>-177</td>
<td>2109</td>
</tr>
<tr>
<td>Operational Margin</td>
<td>2.0%</td>
<td>0.9%</td>
<td>9.3%</td>
</tr>
<tr>
<td>Depreciation</td>
<td>-741</td>
<td>-1503</td>
<td>-1055</td>
</tr>
<tr>
<td>Financial Income</td>
<td>452</td>
<td>1220</td>
<td>1070</td>
</tr>
<tr>
<td>EBIT</td>
<td>142</td>
<td>-460</td>
<td>2124</td>
</tr>
<tr>
<td>Income Tax and</td>
<td>-553</td>
<td>-284</td>
<td>-389</td>
</tr>
<tr>
<td>Social Contribution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Income</td>
<td>-441</td>
<td>744</td>
<td>1735</td>
</tr>
<tr>
<td>Net Margin</td>
<td>-1.9%</td>
<td>-3.8%</td>
<td>7.7%</td>
</tr>
</tbody>
</table>

**Table 1. Financial collected data for the company E in R$ million**


By taking the revenue growth and calculating the average, it is possible to project it as expected revenue growth for the next 5 years, allowing the calculation of the expected net financial income. The calculation of the projected gross and operating margins is also done.
by averaging the respective values presented in Table 1 and taken as constant for the next few years.

<table>
<thead>
<tr>
<th></th>
<th>2022F</th>
<th>2023F</th>
<th>2024F</th>
<th>2025F</th>
<th>2026F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected Revenue Growth</td>
<td>2.75%</td>
<td>2.75%</td>
<td>2.75%</td>
<td>2.75%</td>
<td>2.75%</td>
</tr>
<tr>
<td>Projected Gross Margin</td>
<td>10.33%</td>
<td>10.33%</td>
<td>10.33%</td>
<td>10.33%</td>
<td>10.33%</td>
</tr>
<tr>
<td>Projected Operational Margin</td>
<td>3.47%</td>
<td>3.47%</td>
<td>3.47%</td>
<td>3.47%</td>
<td>3.47%</td>
</tr>
<tr>
<td>Projected Net Financial Revenue (in R$ millions)</td>
<td>1099</td>
<td>1129</td>
<td>1160</td>
<td>1192</td>
<td>1225</td>
</tr>
</tbody>
</table>

**Table 2. Forecast for 5 coming years for company E, based on the collected data**

Source: Authors 2023

Finally, applying the DCF methodology, we obtain Table 3 below, which contains the calculated projection from 2022 to 2026 for the company in question:

<table>
<thead>
<tr>
<th></th>
<th>2022F</th>
<th>2023F</th>
<th>2024F</th>
<th>2025F</th>
<th>2026F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Revenue</td>
<td>21138</td>
<td>21719</td>
<td>22316</td>
<td>22930</td>
<td>23561</td>
</tr>
<tr>
<td>CMV</td>
<td>-18954</td>
<td>-19476</td>
<td>-20011</td>
<td>-20561</td>
<td>-21127</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>2184</td>
<td>2244</td>
<td>2305</td>
<td>2369</td>
<td>2434</td>
</tr>
<tr>
<td>Expenses</td>
<td>-1450</td>
<td>-1490</td>
<td>-1531</td>
<td>-1573</td>
<td>-1616</td>
</tr>
<tr>
<td>EBITDA</td>
<td>733</td>
<td>754</td>
<td>774</td>
<td>796</td>
<td>818</td>
</tr>
<tr>
<td>Depreciation</td>
<td>-1055</td>
<td>-1055</td>
<td>-1055</td>
<td>-1055</td>
<td>-1055</td>
</tr>
<tr>
<td>Financial Income Net</td>
<td>1099</td>
<td>1129</td>
<td>1160</td>
<td>1192</td>
<td>1225</td>
</tr>
<tr>
<td>EBIT</td>
<td>777</td>
<td>828</td>
<td>879</td>
<td>933</td>
<td>988</td>
</tr>
<tr>
<td>Net Income</td>
<td>513</td>
<td>546</td>
<td>580</td>
<td>616</td>
<td>652</td>
</tr>
<tr>
<td>Net Margin</td>
<td>2.4%</td>
<td>2.5%</td>
<td>2.6%</td>
<td>2.7%</td>
<td>2.8%</td>
</tr>
</tbody>
</table>

**Table 3. Calculated forecast until 2026 for the company E in R$ million**

Source: Authors 2023

Furthermore, the value of the company calculated by the DCF valuation is equal to R$ 3455.55 million.

### 4.2 Valuation of The Company N

Repeating the same data collection and indicator calculation process carried out previously for company N, we obtain Tables 4 and 5 below:
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<table>
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</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>32942</td>
<td>9.8%</td>
<td>-11841</td>
<td>21.101</td>
<td>64.1%</td>
<td>-17503</td>
<td>3598</td>
<td>10.9%</td>
<td>-1522</td>
<td></td>
<td>-2795</td>
<td></td>
<td></td>
<td>1236</td>
<td>-149</td>
<td></td>
<td>-149</td>
<td>1087</td>
<td>3.3%</td>
</tr>
<tr>
<td>2020</td>
<td>36922</td>
<td>8.3%</td>
<td>-13229</td>
<td>23.693</td>
<td>64.2%</td>
<td>-20185</td>
<td>3508</td>
<td>9.5%</td>
<td>-2718</td>
<td></td>
<td>-5773</td>
<td></td>
<td></td>
<td>245</td>
<td>-275</td>
<td></td>
<td>-275</td>
<td>-520</td>
<td>-1.4%</td>
</tr>
<tr>
<td>2021</td>
<td>40164</td>
<td></td>
<td>-14011</td>
<td>26.153</td>
<td>65.1%</td>
<td>-22244</td>
<td>3909</td>
<td>9.7%</td>
<td>-2791</td>
<td></td>
<td>-5033</td>
<td></td>
<td></td>
<td>1139</td>
<td>1048</td>
<td></td>
<td></td>
<td>1041</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

**Table 4. Financial collected data for the company N in R$ million**


<table>
<thead>
<tr>
<th>Year</th>
<th>Projected Revenue Growth</th>
<th>Projected Gross Margin</th>
<th>Projected Operational Margin</th>
<th>Projected Financial Income (in R$ millions)</th>
<th>Projected Financial Expenses (in R$ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022F</td>
<td>9.05%</td>
<td>64.47%</td>
<td>10.03%</td>
<td>5511</td>
<td>-5488</td>
</tr>
<tr>
<td>2023F</td>
<td>9.05%</td>
<td>64.47%</td>
<td>10.03%</td>
<td>6009</td>
<td>-5984</td>
</tr>
<tr>
<td>2024F</td>
<td>9.05%</td>
<td>64.47%</td>
<td>10.03%</td>
<td>6552</td>
<td>-6525</td>
</tr>
<tr>
<td>2025F</td>
<td>9.05%</td>
<td>64.47%</td>
<td>10.03%</td>
<td>7144</td>
<td>-7115</td>
</tr>
<tr>
<td>2026F</td>
<td>9.05%</td>
<td>64.47%</td>
<td>10.03%</td>
<td>7790</td>
<td>-7758</td>
</tr>
</tbody>
</table>

**Table 5. Forecast for 5 coming years for company N, based on the collected data**

Source: Authors 2023

Finally, through the formulation of the DCF methodology, it is possible to calculate the projection of the indicators until 2026, whose results are shown in Table 6 below:
Comparison of financial results of companies with different production systems: a case study of lean manufacturing and industry 4.0.

<table>
<thead>
<tr>
<th></th>
<th>2022F</th>
<th>2023F</th>
<th>2024F</th>
<th>2025F</th>
<th>2026F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Revenue</td>
<td>51106</td>
<td>55732</td>
<td>60775</td>
<td>66275</td>
<td>72273</td>
</tr>
<tr>
<td>CMV</td>
<td>-18158</td>
<td>-19801</td>
<td>-21593</td>
<td>-23548</td>
<td>-25679</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>32948</td>
<td>35930</td>
<td>39182</td>
<td>42728</td>
<td>46595</td>
</tr>
<tr>
<td>Expenses</td>
<td>-27822</td>
<td>-30340</td>
<td>-33086</td>
<td>-36080</td>
<td>-39346</td>
</tr>
<tr>
<td>EBITDA</td>
<td>5126</td>
<td>5590</td>
<td>6096</td>
<td>6647</td>
<td>7249</td>
</tr>
<tr>
<td>Depreciation</td>
<td>-2791</td>
<td>-2791</td>
<td>-2791</td>
<td>-2791</td>
<td>-2791</td>
</tr>
<tr>
<td>Financial Income</td>
<td>5511</td>
<td>6009</td>
<td>6552</td>
<td>7144</td>
<td>7790</td>
</tr>
<tr>
<td>Financial Expense</td>
<td>-5488</td>
<td>-5984</td>
<td>-6525</td>
<td>-7115</td>
<td>-7758</td>
</tr>
<tr>
<td>EBIT</td>
<td>2358</td>
<td>2824</td>
<td>3332</td>
<td>3885</td>
<td>4490</td>
</tr>
<tr>
<td>Income Tax and Social Contribution</td>
<td>-801</td>
<td>-960</td>
<td>-1133</td>
<td>-1321</td>
<td>-1527</td>
</tr>
<tr>
<td>Net Income</td>
<td>1.556</td>
<td>1.864</td>
<td>2.199</td>
<td>2.564</td>
<td>2.963</td>
</tr>
<tr>
<td>Net Margin</td>
<td>3.0%</td>
<td>3.3%</td>
<td>3.6%</td>
<td>3.9%</td>
<td>4.1%</td>
</tr>
</tbody>
</table>

Table 6. Calculated forecast until 2026 for the company N in R$ million
Source: Authors 2023

The value of the company was also calculated, by the DCF valuation, which resulted in R$ 13969.22 million.

4.3 Comparison and Analysis

It is important, first, to point out that the years which were chosen to perform the analysis involve the period of socio-economic crisis caused by the COVID-19 pandemic, so that the data reflects the impact of the pandemic on the production and services provided by the company. A very in-depth analysis about the fair share price and other financial indicators will not be performed, as it would be beyond the scope of the article, which intends to use them for the sole purpose of comparing the different production systems adopted by the companies in question.

Taking the revenue growth projected for the companies, present in Tables 2 and 5, we have the value of 2.75% for company E, representing the lean manufacturing system, and 9.05% for company N, which is being recognized for the implementation of the digital transformation program, technological innovation, and Industry 4.0 since 2013. In practice, net revenue comprises the sale of products, goods, and services, already deducting losses caused by returns, rebates and sales taxes. Thus, it is convenient to analyze the indicator that presents a large difference in value between the two companies, as well as its projected variation. Given that the revenue growth projection is based on data collected for the period 2019 to 2021, it is possible to extract the following information from this index:

- The company E, in 2020, showed a negative variation (-9.9%) in revenue, of relatively high module, which led to a drastic decrease in the revenue growth...
Comparison of financial results of companies with different production systems: a case study of lean manufacturing and industry 4.0.

 projection for the following years, evidencing the company's vulnerability to the COVID-19 pandemic; and

- In contrast, the company N revenue value maintained a roughly constant growth around 9% in the years for which the data was collected, which shows the low impact of the crisis on the company's sales and service provision.

In addition, the value of the companies themselves determined by DCF analysis showed highly divergent results: Company E obtained a negative value, implying non-optimistic prospects for the future, dealing from a financial point of view. Company N, in turn, presented a value not only positive, but of great module, representing investments that will bring good returns and, consequently, a good perspective of growth and maintenance in the market. We also have that in this period, obviously, the market faced a drop in demand for products and services, which should, intuitively, impact all companies in the market. However, it is evident after the analysis that N suffered an almost insignificant negative impact on its financial indicators with the pandemic, which become much more expressive in the case of company E.

Furthermore, it should be considered that both companies are from different sectors: E integrates the industrial sector, and N, the retail sector. Along with the steel and oil sectors, the retail sector was one of the most negatively impacted by the pandemic, due to its very nature, which displays a strong dependence on market demands and competitiveness. In this way, it is possible to associate the production system adopted by each company with the results obtained. Research indicates that, in fact, companies that have invested in Industry 4.0 technologies have obtained better results in the issue of the negative impact of the COVID-19 pandemic (CNI, 2020). Overall, technologies such as advanced robotics, big data, machine-to-machine connection systems, and artificial intelligence, which characterize Industry 4.0, play an important role in issues of cost reduction, reduced manual labor, increased productivity, and greater control and traceability over the production process (Schultz, 2021), factors that increase the predictability of the production model and decrease the risks of the process, which played roles as essential factors for stability and growth in this troubled period.

Company E, despite making investments in Industry 4.0 technologies, are directed to the research and innovation area, adopting the lean manufacturing philosophy as a business strategy in its production system since 2007. Regarding the system, with the ideals described in item 2.1, it is not possible to totally discard it, since industry 4.0 does not directly confront it, as was the case of the Toyota model contrasting against the Ford model. The technology
provided by Industry 4.0 can be united to the Lean Manufacturing concept, resulting in an even more effective search for the improvement advocated by the Lean Philosophy.

**Conclusion**

Based on the results of the analysis and the indicators calculated by the DCF methodology, it is possible to conclude that company N, which effectively implements Industry 4.0 technologies and innovations in its production process, suffered minimal negative impacts caused by the COVID-19 pandemic when compared to the results of company E, which has adopted lean manufacturing as a business strategy since 2007. Although there are several external variables that influence the results found, it is possible to establish a relationship between the production systems and the vulnerability presented in front of the crisis. Technologies that are part of Industry 4.0 acted beneficially in issues related to the predictability of the production model and the reduction of process risks, factors that were essential for the stability and even growth of companies that adopted it in the period before the pandemic. Nevertheless, Industry 4.0 should not be treated as a substitute for the lean manufacturing system, but as a complementary one, since the benefits provided by its technologies are aligned with the Lean philosophy, advocated by the TPS.

**References**


Revista Gestão e Secretariado (GeSec), São Paulo, SP, v. 14, n. 12, 2023, p. 21340-21357.
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