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RESEARCH PAPER

Improving Alignment Between Supply and Demand Through The Analysis of Sales and Operations Planning (S&OP)

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ABSTRACT

Sales and operations planning (S&OP) is considered as an important tool at the planning strategic level. It varies depending on industries. The Asian one is known to be very developed. Having several parameters, it proves to be an effective tool, precisely for the study of capacity. However, examples of concrete sales and operations plan used in industry whose parameters are presented and which defines the analysis logic to better align supply and demand are few in the literature. A lack of contribution to the scientific committee that needed to be adjusted. To reduce this gap, we decided to present in our article a real sales and operations plan used in a wire harnesses factory. Thus, various simulations were made on the basis of the data of that sales and operations planning, in order to explain the decision-making process during S&OP meetings. The parameters and the various constraints that were facing the sales and operations planning team are presented and discussed as well as the financial consequences of certain decisions. Recruitment of operators, overtime planning, technical unemployment planning and productivity improvement, many are the adopted solutions. As a result of our study, we can notice that S&OP is indeed a powerful tool that makes it possible to detect in advance the various constraints whose resolution concludes in an optimal alignment between customer demand and factory capacity.

KEYWORDS: *S&OP; Alignment; Simulation; Supply; Demand; Decision-making.*

1. Introduction

To improve their ability to well run their businesses, and in the order of taking the best decisions at the strategic level, companies started using sales and operations plan (S&OP) as a process of well balancing demand and supply. Its parameters vary between companies. Japanese model of S&OP is well known for its various parameters [1]. It is undoubtedly a very powerful tool for decision-making at the strategic level. However, even if the S&OP is considered as an important planning tool, companies struggle to benefit from the results of its implementation [2].

Many practitioners report that vertical and horizontal alignment across functions are improved by using S&OP. According to authors [3], organization's alignment with customers and suppliers is improved based on S&OP.
The practice of sales and operations plan leads to positive performance by improving inventory level [4], forecast accuracy and usage of the factory's capacity [2]. All those improvements lead to a better gross margin and customer retention [5]. Sales and operations planning is an emerging topic with high and growing interest from academics and practitioners. Thus, number of published studies has significantly increased [6-7]. However, there still be a lack of studies about how S&OP works [8-10]. Even if some authors tried to synthesize the research on S&OP, its body still fragmented without clear agenda about advances in S&OP practices [10]. Herein, it seems necessary for practitioners to contribute by empirical research to complete academic knowledge of that topic [11].

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2. Literature Review

2.1. Methods

The purpose here is to describe how literature contributes to sales and operations planning from practical point of view, and to detect what are the limits. Thus, and due to high published number of papers in relation with that topic, we followed the methodology presented in figure 1.

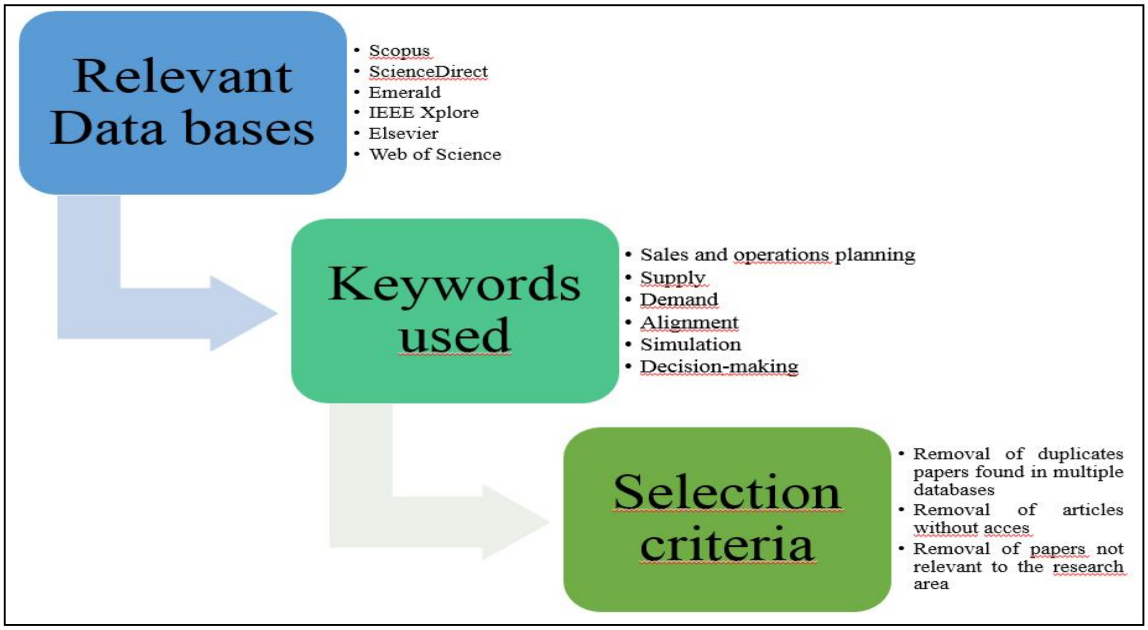

Fig. 1. Literature review research methodology

Using keywords for research in Six databases, more than 250 papers were found. Papers that were found in more than one database were removed, as well as those that couldn't be obtained. Also, papers whose abstract were discussing production planning but without reference to sales and operations planning were excluded.

2.2. Results and findings

Regarding contingencies, it seems that there are less studies from Asia than Europe or America [12]. Researcher's studies are generally limited to one country in their analysis [8]. The majority of studies concern the manufacturing sector. The concerned industries are electronic, chemical, pharmaceutical, beverage and food. However, there are seldom works about service sector and application of S&OP on it [13-14]. There are no studies of a wire harness company. In fact, the study of S&OP was made in multiple multinational companies like IBM [15], Renault [16] and Samsung [17]. Our company is not concerned by any work about sales and operations planning. The manufacturing strategy of the Companies that were studied are MTS and MTO. The S&OP in those companies is positioned in the tactical level to strategic planning level [18]. It is conducted within a planning horizon ranging from 6 to 12 months [19], and can reach from 18 months [8] up to 24 months and 36 months [20]. Aligning strategic and operational plans and balancing supply and demand are done through a five-step process: product planning, demand planning, supply planning, pre-S&OP meeting and the executive S&OP meeting. In addition to conceptual problems of S&OP detected in literature, there is a gap regarding operationally defining and measuring S&OP performance in empirical case or survey studies. Some studies conclusions [21] lead to the fact that empirical evidence is always obtained by practitioners. This gap calls for future case studies that develop operational measures and measurement. Closing it will contribute to a useful knowledge for developing S&OP. Also, future research should explore the under researched areas, particularly by embracing the contingencies of environment, size, and strategy. Despite the various and extensive literature reviews on S&OP, we do not have a clear picture of how the body of literature contributes to the knowledge of how alignment is made between supply and demand based on S&OP. Hence the interest of this work which consists in presenting it.

The sales and operations plan that is presented in table 1 is used by an Asian company of wire harness that has more than 50 factories all over the world. The S&OP is an Excel sheet, prepared by the planning manager of the supply chain & logistics department. After data are received from human resources department, financial department, new project & product department and industrial engineering department, the sheet is fulfilled for a minimum of 12 months and monthly updated. The company data is based on ERP SAP. Despite this, the S&OP is limited to Excel. The global sheet is the consolidation of many sheets, each one related to one of the various projects. Many parameters are presented and used by managers when calculating the capacity vs customer demand. In the next paragraph is presented the S&OP subject of our study. A simulation of decision-making process during S&OP meeting as well as the various constraints considered are explicitly presented.

3. Presentation of S & OP

The company whose sales and operations planning is presented in our work has many ongoing projects. In order to make our simulation the most presentable and for the sake of better understanding, it will be based on a single project. Indeed, the choice will relate to a project chosen among several according to the following criteria:

- Have high sales orders.
- Have the highest number of hours to produce.
- Have suppliers of raw materials with long lead times (supply constraints).
- Have a lot of diversity in product families (engineering constraints).
- Have fluctuations whose impacts on capacity are representative (planning constraints).

Sales orders (customer demand) and forecast planning data are presented in Table 1.

Tab. 1. Data of the factory's projects

Project	Hours to produce	Percentage from total hours	Customer demand	Percentage from total customer demand
P1	109441	2,77%	107638	2,79%
P2	948461	24,31%	966771	25,04%
P3	661875	16,77%	648166	16,79%
P4	446617	11,32%	450603	11,67%
P5	546031	13,83%	530482	13,74%
P6	396391	10,04%	372390	9,65%
P7	2896	0,07%	2712	0,07%
P8	142622	3,61%	152178	3,94%
P9	235997	5,98%	230396	5,97%
P10	411003	10,41%	399470	10,35%
Total	3947037	100,00%	3860806	100,00%

On the basis of these criteria, we opted for a simulation based on the data of the P2 project since it represents more than 25.04% of customer orders and 24.31% of the number of total hours planned. Representing more than 25% of customer orders as well as the provisional production schedule, our model is indeed a representative sample. Add to these the various blocking constraints specific to this project. In addition of having the greatest diversity in Bill of Materials (BOM) according to the engineering department, more than half of the raw material suppliers are located in Europe, America and Japan. Thus, lead times can vary from one week to more than one month. The S&OP of P2 is presented in Table 2.

Tab. 2. S&OP of project 2

Month-Year	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
Term	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78
Direct Headcount	556	550	471	459	487	489	591	546	587	595	601	622
Total Days	31	31	30	31	30	31	31	28	31	30	31	30
Weekends	5	4	5	4	4	5	4	4	5	4	4	5
Holidays	2	6	1	2	3	1	3	0	2	1	3	1
Vacation	0	13	1	0	0	0	0	0	0	0	0	3
Workable Days	24,0	8,0	23,0	25,0	23,0	24,0	24,0	24,0	24,0	25,0	24,0	21,0

Daily Working Hours	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67
Total Workable Hours (A)	102 348	33 748	83 019	88013	85 912	90089	108 839	100 508	107 991	114 176	110 687	100 155
Overtime Hours	0	0	0	0	1 053	0	4 058	0	0	0	2 124	0
% to workable hours	0,0%	0,0%	0,0%	0,0%	1,2%	0,0%	3,7%	0,0%	0,0%	0,0%	1,9%	0,0%
Absentism Hours	1 535	506	1 245	1 320	1 289	1 351	1 633	1 508	1 620	1 713	1 660	1 502
% to workable hours	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%
Attendance Hours (B)	100 813	33 242	81 773	86693	85 676	88737	111 265	99 000	106 371	112 463	111 151	98 653
Training Hours	0	0	0	0	0	0	0	0	0	0	0	0
Non-Productive Hours	1 512	499	1 227	1 300	1 285	1 331	1 669	1 485	1 596	1 687	1 667	1 480
Productive Hours (C)	99 301	32 743	80 547	85393	84 391	87406	109 596	97 515	104 775	110 776	109 484	97 173
Production MH (D)	85 691	28 256	69 507	73689	72 824	75427	94 575	84 150	90 415	95 594	94 478	83 855
Productivity (%) (D/B)	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Efficiency (%) (D/C)	108%	100%	87%	95%	88%	91%	75%	84%	87%	96%	98%	103%
Total MH Produced F	85 691	28 256	69 507	73689	72 824	75427	94 575	84 150	90 415	95 594	94 478	83 855
Sales MH (G)	102 506	32 476	65 809	76882	68 880	38392	78 010	90 602	97 338	106 196	107 745	101 935
Prod-Sales MH Diff. (F-G)	-16 815	-4 220	3 698	-3 193	3 944	37034	16 566	-6 452	-6 923	-10 603	-13 267	-18 081
Cumulative difference	-16 815	-21035	-17337	-20530	-16 586	20449	37 014	30 562	23 640	13 037	-230	-18 310
Daily Stock	-4	-7	-6	-7	-10	6	10	8	6	3	-0	-

To better understand the main analysis based on this table, we will first define the main parameters of that model of S&OP.

- Direct headcount refers to actual operators working at the plant.
- Total workable hours (TWH) are the number of working hours per month.
- Attendance hours refers to last parameter to which the planned overtime hours are added and from which the absences are deducted. Also, by deducting training hours and non-productive hours, we have the productive hours.
- Sales Man-hour refers to customer demand and Production Man hour to what could be planned for production.

Figure 2 schematize the comparison between production planning and customer demand.

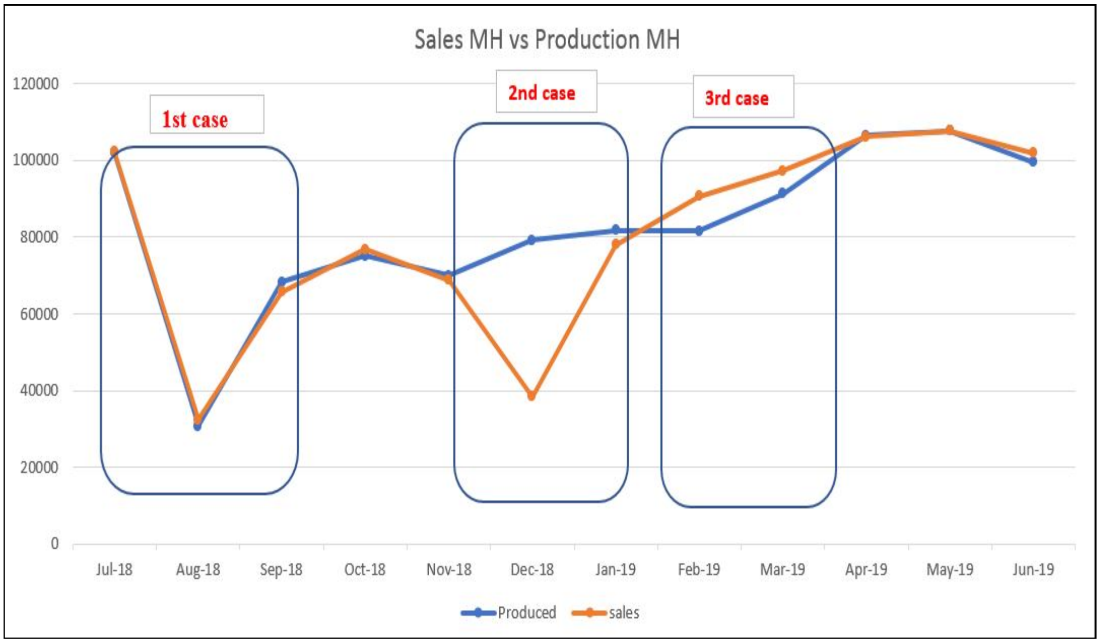

Fig. 2. Comparison of demand and capacity

Referring to the graph above, we see three cases :

- 1st case : Alignment between customer order and provisional planning.

This is the ideal case. An alignment between planning and ordering is the perfect case for a production plant. This means that no financial loss is possible. But is that enough to make such a judgment ?

- 2nd case : The provisional planning exceeds the customer order.

The impact of forecast planning significantly above the sales order is relatively severe. In order to guarantee such production, the supply of the raw material will have to be made in large quantities. Will our suppliers be able to respond favorably to such a request ? do we will have the needed time for supply by the normal way or it will be necessary to carry out shipments by air and at the expense of the company (quite expensive) ? This also means a high stock of work in progress and no doubt of finished products. How do we should analyse the S&OP to better judge ?

- 3rd case : The customer order is greater than the provisional planning.

In industry, the costs of production stoppages amount to hundreds of thousands or even millions of euros per day. With a customer order exceeding production forecast, we are in the perfect case of a customer shutdown. What are the causes and how to fix it ?

To properly handle these different cases, the analysis of the sales and operations plan should not be limited to the capacity study by comparing the planned hours with the order book. There are other important parameters to consider when analyzing the data, namely the 'cumulative difference hours' and 'daily stock'.

4. Aligning Demand and Capacity According To the Detected Contraints

Decision-making at the strategic level is done on the basis of a detailed study and whose financial impacts are measured. These decisions not only concern changes in the provisional production schedule, but also concern :

- Human resources (technical unemployment, recruitment, updating training, versatility training).
- The number of working days.
- Productivity improvement.
- Scheduling overtime.

In our case, the S&OP meeting takes place in January 2018. Its purpose is to prepare the data of the next 18 months and to analyze the results. It is assumed that the next six months are already frozen. Thus, the analysis will mainly focus on the following 12 months.

The company having defined in advance a target of 85% of productivity, the average number of operators (TDH) that will be needed for the period from July 2018 to June 2019 is 556 people.

- ❖ Constraint 1 : High cost of dismissals and serious social impacts.

Given that currently 556 people are already working full-time within the company, making redundancies is an action with serious consequences. Indeed, dismissing part of the staff in order to maintain adequate production capacity will directly result in a feeling of insecurity among the remaining staff. The impact on their efficiency will not be long in coming. Thus, the decision is to maintain the 556 operators.

Given that the planning is 85691 hours of production against 102506 of orders, the next decision is to invest in increasing productivity so that we can nevertheless align with the customer order.

- ❖ Constraint 2 : Defining a new productivity target higher than 85%.

Following the retention of staff, and given the current productivity of 85%, the file still indicates a difference of more than -10,000 hours between customer order and production forecast. Having no other choice, the engineering department carried out a capacity study in order to define a new productivity objective based on its data.

In order to study the capacity at the level of the industrial engineering direction, two parameters must be carefully studied : sequencing by machine and the kanban loop.

Based on a study made by the engineering department, the latter decided that a productivity rate of 95% from July 2018 is achievable. This change and its impact on capacity are shown in table 3 below.

Tab. 3. S&OP with 95% of productivity instead of 85%

Month-Year	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
Term	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78
Direct Headcount	556	556	556	556	556	556	489	489	489	489	489	489
Total Days	31	31	30	31	30	31	31	28	31	30	31	30
Weekends	5	4	5	4	4	5	4	4	5	4	4	5
Holidays	2	6	1	2	3	1	3	0	2	1	3	1
Vacation	0	10	0	0	0	0	0	0	0	0	0	0
Workable Days	24,0	11,0	24,0	25,0	23,0	25,0	24,0	24,0	24,0	25,0	24,0	24,0
Daily Working Hours	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67
Total Workable Hours (A)	102 348	46910	102348	106613	98084	106613	90015	90015	90015	114 176	90015	90015
Overtime Hours	0	0	0	0	0	0	0	0	0	0	0	0
% to workable hours	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Absentism Hours	1 535	704	1535	1599	1471	1599	1350	1350	1350	1406	1350	1350
% to workable hours	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%
Attendance Hours (B)	100 813	46206	100813	105014	96613	105014	88665	88665	88665	92359	88665	88665
Training Hours	0	0	0	0	0	0	0	0	0	0	0	0
Non-Productive Hours	1 535	693	1512	1575	1449	1575	1330	1330	1330	1385	1330	1330
Productive Hours (C)	99278	45513	99301	103439	95164	103439	87335	87335	87335	90974	87335	87335
Production MH (D)	95773	43896	95773	99763	91782	99763	84232	84232	84232	87741	84232	84232
Productivity (%) (D/B)	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Efficiency (%) (D/C)	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Total MH Produced F	95773	43896	95773	99763	91782	99763	84232	84232	84232	87741	84232	84232
Sales MH (G)	102 506	32 476	65 809	76 882	68 880	38 392	78 010	90 602	97 338	106 196	107 745	101 935
Prod-Sales MH Diff. (F-G)	-6733	11420	29964	22881	22902	61371	6222	-6 370	-13106	-18455	-23514	-17704
Cumulative difference	-6733	4686	34650	57531	80433	141804	148026	141656	128550	110095	86581	68877
Daily Stock	-2	2	11	19	52	44	39	35	30	25	20	-

The cost of production per hour (called production Man-hour) being estimated at 27 Euro, this decision of increasing productivity from 85% to 95% has made it possible to increase capacity by 93,159 hours of production, an increase calculated at more than 2,515,000 Euro. This calculation is presented in table 4.

Tab. 4. Financial impact of increasing productivity

Data per month	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Total
Prod MH with 85% of productivity	85691	28256	69507	73689	72824	75427	94575	84150	90415	95594	94478	83855	94841
Estimated cost	2 313 664 €	762 899 €	1 876 696 €	1 989 606 €	1 966 257 €	2 036 524 €	2 553 527 €	2 272 051 €	2 441 207 €	2 581 026 €	2 550 915 €	2 264 077 €	25 608 449 €
Prod MH with 95% of productivity	95773	43895	95773	99763	92924	99763	87420	84232	84232	87741	85873	84232	1041620
New estimated cost	2 585 860 €	11851 77 €	2 585 860 €	2 693 604 €	2508 943 €	2 693 604 €	2 360 345 €	2 274 255 €	2 274 255 €	2 369 015 €	2 318 560 €	2 274 255 €	28 123 732 €
GAP in Euro	272 196 €	422 278 €	709 163 €	703 999 €	542 686 €	657 080 €	-193 182 €	2 203 €	-166 952 €	-212 010 €	-232 355 €	10 177 €	2 515 282 €
GAP in hours	10081	15640	26265	26074	20099	24336	-7155	82	-6183	-7852	-8606	377	93159

Despite these two decisions, we see that the planning remains below the customer order. With a productivity rate of 95%, the factory could now schedule 95,773 working hours in July instead of 85,691 hours. However, with a customer order of 102.506 hours, we still have a gap of -6733 hours. Add to this the fact that we must have a safety stock.

- ❖ Constraint 3 : Customer order still higher than production capacity despite increased productivity.

In order to solve this capacity problem, and despite maintaining the number of staff and increasing productivity to 95%, an increase in production hours is essential. With a negative difference of 6733 hours of work for the month of July, we opted for planning an overtime of 7164 hours. This decision to schedule overtime has not only eliminated the previously calculated gap, but also produced a safety stock of 73 pieces, a stock that is still quite low. However, and taking into consideration 10 days of annual leave planned in August, the 556 people will only produce 43,896 hours against 32,476 hours of order, thus creating the equivalent of 4 days of stock.

Tab. 5. New data with 7% of overtime planned

Month-Year	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
Term	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78
Direct Headcount	556	556	556	556	556	556	489	489	489	489	489	489
Total Days	31	31	30	31	30	31	31	28	31	30	31	30
Weekends	5	4	5	4	4	5	4	4	5	4	4	5
Holidays	2	6	1	2	3	1	3	0	2	1	3	1
Vacation	0	10	0	0	0	0	0	0	0	0	0	0
Workable Days	24,0	11,0	24,0	25,0	23,0	25,0	24,0	24,0	24,0	25,0	24,0	24,0
Daily Working Hours	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67
Total Workable Hours (A)	102 348	46910	102348	106613	98084	106613	90015	90015	90015	114 176	90015	90015
Overtime Hours	7164	0	0	0	0	0	0	0	0	0	0	0
% to workable hours	7,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Absentism Hours	1 535	704	1535	1599	1471	1599	1350	1350	1350	1406	1350	1350
% to workable hours	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%
Attendance Hours (B)	107 978	46206	100813	105014	96613	105014	88665	88665	88665	92359	88665	88665
Training Hours	0	0	0	0	0	0	0	0	0	0	0	0
Non-Productive	1 535	693	1512	1575	1449	1575	1330	1330	1330	1385	1330	1330

Hours												
Productive Hours (C)	106442	45513	99301	103439	95164	103439	87335	87335	87335	90974	87335	87335
Production MH (D)	102579	43896	95773	99763	91782	99763	84232	84232	84232	87741	84232	84232
Productivity (%) (D/B)	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Efficiency (%) (D/C)	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Total MH Produced F	102579	43896	95773	99763	91782	99763	84232	84232	84232	87741	84232	84232
Sales MH (G)	102 506	32 476	65 809	76 882	68 880	38 392	78 010	90 602	97 338	106 196	107 745	101 935
Prod-Sales MH Diff. (F-G)	73	11420	29964	22881	22902	61371	6222	-6 370	-13106	-18455	-23514	-17704
Cumulative difference	73	11493	41456	64337	87239	148610	154832	148462	135356	116901	93387	75684
Daily Stock	0	4	13	21	57	46	41	37	32	26	22	-

According to data, there is overcapacity within the factory. With positive differences of 29,964 hours in September and 22,881 in October, the safety stock will soon exceed 30 days. Such thing is not acceptable. Decisions to drastically reduce this figure must be taken.

Scheduling overtime is neither an easy decision to make nor a simple one to accomplish. On the one hand, the legislation indicates a limit on the number of overtime hours to be worked per person.

On the other hand, working overtime means being paid more than usual. Indeed, planning overtime can be done either during the weekdays or during the weekend (Sunday). For overtime (i.e., 12 hours of work instead of 8 hours per shift) during the week, operators receive 25% more. During Sunday, it is 200%.

The hour of production being estimated in our study at 27 Euro, the cost of this decision is worth :

Tab. 6. Cost of planned overtime in euro

Overtime (OT)	%	Manhour cost	N° of hours	Cost
Planned Sunday	200%	54 EUR	7164	386 856 EUR
During weekdays	25%	33.75 EUR	7164	241 785 EUR
GAP	175%	20.25 EUR		145 071 EUR

- ❖ Constraint 4 : high safety stock and an average of 12% turnover to consider

Over the past decade, the human resources department has seen a 12% reduction in staff directly after the summer holidays. It turns out that some people, having obtained diplomas and having passed public service competitions, resign without notice to join their new employer. Others prefer to continue their higher education. In order to learn from this, changes in the S&OP are to be expected.

Following the departures therefore planned for September, the number of staff has been reduced. With the initial assumption of 12%, the plant staff changed from 556 to 489.

Tab. 7. New S & OP data including 12% turnover since september

Month-Year	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
Term	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78
Direct Headcount	556	556	489	489	489	489	489	489	489	489	489	489
Total Days	31	31	30	31	30	31	31	28	31	30	31	30
Weekends	5	4	5	4	4	5	4	4	5	4	4	5
Holidays	2	6	1	2	3	1	3	0	2	1	3	1
Vacation	0	10	0	0	0	0	0	0	0	0	0	0
Workable Days	24,0	11,0	24,0	25,0	23,0	25,0	24,0	24,0	24,0	25,0	24,0	24,0
Daily Working Hours	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67
Total Workable Hours (A)	102 348	46910	90015	93766	86264	86264	90015	90015	90015	93766	90015	90015
Overtime Hours	7164	0	0	0	0	0	0	0	0	0	0	0
% to workable hours	7,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%

Absentism Hours	1 535	704	1350	1406	1294	1294	1350	1350	1350	1406	1350	1350
% to workable hours	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%
Attendance Hours (B)	107 978	46206	88665	92359	84971	84971	88665	88665	88665	92359	88665	88665
Training Hours	0	0	0	0	0	0	0	0	0	0	0	0
Non-Productive Hours	1 535	693	1330	1385	1275	1275	1330	1330	1330	1385	1330	1330
Productive Hours (C)	106442	45513	87335	90974	83696	83696	87335	87335	87335	90974	87335	87335
Production MH (D)	102579	43896	84232	87741	80722	80722	84232	84232	84232	87741	84232	84232
Productivity (%) (D/B)	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Efficiency (%) (D/C)	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Total MH Produced F	102579	43896	84232	87741	80722	80722	84232	84232	84232	87741	84232	84232
Sales MH (G)	102 506	32 476	65 809	76 882	68 880	38 392	78 010	90 602	97 338	106 196	107 745	101 935
Prod-Sales MH Diff. (F-G)	73	11420	18423	10859	11842	42330	6222	-6 370	-13106	-18455	-23514	-17704
Cumulative difference	73	11493	29915	40774	52616	94946	101168	94798	81692	62237	39723	22020
Daily Stock	0	4	10	14	32	29	27	23	19	14	9	-

With this reduction in the number of staff, the factory's production capacity has been reduced, leading to a reduction in the overstock previously detected. However, the latter remains quite high and again requires managers to take decisions likely to reduce it.

❖ Constraint 5 : An average of 20 days of safety stock

Despite the various decisions taken by the managers, the number of days of stock remains too high. It is around 32 days in November and 29 days in December. Having no other choice, it would be necessary to plan technical stoppages (unemployment) in order to reduce the overstock detected.

After several simulations, the best choice of technical unemployment planning will be as follows:

- 4 days in September
- 4 days in October
- 5 days in November
- 5 days in December

With such gymnastics, the stock is significantly reduced. The following table shows these reductions for the period from October 2018 to March 2019.

Tab. 8. S&OP with planned technical unemployment

Month-Year	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
Term	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78
Direct Headcount	556	556	489	489	489	489	489	489	489	489	489	489
Total Days	31	31	30	31	30	31	31	28	31	30	31	30
Weekends	5	4	5	4	4	5	4	4	5	4	4	5
Holidays	2	6	1	2	3	1	3	0	2	1	3	1
Vacation	0	10	0	0	0	0	0	0	0	0	0	0
Short-time work			4	4	5	5						
Workable Days	24,0	11,0	20,0	21,0	18,0	18,0	24,0	24,0	24,0	25,0	24,0	24,0
Daily Working Hours	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67
Total Workable Hours (A)	102 348	46910	75013	78763	67511	67511	90015	90015	90015	93766	90015	90015
Overtime Hours	7164	0	0	0	0	0	0	0	0	0	0	0
% to workable hours	7,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Absentism Hours	1 535	704	1125	1181	1013	1013	1350	1350	1350	1406	1350	1350
% to workable hours	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%
Attendance Hours (B)	107 978	46206	73887	77582	66499	66499	88665	88665	88665	92359	88665	88665
Training Hours	0	0	0	0	0	0	0	0	0	0	0	0

Non-Productive Hours	1 535	693	1108	1164	997	997	1330	1330	1330	1385	1330	1330
Productive Hours (C)	106442	45513	72779	76418	65501	65501	87335	87335	87335	90974	87335	87335
Production MH (D)	102579	43896	70193	73703	63174	63174	84232	84232	84232	87741	84232	84232
Productivity (%) (D/B)	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Efficiency (%) (D/C)	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Total MH Produced F	102579	43896	70193	73703	63174	63174	84232	84232	84232	87741	84232	84232
Sales MH (G)	102 506	32 476	65 809	76 882	68 880	38 392	78 010	90 602	97 338	106 196	107 745	101 935
Prod-Sales MH Diff. (F-G)	73	11420	4384	-3179	-5706	24781	6222	-6 370	-13106	-18455	-23514	-17704
Cumulative difference	73	11493	15877	12697	6991	31772	37994	31624	18518	63	-23450	-41154
Daily Stock	0	3	4	3	3	10	10	8	4	0	-6	-

We can clearly notice that daily stock has been reduced from 30 days to 3 days starting from October. However, another constraint has appeared in April 2019.

❖ Constraint 6 : The factory is under capacity

It turns out that the plant will be under capacity from April. In this case, it would be necessary either to increase the capacity, or to carry out recruitments. The following table indicates a simulation at 100% productivity (subject to its feasibility). Despite perfect productivity, the result is always negative. That said, the factory will have no choice but to anticipate recruitment in order to be able to respond to customer orders.

Tab. 9. S&OP with 100% of productivity starting from April-19

Month-Year	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
Term	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78	T78
Direct Headcount	556	556	489	489	489	489	489	489	489	489	489	489
Total Days	31	31	30	31	30	31	31	28	31	30	31	30
Weekends	5	4	5	4	4	5	4	4	5	4	4	5
Holidays	2	6	1	2	3	1	3	0	2	1	3	1
Vacation	0	10	0	0	0	0	0	0	0	0	0	0
Short-time work			4	4	5	5						
Workable Days	24,0	11,0	20,0	21,0	18,0	18,0	24,0	24,0	24,0	25,0	24,0	24,0
Daily Working Hours	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67	7,67
Total Workable Hours (A)	102 348	46910	75013	78763	67511	67511	90015	90015	90015	93766	90015	90015
Overtime Hours	7164	0	0	0	0	0	0	0	0	0	0	0
% to workable hours	7,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Absentism Hours	1 535	704	1125	1181	1013	1013	1350	1350	1350	1406	1350	1350
% to workable hours	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%
Attendance Hours (B)	107 978	46206	73887	77582	66499	66499	88665	88665	88665	92359	88665	88665
Training Hours	0	0	0	0	0	0	0	0	0	0	0	0
Non-Productive Hours	1 535	693	1108	1164	997	997	1330	1330	1330	1385	1330	1330
Productive Hours (C)	106442	45513	72779	76418	65501	65501	87335	87335	87335	90974	87335	87335
Production MH (D)	102579	43896	70193	73703	63174	63174	84232	84232	84232	92359	88665	88665
Productivity (%) (D/B)	95%	95%	95%	95%	95%	95%	95%	95%	95%	100%	100%	100%
Efficiency (%) (D/C)	96%	96%	96%	96%	96%	96%	96%	96%	96%	102%	102%	102%
Total MH Produced F	102579	43896	70193	73703	63174	63174	84232	84232	84232	92359	88665	88665
Sales MH (G)	102 506	32 476	65 809	76 882	68 880	38 392	78 010	90 602	97 338	106 196	107 745	101 935

Prod-Sales MH Diff. (F-G)	73	11420	4384	-3179	-5706	24781	6222	-6 370	-13106	-13837	-19080	-13270
Cumulative difference	73	11493	15877	12697	6991	31772	37994	31624	18518	4681	-14399	-27670
Daily Stock	0	3	4	3	3	10	10	8	4	1	-3	-

With a reduced capacity of 4681 hours at the end of April-19, the factory will not respond to all customer demand. There will be a production line stoppage at the end of the first week of May.
Those simulations allowed as to better understand how sales and operations planning contributes to the alignment between supply and demand. However, to better evaluate that company process of sales and operations plan, it would be interesting to make a maturity evaluation. Many maturity models have been developed and presented in literature [22-32]. Wherever classed in a standard or advanced level, systematic planning and basic scheduling techniques based on mathematical principles must be developed to solve supply chain management problems [33], like the study that used the mixed integer nonlinear programming (MINLP) model [34], or taking into consideration some parameters like lead time [35], or in a fuzzy environment [36].

5. Conclusion

An effective sales and operation plan could highly improve the linking between demand and supply. The Asian sales and operations planning is very developed with more than ten parameters considered. Based on it, the top management easily detect if any issues regarding their plant capacity and needed actions are immediately taken.
Based on the literature review, it seems that there is a lack of contributions regarding real sales and operations planning as well as the process of decision making through S&OP meetings. The purpose of this article is to reduce that gap and the main contribution was the presentation of the various constraints that could be faced during S&OP meetings while analyzing a real sales and operations plan by managers. The scientific committe has now a clear overview of real usage of sales and operations planning in industrial factories of wireharness as well as the decision making process at strategic level. In fact, S&OP team member need to carefully make many simulations to choose the one that best fit with their targets. Then, and based on that, managers could take strategic decisions. Those decisions are not limited to recruitment of new operators or technical unemployment. They also concern overtime planning and improving productivity to increase their plant production capacity. Measuring the financial impact of each decision is not always easy to do. A great analysis is the one that is not limited to comparing capacity with demand, but also considering the safety stock as well as the cumulative difference.
Our study was limited to one project in order to make the understanding of the sheet and its analysis easier for readers. However, a better presentation should consider all projects with all constraints. Other studies could compare that example of sales and operations planning with other ones. This might be a great perspective of research.
In this paper, and based on the various parameters of that S&OP and how it makes it easy to detect and correct all gap between plant capacity and customer demand, we can conclude that the sales and operations plan of that Asian factory is at an advanced level. However, some comments regarding the S&OP process should be considered and the process itself improved. An S&OP optimization software need to be implemented as a solution method. There are many such : SAP IBP S&OP, Infor S&OP, Oracle S&OP Cloud, Logility S&OP… Its results might be compared with Excel data for better decisions. Also, presented S&OP could be changed into a mathematical model and then solved. The customers could be involved in S&OP meetings. Instead of considering sales order as firm data, managers could negotiate some changes directly with customers and have less constraints. By presenting this paper, we are also giving opportunity to scientific committee to apply various maturity models to that sales and operations plan, since there is a lack of maturity evaluation.

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