calculation is considered according to the package group or capacity by operation or by machine model but not analyzed in detail with the product capacity. Therefore, the result is always different dramatically from the product capacity that it should be. Moreover, the measurement unit is not a good representative and commonly cannot describe the difference of resource requirement among the packages. It cannot provides implication and guidance to the planner to decide or know how many capacity or available capacity that company has because each products has its own characteristic in terms of capacity. Also, the calculation software was developed for a long time ago and not up-to-date. Many job functions have to be done with many consequentially steps by manual. It is distinctive by each operations and not in general format and thus calculation cannot be done for all major and special concerned operations. Therefore, planners can overlook some major or special concerned operations and make the decision for customer's commitment incorrectly. Capacity planning report is separated in parts to see by operations and cannot be viewed in one page report causing the planners cannot see the overall concerned capacity in planning.

From the historical planning data from January 2015 - November 2015, it was found that capacity planning accepted many overtimes that was exceeded the actual requirements. This occurs when the planner do not know the exactly capacity and demands in each cycle leading to the grant of over-provided overtimes. When the calculation is superficial, the customers' commitment may be incorrect. By analyzing its historical data, it was revealed that the production amounts in some months were much lower than the capacity of the factory while the master plan of those months established prior to the actual production started at the beginning of the months indicated that the full capacity had already been committed, and vice versa. This inaccurate planning makes the company to substantially loose sales opportunity and profit. Also, the capacity cannot be utilized as much as it should be.

III. PROCESS IMPROVEMENT

The proposed capacity planning procedure was developed and setup under the agreement in the meeting of all planning parties consisting of Industrial Engineer, Material Control planner, and Production Planning and Control planner. The meeting was conducted many times to discuss and conclude the effective way of working. The proposed procedure with some examples of capacity planning data are shown and then the proposed capacity planning procedure is developed together. Many concerns and recommendations are highlighted in the meeting for the next improvement. Also, the trial runs with calculation of aggregate capacity planning and rough cut capacity planning or capacity requirement planning were conducted for one cycle of capacity planning to confirm the appropriateness of the procedure. To proceed the steps as proposed in capacity planning procedure of the company, a new work instruction was provided and trained to all concerned departments. The procedure flow of current capacity planning and new proposed improvement are illustrated in Figure 1.

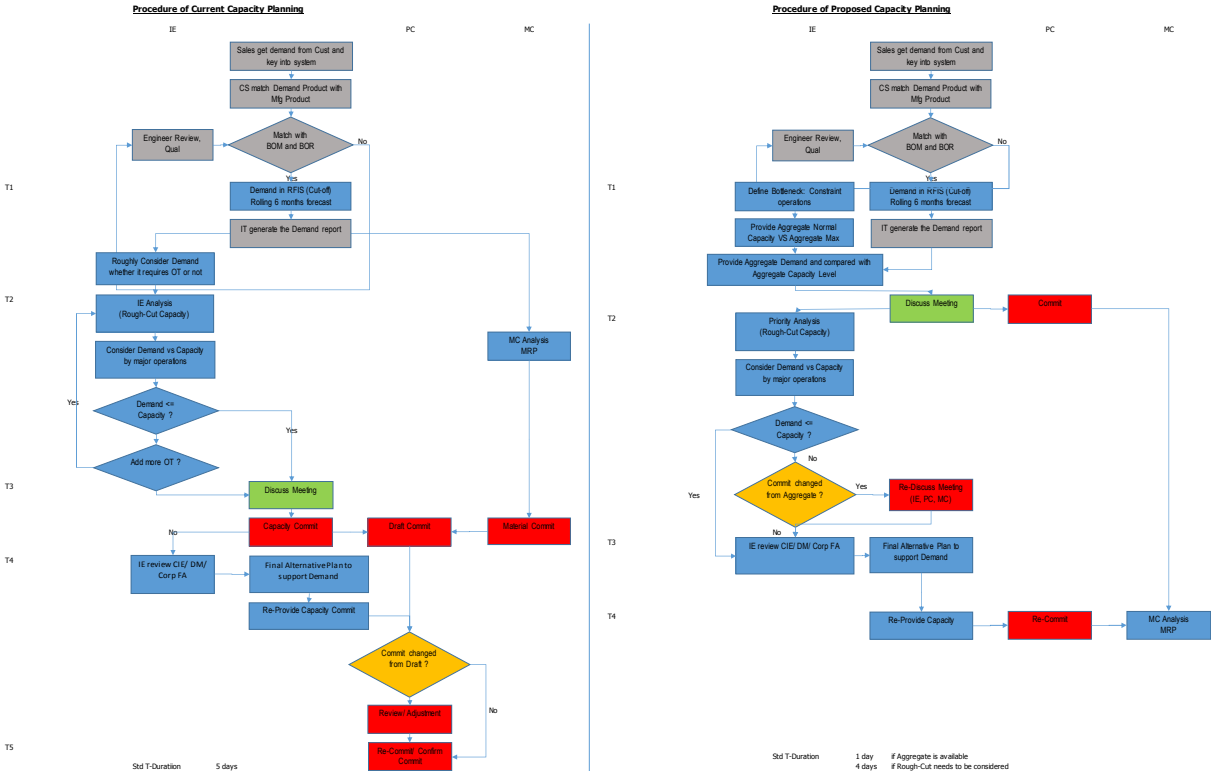


Figure 1. Comparison of current capacity planning procedure and proposed capacity planning procedures

To comply the procedure and process flow with the production planning concept, a new improvement of master production planning that adopted the aggregate planning and rough cut capacity planning concepts is proposed. The simple approach between current and proposed algorithm of the process flow to do capacity production planning are illustrated in Figure 2. First, bottleneck operation is defined for the proposed approach. The overtime is applied according to customers' demand and special requirement in some operations instead of maximum overtime as current. Instead of individual consideration about capacity and materials, and calculation of material requirement according to customers' demand at the beginning phase of production planning, the concept of aggregate production planning is proposed to do first among all concerned persons consisting of industrial engineer, material control and production planning and control staffs in order to make a decision together. It requires to know the bottleneck or constraint operations to provide aggregate capacity both with normal working days and maximum working days with overtimes. Then, the customers' demand is converted to the same measurement unit as capacity in order to be compared and see whether aggregate capacity can support the customers' demand or not and how many overtimes are required to serve the requirement. This can provide the primary commitment to the customers with totally agreed from all concerned planning staffs.

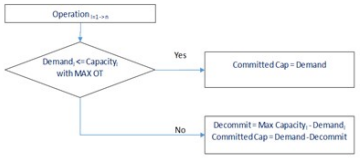
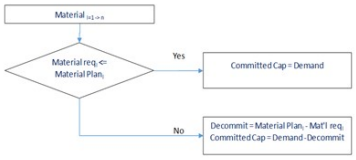
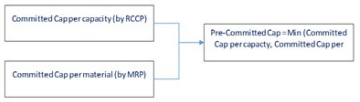
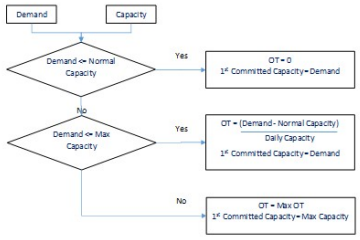
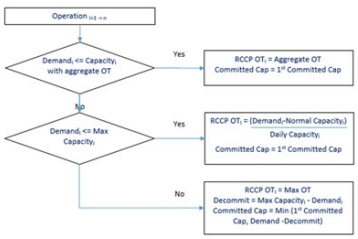
Current approach	Proposed approach
1. Consider maximum overtime	1. Define bottleneck operation
2. Do RCCP according to the demand  (for some highlighted operations)	2. Provide aggregate normal capacity VS aggregate max capacity
3. Do MRP with customer's demand  (for major materials)	3. Provide aggregate demand according to the demand
4. Do pre-committed capacity plan  	4. Consider aggregate demand with aggregate capacity 
5. Review and Justify for final committed plan according to planner's consideration by considering pre-committed capacity plan	5. Do RCCP to validate the 1st committed capacity plan for all major operations with OT provided from aggregate plan  (for all major and special operations)
6. Re-do MRP with final committed plan	6. Do MRP with committed capacity plan

Figure 2. Comparison of current approach and proposed approach to do capacity planning

Rough cut capacity planning is also applied to verify and validate the master plan against key and critical resources before using the planning process to generate detailed material requirement plan. If there is anything changed with the primary decision to commit capacity with the customers, the meeting is called upon to inform, discuss, and make a new decision together with the planning team. When the commitment is finalized, the Material Control department plans about material requirements in detail to support the capacity commitment and production plan.

In addition, the computer software for calculation both aggregate capacity planning and rough cut capacity planning is developed for easier to use and understand. It is generic and can cover all necessary requirements for every major concerned or special operations that may have capacity impacts. The report was generated in a one-page format to present the overview plan in the meeting that can include all important information for decision making about capacity planning. Moreover, it was flexible to adjust to any changes in demand or capacity consideration that can show the result in sudden.

IV. RESULTS AND DISCUSSION

Having implemented the new proposed procedure in the company, the result indicated that the planning process is improved significantly in terms of shortened planning time and much more accuracy. The process time of planning can be reduced from five working days to as much as one working day for the basic requirement, or four working days for the special requirement. Also, the newly developed computer software for calculation can support by product consideration in detail instead of product group. As a result, much more accuracy of the calculation and the result can be acquired. The planning time of the Industrial Engineering department is shortened from 16 working hours to only 4-6 working hours. Moreover, the company gained more effective capability to commit to customer's demand. In terms of cost, the overtime can be granted according to the requirements in overall and specific operations; hence, it can be reduced by 28.5 days per 6-month cycle. As shown in Table 1, the customers' commitment can be improved by 2.7% or about 44 million units per cycle. Consequently, the company can consider to commit the customer's demand more than previously and can get more opportunity to take the business and gain more revenue about 2.2 million US$. Also, the result showed that the percentage of capacity utilization can be increased by 5%.

Table 1. Capacity production planning with improvement in % commitment and % utilization

		Month	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Cycle 6	Cycle 7	Cycle 8	Cycle 9	Cycle 10	Cycle 11
	Normal Working day	Days	149.00	146.00	147.00	148.00	150.00	151.00	151.00	150.00	149.00	150.00	149.00
Current	OT days	Days	20.10	24.20	27.60	28.00	30.60	27.80	29.40	15.60	20.20	19.00	18.60
	Demand	K.units	1,436,401	1,537,154	1,531,262	1,495,489	1,635,410	1,497,924	1,491,271	1,458,202	1,497,288	1,605,292	1,355,538
	Capacity	K.units	1,549,168	1,587,408	1,567,804	1,548,589	1,591,383	1,533,496	1,584,080	1,513,008	1,537,530	1,565,770	1,521,741
	Commit/Roll Over	K.units	1,399,438	1,517,489	1,517,604	1,483,789	1,583,150	1,493,469	1,491,271	1,456,489	1,472,057	1,560,213	1,355,538
	Total Decommit	K.units	36,963	32,552	28,360	11,722	52,260	4,455	-	1,610	25,231	45,270	-
	% Utilization		90%	96%	97%	96%	99%	97%	94%	96%	96%	100%	89%
Proposed	OT days	Days	0.27	4.96	3.05	1.46	9.92	-	0.87	0.87	2.96	10.55	-
	Demand	Hrs	775,477	852,582	845,543	837,267	916,201	841,108	856,185	817,091	857,213	917,903	782,377
	Capacity	Hrs	838,000	864,903	859,697	856,307	916,201	865,119	870,094	870,094	870,598	919,853	853,660
	Commit/Roll Over	K.units	1,436,122	1,516,955	1,530,536	1,495,489	1,618,240	1,497,924	1,491,271	1,457,427	1,497,288	1,603,749	1,355,359
	Total Decommit	K.units	279	20,199	726	-	17,170	-	-	775	-	1,325	179
	% Utilization		93%	97%	98%	98%	99%	97%	98%	94%	98%	100%	92%
	% Improvement (Util)		2%	2%	2%	2%	-1%	0%	5%	-2%	3%	0%	3%
	Improvement in OT days		19.83	19.24	24.55	26.54	20.68	27.80	28.53	14.73	17.24	8.45	18.60
	% Decommit (Current)		2.6%	2.1%	1.9%	0.8%	3.2%	0.3%	0.0%	0.1%	1.7%	2.8%	0.0%
	% Decommit (Proposed)		0.0%	1.3%	0.0%	0.0%	1.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%
	% Improvement (Decommit)		2.6%	0.8%	1.8%	0.8%	2.1%	0.3%	0.0%	0.1%	1.7%	2.7%	0.0%
	Decommit (Current)	K.units	36,963	32,552	28,360	11,722	52,260	4,455	-	1,610	25,231	45,270	-
	Decommit (Proposed)	K.units	279	20,199	726	-	17,170	-	-	775	-	1,325	179
	Improvement (Decommit)	K.units	36,684	12,354	27,634	11,722	35,090	4,455	-	836	25,231	43,945	(179)
	Revenue Improvement	0.05 K.$/K.unit	1,834	618	1,382	586	1,754	223	-	42	1,262	2,197	(9)

V. CONCLUSION

In this study, the concept of master production planning is discussed and adapted among planning staffs. New procedures, work instructions, and job descriptions of the Industrial Engineering, Material Control, and Production Planning and Control staffs concerning with planning process are re-written and developed according to the new proposed improvement of planning process to achieve centralize planning. The computer software is also employed to facilitate the planning process. It is also developed to be easier to use and adjustable to any changes or additional demands from the customer. It integrates the calculation files of each operation into one calculation software of production planning and can summarize the result of key and critical operations in one page. It is able to re-calculate by putting the customers' demand in manufacturing products into the provided format and convert it to the required measurement unit of demand similar to the capacity. Following a few steps in developing production planning computer software, the calculation is done and the result can be provided in a short time. This is applicable both in analyzing phase of aggregate capacity and rough cut capacity planning. It is showed in form of general format to understand and capable to see along the all critical process and find out which ones are constraint. Due to special requirements from each customers, the process flow is complicated and this summary can display the special operations obscured from the whole picture of consideration in constraint capacity concerns. Therefore, it can conclude that the company gain more benefits and many advantages from this kind of improvement in production capacity planning. However, the capacity planning procedure and calculation software should be studied further and developed to match and serve with the company requirements in order to get the most advantages in the future.

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