Decision Making Tools **Paper 1**

Production Order Decision Making from Multiple Product Choice and production Constraints.

Sunil Kumar Puri

"Somewhere along the line of development we discover what we really are, and then we make our real decision for which we are responsible. Make that decision primarily for yourself because you can never really live anyone else's life."

-- *Eleanor Roosevelt*

Introduction

Good decisions are the roots of success, and at times there are moments when the process of decision making can be difficult, perplexing, and nerve-racking. However, the boldest decisions are also the safest. Nothing succeeds a success better than another sweet success.

A leader is a person who knows and recognizes his/her feasible limits set by his/her surroundings. A leader recognizes what is under his/her control and what is not, and has the ability to accept the first and extend the second one. There is an old saying that goes like "If there is a will, then there must be a way". In fact the opposite of this is the truth, i.e. "If there is a way, then there must be a will". If there are gaps in the feasible region and if one ignores one or some constraints, and then one can invite big trouble, e.g., willingness beyond ones' ability. Willingness alone is not sufficient to carve out a way. Willingness, ability, dedication and determination to apply are necessary ingredients of success. It is therefore very important to understand one's abilities and expertise as well as one's constraints. Any decision made without acknowledging both, the ability and the constraints can invite more disaster and no progress. Often, because of frustrations or ignorance of decision making science while facing a difficult problem, one may unfortunately solve it by creating a bigger problem. This strategy may get rid of a present problem but it creates a new problem as a side effect. The decision making tools help us in taking the right decisions. These tools are simple to understand and follow. But the outcome is remarkably clear and correct.

In day to day business we all encounter situations where we are confronted with various propositions that come attached with several opportunities and constraints. With this paper we will start a series of papers that will take a look at some of the simple but effective decision making tools. As business decision becomes more and more complex we may need to take help of more that one tool to arrive at the right conclusion.

The Problem

We start the series with a tricky situation where a manufacturer who has more order than he can deliver for products which have different margins of contribution, different production rates, different order sizes and different costs of production as well. Given on the next page is a table of orders received by a manufacturer of Sweaters which states the Style No, the Sale price, the cost price, the margin of contribution, the order quantity the production rate , the number of processes involved in manufacturing the style as well the manufacturers evaluation of the degree of difficulty in manufacturing the style and the number of production days available to him. This kind of a situation is faced by many manufacturers of Sweaters in

Ludhiana when they have multiple style orders with no uniformity in cost price, the margin of contribution, production rate, number of processes involved in manufacturing as well the order quantities.

To be able to solve the problem which styles to manufacture to obtain maximum contribution in profits as well as considering the various other aspects in mind can be a harrowing experience without knowledge of some simple decision making tools. Here the manufacturer has to see that he shall be able to manufacture a maximum number of pieces at the lowest cost and he shall also not overlook the order quantities. A style that has been sold the most cannot be ignored even if it fetches a lesser margin of contribution. After all this is a style which has been liked by all his retail customers, ignoring this style may also effect the reputation of the manufacturer.

A Japanese proverb says, "Thinking without action is a daydream. Action without thinking is a nightmare." The origin of decision theory is derived from economics by using the utility functions of payoff. It suggests that decisions be made by computing the utility and probability, and the ranges of options. It also lays down strategies for good decisions. Any business decision shall therefore be based on the utilization of all functions of payoff by computing the utilities and probabilities keeping all ranges of options as well as constraints in mind. In the case of study the manufacturer has to consider the cost price of each style in mind as lower the cost of style, lower will be the inventory cost and thus lower overall cost of manufacturing, the margin of contribution is the most important part of the decision making.

The Solution

S. No.	Sale Price	Cost Price	Margin of contribution	Order Qty	Prod per Day	No of process involved	Deg of difficulty	Change Over time	Available Days for Production
Style 1	560	365	195	1100	70	20	1	0.25	180
Style 2	425	255	170	1400	75	15	1	0.2	
Style 3	360	225	135	800	70	21	2	0.2	
Style 4	475	325	150	750	80	17	1	0.25	
Style 5	320	225	95	600	85	16	3	0.3	
Style 6	375	240	135	400	75	19	2	0.5	
Style 7	595	375	220	900	60	18	3	0.25	
Style 8	855	610	245	1200	85	21	5	0.2	
Style 9	720	450	270	1000	75	21	1	0.3	
Style 10	560	385	175	750	90	17	2	0.4	
Style 11	420	275	145	550	80	19	4	0.3	
Style 12	520	325	195	2100	75	15	2	0.25	
Style 13	630	440	190	180	65	20	1	0.3	
Style 14	340	215	125	690	75	16	3	0.5	
Style 15	665	435	230	330	85	21	1	0.2	
Style 16	450	305	145	570	80	17	4	0.3	
Style 17	700	465	235	840	90	14	5	0.5	
Style 18	855	625	230	260	95	19	2	0.2	
Style 19	420	285	135	480	70	16	1	0.3	
Style 20	300	190	110	680	75	18	4	0.5	
Total	10545	7015		15580					

Table A

As per the table the margin varies, the real value however is dependent on the cost price, the contribution factor shall not be considered without matching it with the cost of production as it is this cost which determines the percentage of the margin. A garment fetching more margin in Rupees may not be more profitable to manufacture and therefore while evaluating the real contribution factor the margin per style shall be divided by the cost of the style to arrive at the cumulative and effective margin. And then there are other factors which will affect the profitability of the manufacturer, e.g., order quantities, the rate of production, the number of processes involved, the degree of difficulty etc.

Where as it is easier to understand the production rate and degree of difficulty affecting the margins the number of processes involved also plays a vital role in productivity. As the number of processes increases, even if the production rate is the same there still a chance of higher product cost. The reason is more the number of processes more the number of people have to be employed to realize the product. And when more processes are involved the value chain becomes lengthier, the waiting time may increase and all these factors will accumulate in higher production costs. In cases like this where there is a definite constraint of a number of working days the most preferred style of manufacturing shall consist of a lesser number of processes.

The model to provide a solution in similar situations shall be based on the evaluation of, cost price, co-efficient of margins of contribution, the production time, and the change over time for simple calculations of the utilization of a number of days available. As there is no significant time involved the factor may not be used for selecting the style for manufacturing. Apart from these the other factors to be considered are; the degree of difficulty and the number of processes.

The Table A shows the Style No, the cost price, the selling price, the margin of contribution, the order quantity, the production per day, the number of processes involved, the degree of difficulty, the change over time and finally the number of days available to manufacture the entire or the part of the order.

In Table B the factors in consideration for decision making with their weighted values are mentioned against the style numbers. The cost price factor is the cost price divided by the cumulative cost of all the styles, the margin of contribution is the margin of style divided by the cost price of the style. The demand factor of the style is the demand of the style divided by the total demand. The production per day is as per the actual production mentioned in Table A, the Weight age of Number of processes involved is calculated by adding one to the maximum number of processes involved in any of the styles and then subtracting the actual number of processes involved in manufacturing of the particular style. The degree of difficulty is as per the evaluation of the production team of the manufacturing company on a scale of 1-5 given in Table A. The cumulative weight age of the style is the multiple of all the factors involved. The rank is obtained in descending order of the cumulative weight achieved by each style.

Here it may be observed that two of the given styles have the same rating. In such eventualities though all other parameters are different, preferably the decision shall be made by keeping the cost, demand, degree of difficulty, and production rate in mind in respective order. In our study we observe that style number 2 and style number 8 have accumulated the same weight and both stand at rank 5. The cost of style number 2 being lesser than the style number 8 the 5^{th} rank shall be allocated to style 2 and sixth rank to style number 8.

Factors Weights	Cost Price	Margin of Contribution	Demand	Prod per Day	No of process involved	Deg of difficulty	Cumulative Weight	Rank
Style 1	5.20	5.34	7.06	70	2	1	27476.42362	14
Style 2	3.64	6.67	8.99	75	7	1	114324.9794	5
Style 3	3.21	6.00	5.13	70	1	2	13834.28322	18
Style 4	4.63	4.62	4.81	80	5	1	41173.46197	12
Style 5	3.21	4.22	3.85	85	6	3	79794.16929	10
Style 6	3.42	5.63	2.57	75	3	2	22233.66946	16
Style 7	5.35	5.87	5.78	60	4	3	130437.5275	3
Style 8	8.70	4.02	7.70	85	1	5	114324.9794	5
Style 9	6.41	6.00	6.42	75	1	1	18528.05788	17
Style 10	5.49	4.55	4.81	90	5	2	108080.3377	7
Style 11	3.92	5.27	3.53	80	3	4	70049.78329	11
Style 12	4.63	6.00	13.48	75	7	2	393412.4291	2
Style 13	6.27	4.32	1.16	65	2	1	4067.938042	20
Style 14	3.06	5.81	4.43	75	6	3	106536.3328	8
Style 15	6.20	5.29	2.12	85	1	1	5902.901997	19
Style 16	4.35	4.75	3.66	80	5	4	120995.0802	4
Style 17	6.63	5.05	5.39	90	8	5	650211.3114	1
Style 18	8.91	3.68	1.67	95	3	2	31187.52499	13
Style 19	4.06	4.74	3.08	70	6	1	24901.7098	15
Style 20	2.71	5.79	4.36	75	4	4	82127.33213	9

Table B

From this table it is clear the order of preference in production of the styles for achieving the maximum margins of contribution but as we have constraints of the availability of the number of production days, we need to calculate how many styles and how many garments can be made to achieve the maximum margins of contribution. The exercise will also help us in planning the purchase of necessary raw material. Any purchase of raw materials that may not be utilized for want of production time shall remain as surplus yarn inflating the inventory costs. The inventory costs do not consist of the extra raw material alone but the extra raw material needs extra space for storage, extra holding cost, and at times as unnecessary salvage. All these factors reduce the margins of contribution and are counter productive as well as a result of decision without thinking.

In Table C we allocate the production order quantities and calculate the number of days required to manufacture the required order quantity. The number of days required to manufacture the required quantity is subtracted from the available days. Here it also necessary to take care of the change over time in order to have a precise idea of the time factor. The margins available are multiplied to the production order quantity and are added style by style to access the total margin of contribution. The no of days left is matched with the number of days required to manufacture the order quantity until there is a gap observed in the available days as well as the required number of days. In such an eventuality as in the case of style no 9 where order quantity is 1000 pcs and number of days required to manufacture is not enough i.e., the number of days required is thirteen and the available number of days are only two, the production order quantity shall be reduced to the quantity that can be manufactured in two days.

Here the manufacturer can use his intelligence and opt to manufacture any left out style and its quantity which can be manufactured in the balance number of days. How ever the decision shall depend on the degree of difficulty. The total number of order quantity, the raw material used in the styles. If the raw material used is common to the styles already covered in production order it will help in reducing the leftover raw materials.

It may be noted that in this exercise the excel program is used to draw conclusions using simple formulas like, "If"," Round"," Rank"," Multiplication", "Division", "Vlookup" etc. Simple use of such readily available tools can help a manufacturer in getting the optimum results.

S. No.	Style	Order Qty	Prod per Day	Days Required for Production	Change Over time	Balance no. of Days	Prod Order Quantity	Margin of contribution	Total Margin
1	Style 17	840	90	9.33	0.5	170.17	840	235	197400
2	Style 12	2100	75	28.00	0.25	141.92	2100	195	409500
3	Style 7	900	60	15.00	0.25	126.67	900	220	198000
4	Style 16	570	80	7.13	0.3	119.24	570	145	82650
5	Style 2	1400	75	18.67	0.2	100.38	1400	170	238000
6	Style 8	1200	85	14.12	0.2	86.06	1200	245	294000
7	Style 10	750	90	8.33	0.4	77.32	750	175	131250
8	Style 14	690	75	9.20	0.5	67.62	690	125	86250
9	Style 20	680	75	9.07	0.5	58.06	680	110	74800
10	Style 5	600	85	7.06	0.3	50.70	600	95	57000
11	Style 11	550	80	6.88	0.3	43.52	550	145	79750
12	Style 4	750	80	9.38	0.25	33.90	750	150	112500
13	Style 18	260	95	2.74	0.2	30.96	260	230	59800
14	Style 1	1100	70	15.71	0.25	15.00	1100	195	214500
15	Style 19	480	70	6.86	0.3	7.84	480	135	64800
16	Style 6	400	75	5.33	0.5	2.01	400	135	54000
17	Style 9	1000	75	13.33	0.3	0.00	151	270	40770
18	Style 3	800	70	11.43	0.2	0.00	0	135	0
19	Style 15	330	85	3.88	0.2	0.00	0	230	0
20	Style 13	180	65	2.77	0.3	0.00	0	190	0
								Cumulative margin of contribution = Rs. 23,94,970.00	

Table C

Results and Conclusions:

Simple and effective tools can be used by any person with the necessary skills to use simple programs like "Microsoft Excel" in drawing the required results.

About the Author:

The author is the Executive Director of the Sportking Institute of Fashion Technology, Ludhiana and has working experience of over thirty years in knitting. He is also a qualified professional in Total Quality Management, Kaizen and Lean Production. He has his own company in the name and style of M/s Techknit Overseas Pvt. Ltd. and has worked as an Indian agent of the top three computerized flat bed knitting machine manufacturers for many years. Currently he also looks after the interests of Toyota Tsusho India Pvt. Ltd. an associate company of the famous Toyota Automobile Company of Japan for Punjab and surrounding areas. He is also working as a marketing consultant for a Chinese Machinery Manufacturing Company and as TQM consultant for a few Knitwear Companies.