



IMPACT ON THE PRODUCTIVE STABILITY CAUSED BY THE VARIATIONS OF PRESTRESSED PRECAST ELEMENTS

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Introduction

- Way precast production;
- Main differences between industrialized concrete production and conventional;
- Difficulty making this production lean.



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Case study

- Factory located on the State of São Paulo (Brazil);
- Its products are pillars, beams, and strutting beam as structural elements; solid closing panel and custom parts;
- Action Research (AR).

Production of beams



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- Produced in track





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Production of beam

- Necessary to compose production according to the “MIX” of parts;
- Shed, Shopping mall, Shopping Centers, Hotels, etc.

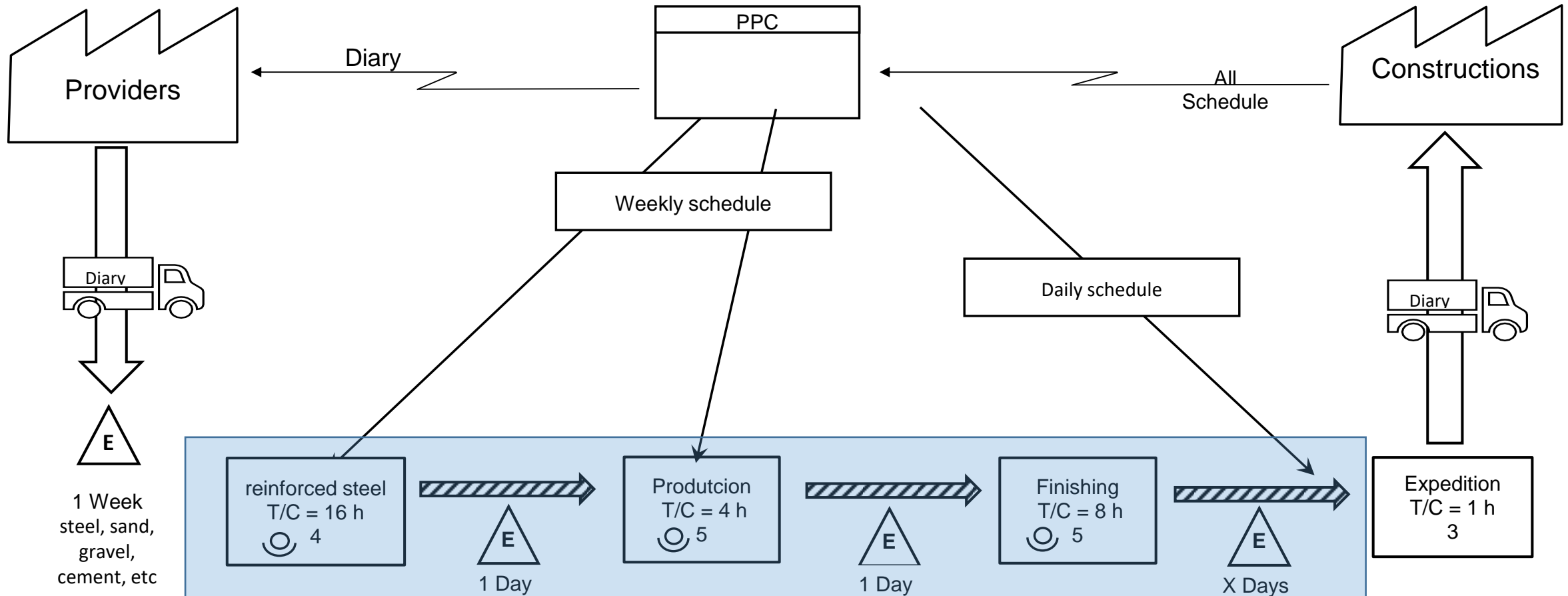
Value stream mapping



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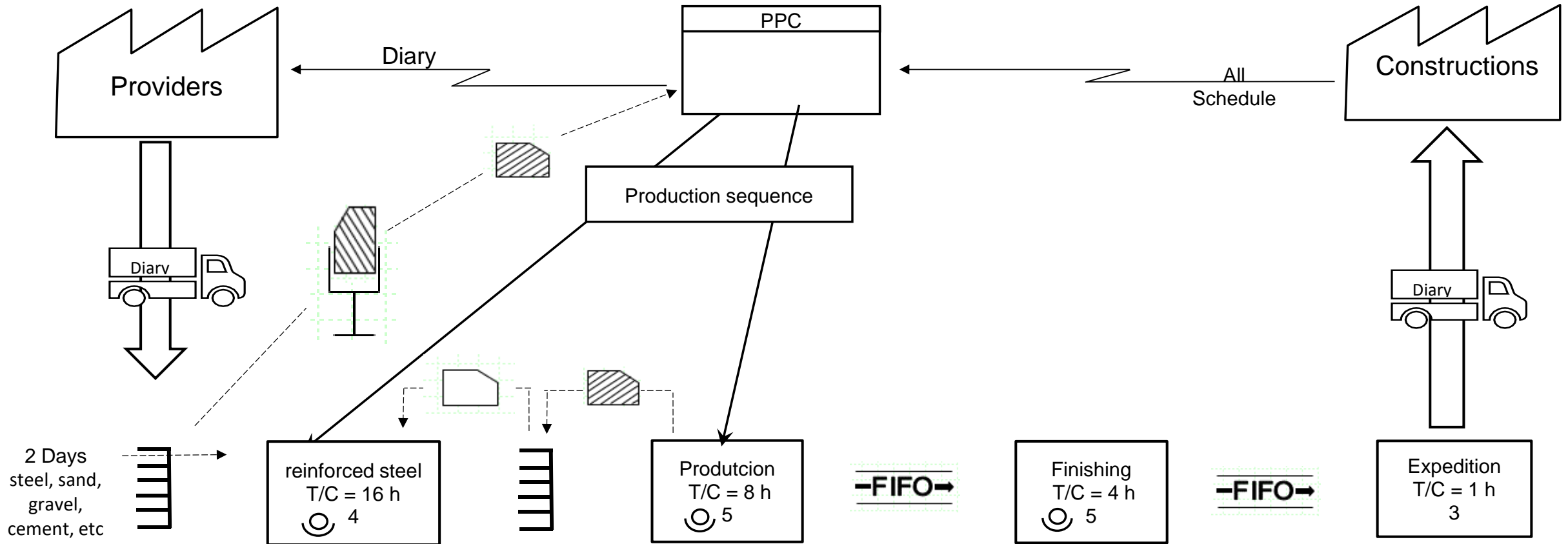
Future value stream mapping



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Basic Standardization

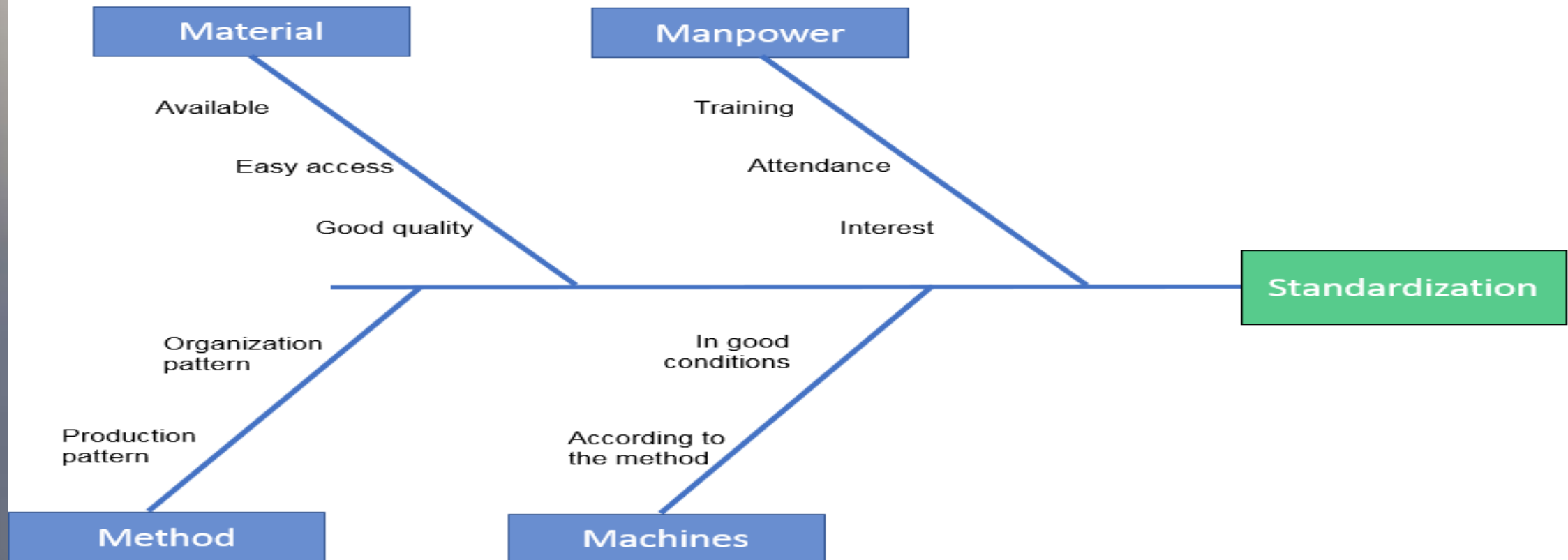


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- The stability is determined by the degree of confidence in the production line



Production



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- **Preparation**
 - Passage to string prestressed steel
 - Protection
- **Assembly**
- **Closure**
- **Concreting**
- **Curing**
- **opening and withdrawal**



Adapted Standardized Work



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- Stages were divided into small activities;
- Create a single workable method;
- Train the team



Impact of variation

- Data collect:
 - Ten-stroke average of carrying out an activity (A)
 - Number of employees (E)
 - Initial displacement (D)
 - Interference feature (F)
 - Interference characteristic module (M)

$$Duration = \frac{A * E * F}{M} + D$$

Estimated time - Assembly



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Activity	interference characteristic	Lifted times										average time	number of employees	initial displacement	Expected activity time
		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10				
Project reading	-	27:00	08:00	45:00	15:00	16:00	21:00	22:00	07:00	17:00	10:00	18,8	1	00:00	18,08
Check length	Number of beam (nb)	00:51	01:08	00:55	00:44	00:37	00:48	01:06	00:46	00:51	00:50	0,87	6	02:00	$6+(0,87*2)*nb$
Check square	Number of beam (nb)	00:25	00:20	00:20	00:21	00:24	00:40	00:42	00:22	00:25	00:21	0,43	1	02:00	$2+(0,43*1)*nb$
Fasten clip	Number of beam (nb)	00:42	00:38	00:45	00:40	00:42	00:41	00:42	00:40	00:45	00:42	0,7	1	02:00	$2+(0,70*1)*nb$
Spread pins	Number of beam (nb)	01:21	01:12	01:14	01:25	01:35	01:35	01:15	01:18	01:14	01:25	0,135	1	02:00	$2+(1,35*1)*nb$
Add inserts	Number of inserts (ni)	10:25	11:45	12:30	09:50	10:15	11:45	09:15	12:03	11:16	12:15	11,13	1	00:00	$11,31*ni$
Distribute form of woods to tab	Length of the track with tab (lt)	01:45	01:21	01:26	01:16	01:47	01:26	01:27	01:40	01:31	01:22	1,5	2	02:00	$5+(1,50*2/2,1)*lt$
execute the tab	Length of the track with tab (lt)	03:55	03:55	04:03	03:48	03:51	03:57	03:59	04:05	03:45	03:55	3,91	1	02:00	$2+(3,91*2/2,1)*lt$
fix sealing rubber	Length of the track (ltotal)	01:24	01:11	01:10	01:16	01:54	01:45	01:13	01:12	01:15	01:20	1,37	1	02:00	$2+(1,37*1/6)*ltotal$
Expected duration of the assembly step														$39+0,26*ltotal+4,22*nb+11,13ni+3,29*lt$	

identify the characteristics of the pieces/track

- Number of inserts;
- Number of beams;
- Number of cables;
- Length of the track;
- Length of the track with tab;
- Weight of reinforced steel.



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Production track characteristics



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TRACK	LENGTH (m)			NUMBER OF INSERTS	NUMBER OF BEAMS	NUMBER OF CABLES	VOLUME	WEIGHT OF REINFORCED STEEL (kg)
	WITHOUT TAB	WITH TAB	TOTAL					
dez/04	0,0	94,1	94,1	2,0	10,0	10,0	21,3	3047,0
dez/06	12,3	67,0	79,3	4,0	10,0	8,0	13,1	2411,5
dez/11	15,3	70,4	85,6	9,0	11,0	10,0	19,2	2814,6
dez/13	58,3	36,4	94,7	0,0	10,0	8,0	20,9	2438,0
dez/18	70,6	19,0	89,6	0,0	11,0	3,0	16,3	2303,0
dez/20	0,0	93,8	93,8	0,0	13,0	5,0	16,6	2255,8
jan/09	39,9	54,7	94,6	0,0	11,0	8,0	21,1	2870,1
jan/15	56,0	39,6	95,6	3,0	17,0	7,0	16,0	2006,5
jan/19	14,6	70,7	85,3	0,0	13,0	5,0	14,5	1350,7
jan/25	70,3	7,9	78,2	1,0	9,0	12,0	17,1	3346,4
jan/30	45,4	5,5	50,9	4,0	9,0	5,0	7,6	810,1
feb/02	51,8	25,4	77,3	0,0	9,0	9,0	13,7	194,2
feb/06	67,0	0,0	67,0	0,0	9,0	6,0	12,0	1390,1
feb/12	66,6	0,0	66,6	0,0	9,0	6,0	14,9	1385,2
mar/13	71,3	0,0	71,3	6,0	11,0	4,0	12,3	1501,3
mar/21	74,5	13,7	88,2	0,0	11,0	8,0	16,0	2408,7
apr/19	89,7	0,0	89,7	0,0	9,0	5,0	18,8	2333,9
AVERAGE OF CHARACTERISTICS	47,3	35,2	82,5	1,7	10,7	7,0	16,0	2051,0

Characteristics vs. Estimated time



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TRACK	STEPS OF PREPARATION (min)	STEPS OF ASSEMBLY (min)	STEPS OF CLOSING (min)
dez/04	717,23	1313,35	790,80
dez/06	653,68	1112,36	672,56
dez/11	701,54	1280,75	725,20
dez/13	719,72	751,54	795,44
dez/18	7,18,87	631,17	757,44
dez/20	778,52	1370,15	768,60
jan/09	740,07	957,63	769,88
jan/15	869,66	1096,45	819,52
jan/19	741,84	1149,89	727,36
jan/25	628,09	493,76	661,38
jan/30	510,57	524,50	442,72
feb/02	624,04	622,49	653,84
feb/06	579,71	401,34	571,36
feb/12	577,99	401,14	568,16
mar/13	640,18	602,82	611,04
mar/	715,55	587,23	745,68
apr/	677,49	412,71	753,28

241%

Discussion



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- A great variation of Routine;
- Failure in programming;
- Unevenness between the processes of reinforced steel, production, and finishing of beams ;
- Generating a high index of defects;

Discussion



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- Variation greater than 30%;
- Reduce track size;
- level the difficulty of the beams present in the production tracks;
- invest in automation in the steps that generate the most significant variation.

Conclusions



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- Wide variation in activity durations;
- Difficulty in stabilizing production and leveling the production of processes;
- Quickly identify the best workflow and scale the actual production capacity for the current parts MIX.

DOUBTS?

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THANK YOU

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