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ABSTRACT

Haque MN (2016) Impact of workers fatigue and boredom in garments production line. *Ins. Engg. Tech.* 6(1), 1-10.

The aim of this work is to analysis worker fatigue in a garments production line calculating faults percentage. Factories receive order from buyer and complete the production with stipulated time and schedule bounded by buyer. Worker gets fatigue and boredom in different hour in a particular day. In case of garments production there will be faults. Faults can happen in two way – one of them will be time basis (Time vs. faults) which means that faults that incurred in garments production line with the progression of different time until the completion of production and another of them will be day basis (Day vs. faults) which means faults that incurred in garments production line in each days until the completion of its production. In this experiment tried to sorting out which portion of time and which day worker feels more impact of fatigue and boredom.

Key words: *garments fault, smv, fatigue, boredom, control chart, CV (%)*

INTRODUCTION

Garments industry is one of the expanded sectors in our country. According to BGMEA report 2014-15 there is 4296 garments factory in our country and employment of 04 million workers. Most of the garments factory in Bangladesh starts work from 08.00 am and ends at 08.00 pm in a particular day with overtime. These long hours of sitting work cause them physical fatigue as well as mental fatigue. Doing the same work in repetitive manner cause them boredom. It is noteworthy that 80% of these workers are female and remaining of them is male (BGMEA 2014). In case of female their work load is more compare with male because they do household chore responsibilities, side by side job responsibilities. Even a skilled worker will behave like unskilled worker if he/she got the impact of huge amount of workload with long hours of work. Fatigue and boredom plays major roles in here. Fatigue is a state that is familiar to all of us in everyday Life. The term usually denotes a loss of efficiency, and a disinclination for any kind of effort, but it is not a single, definite state. Nor does it become clearer if we define it more closely, as physical fatigue, mental fatigue, and so on. The term fatigue has been used in so many different senses that its applications have become almost chaotic. Nevertheless the common division into physical (or muscular) fatigue and mental fatigue is a reasonable distinction. The former is an acutely painful phenomenon, which arises in overstressed muscles and is localize there. Mental fatigue, in contrast, is a diffuse sensation which is accompanied by feelings of indolence and disinclination for any kind of activity. These two forms of fatigue arise from completely different physiological processes, and must be discussed separately (Grandjean 1979). Experimental results are led to the assumption that the central nervous system acts as a compensatory mechanism during the early stages of fatigue. Fatigue is defined as lassitude, or exhaustion of mental and physical strength resulting from bodily labor or mental exertion. It is a concern of workers in many occupations throughout the world. While occupational safety and health has improved in recent decades, fatigue remains a common problem in developed countries (Jahandideh 2012). There are a number of different theoretical viewpoints in the analysis of the causation of boredom. Boredom arises when we must not do what we want to do, or must do what we do not want to do. Similarly, boredom is related to the impossibility of involvement in some alternative activity in the work situation (Shackleton 1981). Contrary to popular wisdom, boredom is not the result of having nothing to do. It is very hard to come up with a situation where a person's options are so limited that he or she literally can do nothing. Boredom is thought by some to be a distinct emotional state in which the level of stimulation is perceived as unsatisfactorily low (Mann 2015). Boredom is an emotional state that has a long history in organizational research. Despite recent changes in technology and the organization of work, boredom remains a part of the experience of work (Loukidou *et al.* 2009). Garments production process involves different types of sewing operation. All of this process involves precise care and concentration. Long hour of work without any sorts of break increases faults percentage. Analyzing "time vs. faults" with "day vs. faults" perhaps given better idea which portion of time and which day worker feel the impact of fatigue and boredom. One thing for sure garments faults not only created for the difficulty of the product design or unskilled worker, it may also created by skilled worker who faced fatigue/boredom because of long hours of work.

MATERIALS AND METHODS

This experiment was done in AMTRANET Group factory- Export village Limited. Experiment has been done in one garments production line which production system is progressive bundle system. Products name long sleeve mans shirt and it's the product of one of the reputed buyer. Some parameter to produce this long sleeve mans shirt has given below-

Product name: Dress shirt Total target/hr= 115 pcs Total no of m/c= 70
Order quantity: 20500 Total working days= 16 days Total no of worker= 80
Total production: 21206 Total working hour= 11 hour SMV of garments= 20 minutes

This factory is a compliance factory which got 11 hours production slot to produce this garments and it takes 16 days to complete that production. As experimental procedure we collect data for every one hour interval which has been checked by operator at the end of the production line. After collecting data Table 1 has been made.

Table 1. Total produce (Total check) garments quantity in different time and different days

Day	**08.00am-09.00am**	**9.01am-10.00am**	**10.01am-11.00am**	**11.01am-12.00am**	**12.01am-1.00pm**	**2.00pm-3.00pm**	**3.01pm-4.00pm**	**4.01pm-5.00pm**	**5.01pm-6.00pm**	**6.01pm-7.00pm**	**7.01pm-8.00pm**	**Avg. check/Day**
	Total check	**Total check**	**Total check**	**Total check**	**Total check**	**Total check**	**Total check**	**Total check**	**Total check**	**Total check**	**Total check**	
Tue-Day1	60	62	72	80	90	85	100	100	102	100	100	**86.45**
Wed-Day2	100	100	110	108	110	100	111	111	114	120	126	**110.00**
Thu-Day3	100	100	112	110	115	100	110	112	115	120	129	**111.18**
Sat-Day4	100	110	115	115	112	100	114	115	114	120	127	**112.91**
Sun-Day5	110	109	113	114	114	110	114	114	115	122	120	**114.09**
Mon-Day6	110	115	113	115	113	110	113	115	116	126	128	**115.82**
Tue-Day7	115	114	111	111	111	115	111	115	120	120	128	**115.55**
Wed-Day8	114	114	115	116	115	114	115	115	120	128	130	**117.82**
Thu-Day9	114	112	120	120	122	114	121	123	128	129	130	**121.18**
Sat-Day10	111	115	130	130	130	111	130	131	134	135	134	**126.45**
Sun-Day11	115	120	135	135	135	115	132	135	136	137	136	**130.09**
Mon-Day12	120	130	135	135	135	120	133	134	138	135	135	**131.82**
Tue-Day13	130	135	130	130	130	130	135	133	135	136	136	**132.73**
Wed-Day14	135	135	130	130	130	135	135	133	134	138	136	**133.73**
Thu-Day15	135	130	130	135	135	135	133	135	135	135	136	**134.00**
Sat-Day16	135	134	135	130	130	135	135	134	135	135	136	**134.00**
Avg. check/Hr	**112.75**	**114.69**	**119.13**	**119.63**	**120.44**	**114.31**	**121.38**	**122.19**	**124.44**	**127.25**	**129.19**	

After collecting the garments every one hour interval in each day, defected garment has been separated from non defected garments. Garment which has no defect symbolize as “ok” by operator. With such “ok” symbolize garments Table 2 has been made to list out the defect free garments.

Table 2. Total "ok" (Total defect free) garments quantity in different time and different days

Day	**08.00am-09.00am**	**9.01am-10.00am**	**10.01am-11.00am**	**11.01am-12.00am**	**12.01am-1.00pm**	**2.00pm-3.00pm**	**3.01pm-4.00pm**	**4.01pm-5.00pm**	**5.01pm-6.00pm**	**6.01pm-7.00pm**	**7.01pm-8.00pm**	**Avg. ok/Day**
	Total ok	**Total ok**	**Total ok**	**Total ok**	**Total ok**	**Total ok**	**Total ok**	**Total ok**	**Total ok**	**Total ok**	**Total ok**	
Tue-Day1	58	58	68	76	85	82	96	96	97	95	95	**82.36**
Wed-Day2	96	96	105	102	103	96	106	106	106	114	119	**104.45**
Thu-Day3	97	95	106	103	106	97	104	105	106	110	118	**104.27**
Sat-Day4	98	107	112	110	107	98	111	112	110	109	118	**108.36**
Sun-Day5	108	103	108	108	107	108	110	111	111	118	110	**109.27**
Mon-Day6	108	112	109	109	106	108	110	106	108	118	118	**110.18**
Tue-Day7	112	110	106	106	105	112	106	106	113	114	118	**109.82**
Wed-Day8	110	109	110	110	108	110	111	112	113	121	120	**112.18**
Thu-Day9	110	107	113	112	114	110	116	117	118	119	118	**114.00**
Sat-Day10	109	112	125	124	124	109	122	123	123	122	122	**119.55**
Sun-Day11	112	116	129	128	127	111	128	130	130	126	125	**123.82**
Mon-Day12	116	124	128	130	128	116	126	131	125	123	121	**124.36**
Tue-Day13	124	128	126	120	118	123	126	120	122	122	123	**122.91**
Wed-Day14	129	129	123	123	120	127	123	125	120	122	121	**123.82**
Thu-Day15	130	125	124	123	124	130	125	123	120	119	120	**123.91**
Sat-Day16	130	128	122	122	121	130	125	121	125	120	120	**124.00**
Avg. ok/Hr	**109.19**	**109.94**	**113.375**	**112.875**	**112.688**	**110.438**	**115.313**	**115.25**	**115.44**	**117**	**117.88**	

To produce these mans long sleeve shirt (Fig. 1) different types of defected garments are found like Slipped stitch, Broken stitch, Staggered stitch, unbalanced stitch, Puckering, Irregular stitch density, Slanted pocket attach, Loose joining in seam, Wrong measured pleat, Over stitch, Nose up down in collar, Wrong side label attach, Check bias, Oil stain, Number mistake, Placket uneven, Improper collar attach, Improper sleeve attach, Raw edge, Bad tension, Bad shape, width Irregular, Sewing allowance uneven, Bottom hem projection, Wrong back and front matching, Wrong front matching, Shoulder up and down, Sewing edge projection etc. Fair amount of concentration and reducing work load can reduced these sorts of faults.

Fig. 1. Mens long sleeve shirt

Garments faults are three types according to the quality point of view. They are major faults, minor faults and critical faults. Major faults are those which needs major rectification, minor faults are those which needs minor rectification and critical faults are those which could not be rectified or totally rejected from quality point of view. In this experiment for long sleeve mans shirt we account these three categories as defect. Every day every hour interval data has been collected from floor until the completion of total order delivery. After every one hour interval number of garments that's produced by a particular production line, number of defected garments found has been recorded and with that faults (%) calculated. Faults (%) = (Number of defected garments per hour/Total produced garments per hour) x 100. Number of defected garments = (Total check garments-Total ok garments). With the mentioned formulation Table 3 has been made. Avg. Faults (%)/Day in Table 3 represent "Day vs. faults (%)" which represents total 16 days production average faults percentage. Avg. Faults (%)/Hr represent different hour faults percentage in 16 days and there is 11 hours slot to produce long sleeve mans dress shirt garments. Every day worker not faced same sorts of fatigue and boredom. Also different hours production in a particular day worker not faced same sorts of fatigue and boredom. This experiment its tried to marking out which portions of time and in which days during production worker feel more impact of fatigue and boredom. Comparison between "Time vs. faults (%)" with "Day vs. faults (%)" using CV (%), control chart and Regression analysis as statistical tools to see which one get more impact of fatigue and boredom.

Table 3. Total faults (%) of garment production in different time and different day

Day	**08.00am-09.00am**	**9.01am-10.00am**	**10.01am-11.00am**	**11.01am-12.00am**	**12.01am-1.00pm**	**2.00pm-3.00pm**	**3.01pm-4.00pm**	**4.01pm-5.00pm**	**5.01pm-6.00pm**	**6.01pm-7.00pm**	**7.01pm-8.00pm**	**Avg. Faults (%)/Day**
	Faults (%)	**Faults (%)**	**Faults (%)**	**Faults (%)**	**Faults (%)**	**Faults (%)**	**Faults (%)**	**Faults (%)**	**Faults (%)**	**Faults (%)**	**Faults (%)**	
Tue-Day1	3.33	6.45	5.56	5.00	5.56	3.53	4.00	4.00	4.90	5.00	5.00	**4.76**
Wed-Day2	4.00	4.00	4.55	5.56	6.36	4.00	4.50	4.50	7.02	5.00	5.56	**5.00**
Thu-Day3	3.00	5.00	5.36	6.36	7.83	3.00	5.45	6.25	7.83	8.33	8.53	**6.09**
Sat-Day4	2.00	2.73	2.61	4.35	4.46	2.00	2.63	2.61	3.51	9.17	7.09	**3.92**
Sun-Day5	1.82	5.50	4.42	5.26	6.14	1.82	3.51	2.63	3.48	3.28	8.33	**4.20**
Mon-Day6	1.82	2.61	3.54	5.22	6.19	1.82	2.65	7.83	6.90	6.35	7.81	**4.79**
Tue-Day7	2.61	3.51	4.50	4.50	5.41	2.61	4.50	7.83	5.83	5.00	7.81	**4.92**
Wed-Day8	3.51	4.39	4.35	5.17	6.09	3.51	3.48	2.61	5.83	5.47	7.69	**4.74**
Thu-Day9	3.51	4.46	5.83	6.67	6.56	3.51	4.13	4.88	7.81	7.75	9.23	**5.85**
Sat-Day10	1.80	2.61	3.85	4.62	4.62	1.80	6.15	6.11	8.21	9.63	8.96	**5.30**
Sun-Day11	2.61	3.33	4.44	5.19	5.93	3.48	3.03	3.70	4.41	8.03	8.09	**4.75**
Mon-Day12	3.33	4.62	5.19	3.70	5.19	3.33	5.26	2.24	9.42	8.89	10.37	**5.59**
Tue-Day13	4.62	5.19	3.08	7.69	9.23	5.38	6.67	9.77	9.63	10.29	9.56	**7.37**
Wed-Day14	4.44	4.44	5.38	5.38	7.69	5.93	8.89	6.02	10.45	11.59	11.03	**7.39**
Thu-Day15	3.70	3.85	4.62	8.89	8.15	3.70	6.02	8.89	11.11	11.85	11.76	**7.50**
Sat-Day16	3.70	4.48	9.63	6.15	6.92	3.70	7.41	9.70	7.41	11.11	11.76	**7.45**
Avg. Faults (%)/Hr	**3.11**	**4.20**	**4.81**	**5.61**	**6.39**	**3.32**	**4.89**	**5.60**	**7.11**	**7.92**	**8.66**	

RESULTS AND DISCUSSION

Day vs. faults (%):

Collecting avg. faults percentage in different day basis from Table 3 and total avg. check or produce garments in different days, a summarize Table 4 has been made for Day vs. Faults (%).

Table 4. Avg. Faults (%) of "Day vs. Faults" in 16 days production

Day	Total average check	Avg. Fault(%) of "Day vs. Faults"	Mean of Avg. Fault(%) of "Day vs. Faults"
Tue-Day1	86.45	4.76	
Wed-Day2	110	5	
Thu-Day3	111.18	6.09	
Sat-Day4	112.91	3.92	
Sun-Day5	114.09	4.2	
Mon-Day6	115.82	4.79	
Tue-Day7	115.55	4.92	
Wed-Day8	117.82	4.74	5.60
Thu-Day9	121.18	5.85	
Sat-Day10	126.45	5.3	
Sun-Day11	130.09	4.75	
Mon-Day12	131.82	5.59	
Tue-Day13	132.73	7.37	
Wed-Day14	133.73	7.39	
Thu-Day15	134	7.5	
Sat-Day16	134	7.45	

Fig. 2 has been drawn from Table 4. Fig. 2 shows that from Day1 to Day16 Total 16 day productivity, productivity low in first days because of new styles introduced in the floor. As the day progress productivity increases, on average around closer same in from Day2 to Day9. But that was not quite enough to meet the required target production. Last few days productivity increases 135 or above to meet production dead line. This just clearly indicates that there is a huge amount of pressure for last 05 days among worker.

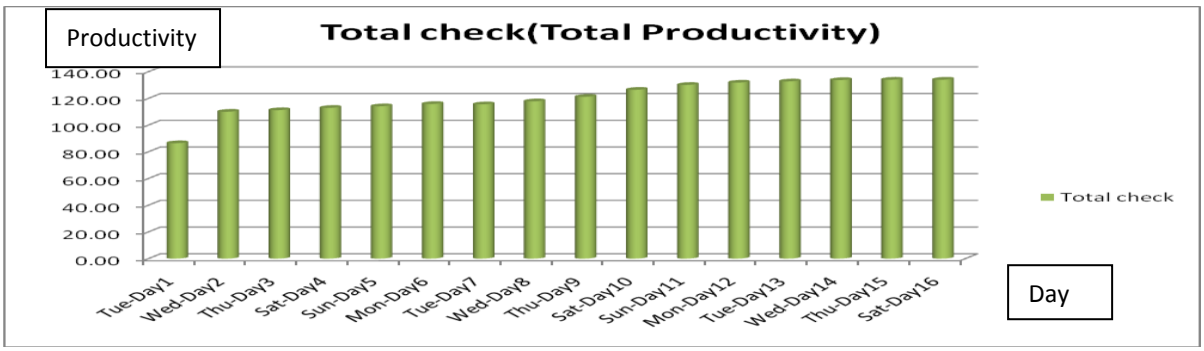

Fig. 2. Total garments production chart for 16 days production

There is a physical pressure and as well as mental pressure works among worker to meet target production. This pressure actually lows among day1 to day9 compare with Day11 to Day16.

Fig. 3 has been drawn from Table 4. Fig. 3 shows that faults (%) little bit increase in Day1 to Day3 because of new style introduced in the floor. These faults (%) become minimal in Day4 to Day12. But these become increase for last four days from Day13 to Day16. Worker got huge amount pressure to meet deadline to meet production target. This cause huge amount of mental fatigue among worker as a result productivity increases, side by side faults (%) also increases. There is also another reason for this cause will be said as physical fatigue among worker for long hours of work. Another factor which can be responsible for increases faults (%) these said to be boredom because worker doing the same task in 16 days.

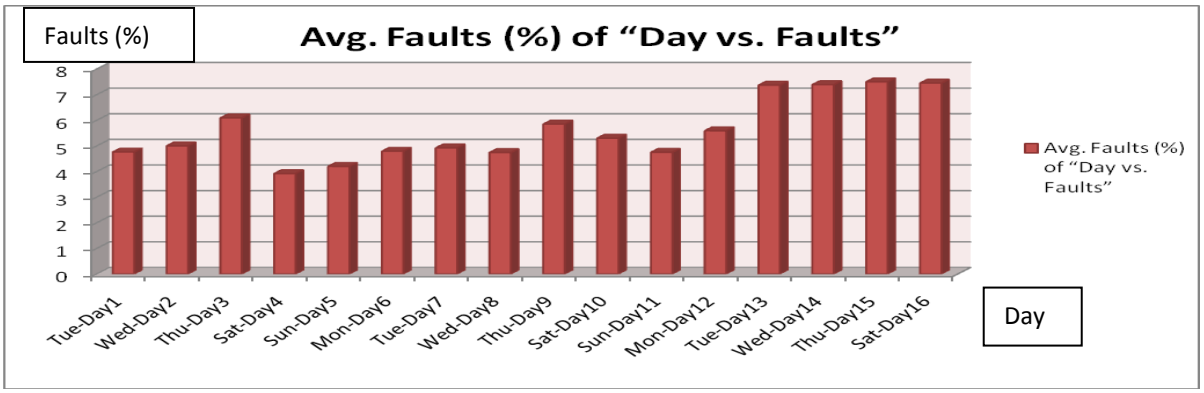

Fig. 3. Total 16 days garments production average faults percentage in different days

They feel monotonous for work and also boring to do the same task again and again. These can be another factor which responsible for increasing faults (%). Another observable fact in Fig. 3 that after one holiday faults (%) decreases compare with faults (%) days before holiday. If it is look carefully that it has been seen that incase of Day3 to Day4, Day9 to Day10 and Day15 to Day16 after one holiday faults percentage reduces. The reason behind these sorts of situation is release from physical fatigue because of relaxation for one whole day. This releases stresses among worker which reduces faults (%) during garments production during that day.

Time vs. Faults (%):

Collecting avg. faults percentage in different time basis from Table 3 and total avg. check or produce garments in different time, a summarize Table 5 has been made for Day vs. Faults (%).

Table 5. Avg. Faults (%) of "Time vs. Faults" in 11 hour production

Time	Total average check in 16 days production in 11 hours slot	Avg. Faults (%) of Time vs. faults	Mean of Avg. Fault(%) of "Day vs. Faults"
8.01am-9.00am	112.75	3.11	
9.01am-10.00am	114.69	4.2	
10.01am-11.00am	119.13	4.81	
11.01am-12.00pm	119.63	5.61	
12.01pm-1.00pm	120.44	6.39	
2.01pm-3.00pm	114.31	3.32	5.60
3.01pm-4.00pm	121.38	4.89	
4.01pm-5.00pm	122.19	5.6	
5.01pm-6.00pm	124.44	7.11	
6.01pm-7.00pm	127.25	7.92	
7.01pm-08.00pm	129.19	8.66	

Fig. 4 has been drawn from Table 5. It has been observable fact in Fig. 4 that productivity increases from morning to before lunch time with the progression of time from 08.00am to 01.00pm.

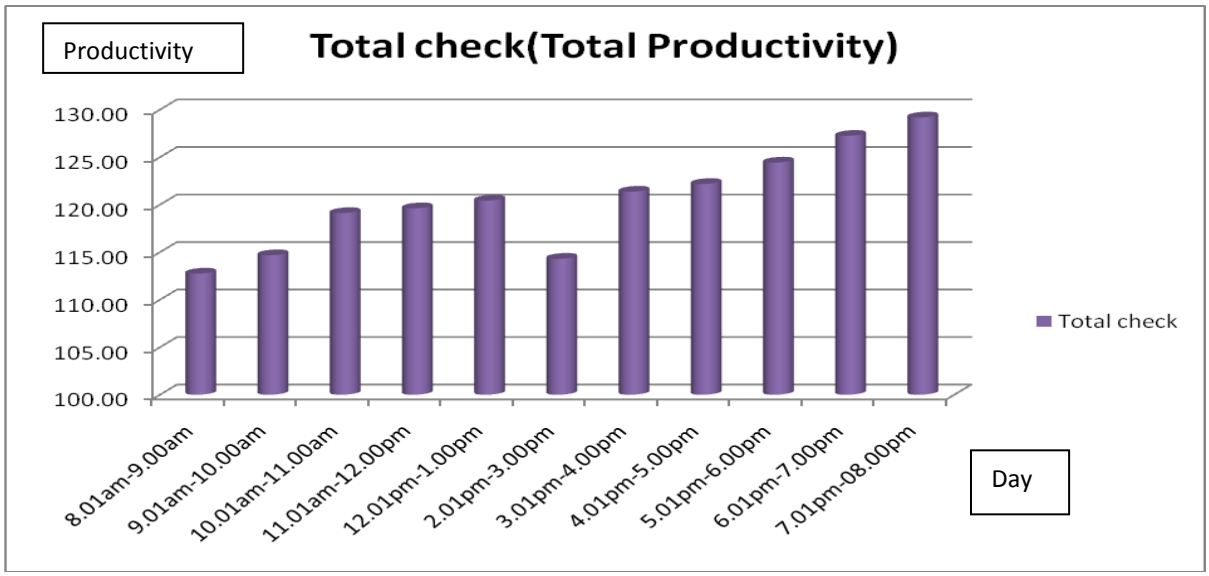

Fig. 4. Total 11 hour average garments production chart for 16 days production

After lunch time this productivity slightly reduces but increases with the progression of time. After lunch time increases of production rate higher than the morning time from 08.00am to 01.00pm. This sorts of productivity increase or decrease shows in there because there is a minimum target for production in a specific day. There is a tendency in garments industry if there is one hour less production in particular hour, they actually try to recover that into the next hour. Starts from the morning they show slow work rate to produce goods. But before lunch time they show more seriousness to fulfill target production. After lunch time same way productivity starts from slow to a maximum rate to cover up any lacking shows in morning time. As a result hurry up situation was created to fulfill the target. This create huge amount of load and pressure which also responsible for fatigue in worker.

Fig. 5 has been drawn from Table 5. This table shows fault (%) with the progression of time. It has been shows that fault (%) was little in the morning time but it was increased as the time progress. It has been seen Fig. 5 that fault (%) in 08.00 am is the lowest one but it has been increased until 01.00pm. Perhaps because in morning time worker feel little relaxation because it was a 12 hours rest from work. There is no stress among worker.

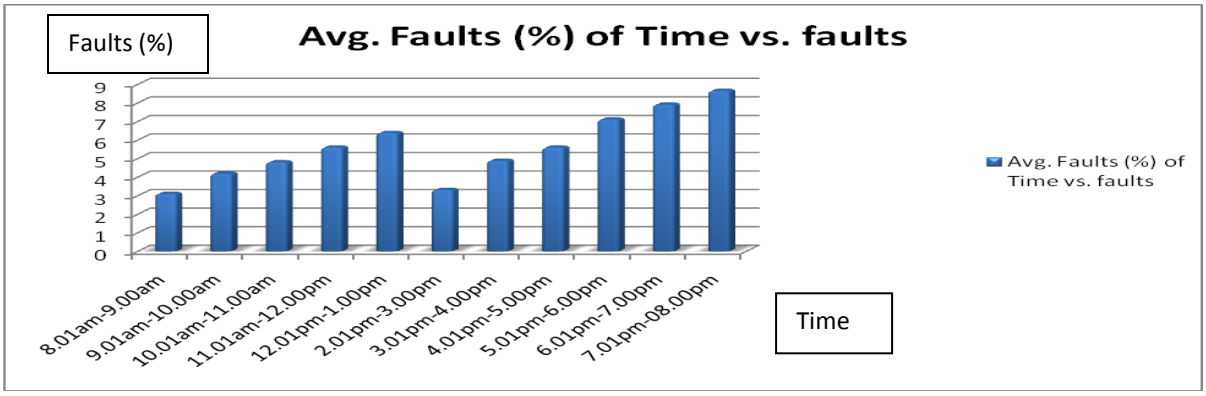

Fig. 5. Total 11 hour average garments production faults percentage in different time

But as the time progress worker feel stress to complete the task and also have the target production to meet up before getting lunch break. As a result got physical pressure and mental pressure which create physical fatigue, side by side mental fatigue because there is a certain amount of target they need to fulfill before lunch. After one hour lunch break worker feel little bit of relax to do the work and little bit charge up. Faults (%) was reduced in 02.00pm, starts to increase with the progression of time. But this increase of fault(%) increased rate little bit higher than before lunch break, was maximum in 06.00pm to 08.00pm. Perhaps because as the time worker feel the impact of physical fatigue because of long hours of work, boredom plays a key role in here. Because doing the same task over again and again. Worker feels monotony and Boredom. Side by side mental fatigue to complete the target of a total day because if there is any lacking in target production before lunch breaks, that's also need to be fill up in that time. Physical fatigue and mental fatigue which both works comprehensively to increase fault (%).

Comparison of "day vs. faults" with "time vs. faults" with CV(%):

In Table 6 it has been seen that Mean of Avg. Faults (%) of Day vs. Faults and Mean of Avg. Faults (%) of Time vs. Faults has been same for both the cases and it is 5.60. But standard deviation is totally different in both the cases.

Table 6. CV (%) of Day vs. faults and Time vs. faults

Day	Avg. Fault (%) of Day vs. Faults	Mean of Avg. Faults (%) of Day vs. Faults	SD of Avg. Faults (%) of Day vs. Faults	CV(%) of Day vs. Faults	Time	Avg. Faults (%) of Time vs. faults	Mean of Avg. Faults (%) of Time vs. Faults	SD of Avg. Faults (%) of Time vs. Faults	CV(%) of Time vs. Faults
Tue-Day1	4.76	5.6	1.22	21.71	8.01am-9.00am	3.11	5.6	1.79	32
Wed-Day2	5				9.01am-10.00am	4.2			
Thu-Day3	6.09				10.01am-11.00am	4.81			
Sat-Day4	3.92				11.01am-12.00pm	5.61			
Sun-Day5	4.2				12.01pm-1.00pm	6.39			
Mon-Day6	4.79				2.01pm-3.00pm	3.32			
Tue-Day7	4.92				3.01pm-4.00pm	4.89			
Wed-Day8	4.74				4.01pm-5.00pm	5.6			
Thu-Day9	5.85				5.01pm-6.00pm	7.11			
Sat-Day10	5.3				6.01pm-7.00pm	7.92			
Sun-Day11	4.75				7.01pm-08.00pm	8.66			
Mon-Day12	5.59				Difference between CV (%)				
Tue-Day13	7.37				10.29				
Wed-Day14	7.39								
Thu-Day15	7.5								
Sat-Day16	7.45								

As the definition of standard deviation it means how much a data actually deviates from the mean and CV (%) is the ratio of standard deviation to the mean which expressed as percentage. Day vs. Faults CV (%) 21.71 means that standard deviation is equal to 21.71% of the average or this portion actually deviates from the mean. Time vs. Faults CV (%) 32 means that standard deviation is equal to 32% of the average or this portion actually deviates from the mean. Because both the cases average same which is 5.60 and the difference between CV (%) of Time vs. Faults and Day vs. Faults is 10.29 which just clearly indicates that in case of Time vs. Faults too much variation in the data. Worker feels more fatigue and boredom in a particular day work. It was little when its morning but as the time goes worker feel more physical and mental fatigue. In case of time vs. faults (%) in

morning faults (%) was low but it has been increased before lunch time. After lunch it was less but it increases as the time goes by which become maximize in 05.00pm to 08.00pm. Because of too much variation of avg. faults (%) in a particular day in different time, got impact of fatigue and boredom, that's why CV (%) increased in Time vs. Faults compare with the Day vs. Faults. Worker fatigue and boredom plays a key role in here. As a result of less concentration on work this Faults (%) increases. With CV (%) analysis it can be concluded that Time vs. faults got more impact of fatigue and boredom as result this Faults (%) increases.

Comparison of "day vs. faults" with "time vs. faults" with control charts:

Control chart has been made for day vs. faults and time vs. faults. This control chart will show wide variation of deviation from the mean. Center line will represent mean of average faults percentage of different time and different day respectively.

Table 7. Control charts of Day vs. faults and Time vs. faults

Day	Avg. Faults (%) of Day vs. Faults	Mean of Avg. Faults(%) of Day vs. Faults(CL)	UCAL	LCAL	UCL	LCL	Avg. Faults (%) of Time vs. faults	Mean of Avg. Faults (%) of Time vs. Faults(CL)	UCAL	LCAL	UCL	LCL
Tue-Day1	4.76	5.6	8.03	3.17	9.25	1.95	3.11	5.6	9.187	2.016	10.97	0.223
Wed-Day2	5	5.6	8.03	3.17	9.25	1.95	4.2	5.6	9.187	2.016	10.97	0.223
Thu-Day3	6.09	5.6	8.03	3.17	9.25	1.95	4.81	5.6	9.187	2.016	10.97	0.223
Sat-Day4	3.92	5.6	8.03	3.17	9.25	1.95	5.61	5.6	9.187	2.016	10.97	0.223
Sun-Day5	4.2	5.6	8.03	3.17	9.25	1.95	6.39	5.6	9.187	2.016	10.97	0.223
Mon-Day6	4.79	5.6	8.03	3.17	9.25	1.95	3.32	5.6	9.187	2.016	10.97	0.223
Tue-Day7	4.92	5.6	8.03	3.17	9.25	1.95	4.89	5.6	9.187	2.016	10.97	0.223
Wed-Day8	4.74	5.6	8.03	3.17	9.25	1.95	5.6	5.6	9.187	2.016	10.97	0.223
Thu-Day9	5.85	5.6	8.03	3.17	9.25	1.95	7.11	5.6	9.187	2.016	10.97	0.223
Sat-Day10	5.3	5.6	8.03	3.17	9.25	1.95	7.92	5.6	9.187	2.016	10.97	0.223
Sun-Day11	4.75	5.6	8.03	3.17	9.25	1.95	8.66	5.6	9.187	2.016	10.97	0.223
Mon-Day12	5.59	5.6	8.03	3.17	9.25	1.95	UPPER CONTROL LIMIT=MEAN+(3*SD)					
Tue-Day13	7.37	5.6	8.03	3.17	9.25	1.95	LOWER CONTROL LIMIT=MEAN-(3*SD)					
Wed-Day14	7.39	5.6	8.03	3.17	9.25	1.95	UPPER CONTROL ACTION LIMIT=MEAN+(2*SD)					
Thu-Day15	7.5	5.6	8.03	3.17	9.25	1.95	LOWER CONTROL ACTION LIMIT=MEAN-(2*SD)					
Sat-Day16	7.45	5.6	8.03	3.17	9.25	1.95						

Fig. 6 and Fig. 7 has been drawn from Table 7. Compare with Fig. 6 and Fig. 7 Control graph analysis of Time vs. Faults (%) with Day vs. faults (%) shows that Avg. Faults (%) in a particular day in different time (Time vs. Faults) which shows more variation.

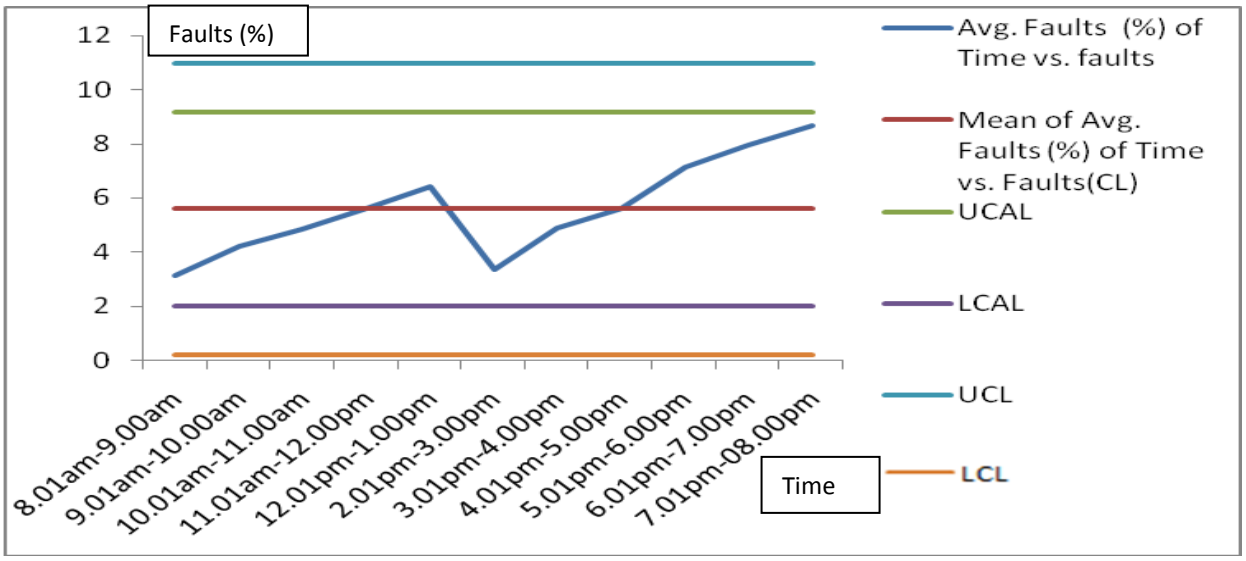

Fig. 6. Control graph analysis of Time vs. Faults (%)

It means that Time vs. Fault (progression of time in particular day faults percentage) got more impact of fatigue and boredom. As the graph it has been seen that in case of time vs. Faults (%) the avg. Faults (%) line deviates more readily from CL (center line= Mean of avg. faults (%)) compare with Day vs. faults(Progression of day faults percentage, the day it will take to complete the production).

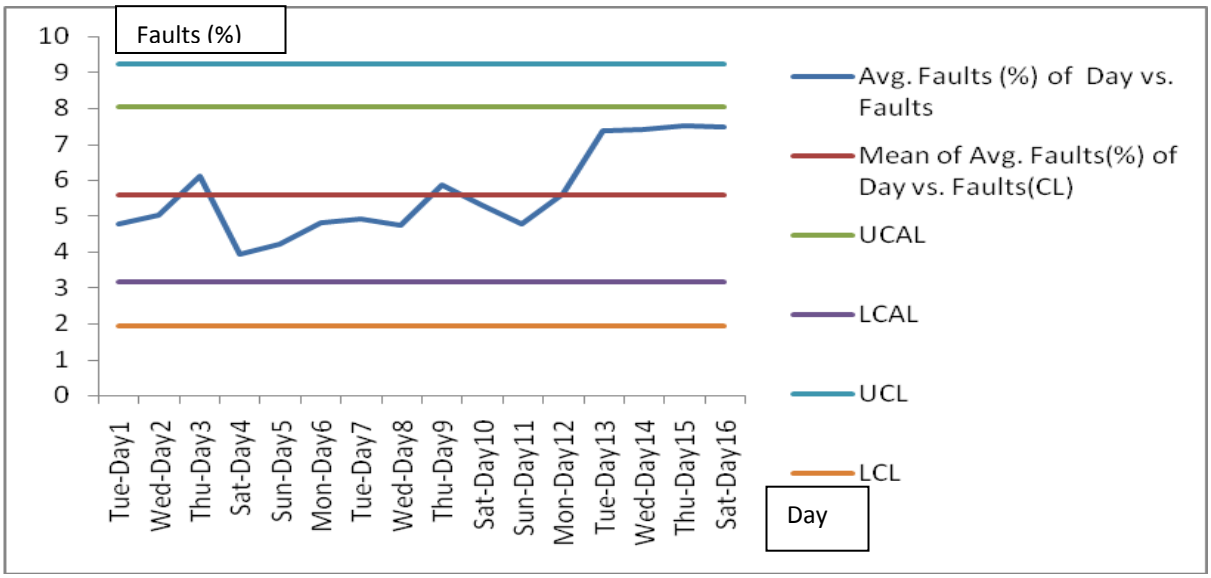

Fig. 7. Control graph analysis of Day vs. Faults (%)

With that control chart graph analysis it can be concluded that Time vs. faults got more impact of fatigue and boredom as result this Faults (%) increases.

Comparison of "day vs. faults" with "time vs. faults" with regression analysis:

More specifically, regression analysis helps one understand how the typical value of the dependent variable (or 'criterion variable') changes when any one of the independent variables is varied, while the other independent variables are held fixed. Co efficient of determination indicates in $R^{2.}$

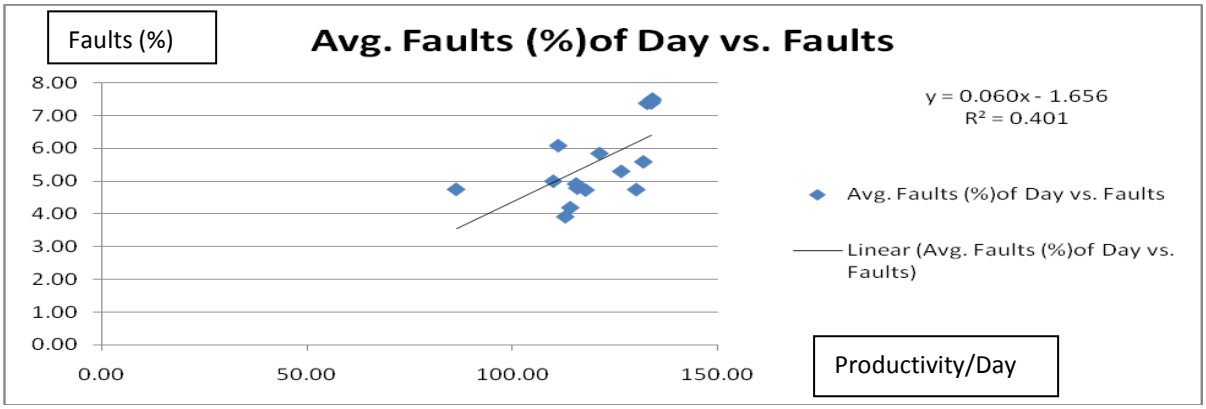

Fig. 8. Day vs. Faults regression analyze

An R^2 between 0 and 1 indicates the extent to which the dependent variable is predictable. An R^2 of 0.10 means that 10 percent of the variance in *Y* is predictable from *X*. Considering this Fig. 8 Day vs. Faults R^2 value 0.401 which is not as closer to 1 compare with Fig 9 Time vs. Faults R^2 value 0.919 which is very much closer to 1

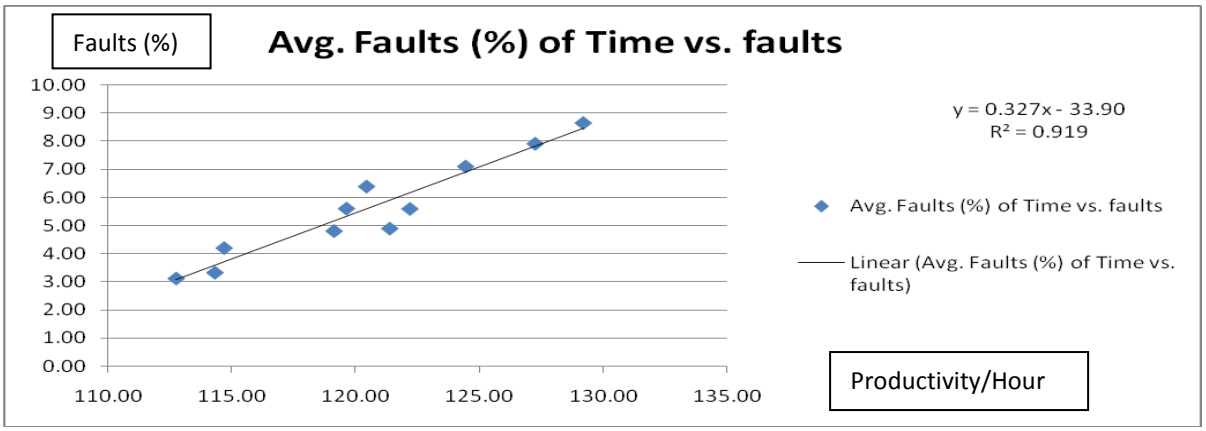

Fig. 9. Time vs. Faults regression analyze

Fig. 9 indicates that incase of Time vs. Faults 91.9 percent of the variance in Y (Faults percentage) is predictable from X (Productivity /Hour). With that regression graph analysis it can be concluded that Time vs. faults got more impact of fatigue and boredom as result when productivity per hour in particular day at different time increases faults (%) side by side also increases. Worker got more impact of fatigue and boredom in Time vs. Faults (progression of time in particular day faults percentage).

With the overall summary it can be concluded that to produce garments in garments factory faults can be categorized into two categories-one of them is Time vs. Fault (%) (Progression of time in particular day faults percentage) and another of them is Day vs. faults (Progression of day faults percentage, the day it will take to complete the production). It is not all about skill worker who make lesser mistakes during production. This experiment shows even a skill worker will behave like unskilled worker or will mistakes like unskilled worker during production if he or she got the impact of fatigue and boredom both the cases of Day vs. faults and time vs. faults. In case of day vs. faults first few days work load is less, new style introduced that's why faults percentage slightly increase for first few days but faults percentage increases alarmingly for last few days. Worker got impact of fatigue and boredom to fill up the target that production line set up during production. Also it has been seen that after one holiday faults percentage slightly reduced because worker get sufficient amount of rest before working that day. In case of time vs. faults morning time it was less faults percentage but it increases as the time progress until lunch time at 01.00pm. After lunch time faults percentage decreases slightly because of one hour rest but increases alarmingly as the time progress. It becomes maximum 05.00pm to 08.00pm because of huge amount of load and pressure. Worker got the impact of fatigue and boredom, as a result these faults percentage increases. With the analysis of CV (%), Control charts and Regression analysis it has been seen that compare with day vs. faults (%) with Time vs. Faults (%), Time vs. faults got more impact of fatigue and boredom because in case day vs. faults worker got12 hours rest before go to production. But in case of Time vs. faults worker will have to do continuously 11 hours work adding their house hold chores activities. As a result they got huge amount of load and pressure, got the impact of physical and mental fatigue. Because of long hours of work (Only one hour lunch break) they also got the impact of boredom, these faults increases. Industry may need to think new ways to give concentration of impact of fatigue and boredom in worker skills. They can give 10-15 minutes break before lunch time and also another 10-15 minutes after lunch time in different extent. Worker can get rest these time, Muslim workers may have time to take ritual prayer and may take slight amount of foods/snacks with water during this time to boost up. They can include song during production hour to reduce boredom in worker. Continuous work may increase their skill but impact of fatigue and boredom because of lacks amount of rest may endanger their health condition and reduces their skill to work. Productivity should need to be controlled in a strict manner. There is a tendency in garments industry if there is one hour less production in particular Day/hour, they actually try to recover that into the next day/hour. As a result of these faults percentage increases with productivity because worker gets huge amount of pressure, this creates physical and mental fatigue in worker. Industry owner should need to concentrate on that. There is a word saying that if you take care about your employee they will take care about your product.

CONCLUSION

If industry increases relaxation time more than 30 minutes to 1 hour in different time in a particular day at different interval that will reduce the faults percentage and also reduce physical and mental fatigue among worker. This work has been done in only one garments factory in Bangladesh and calculating faults percentage of garments for one particular style. Also this experiment carried through woven tops item (Mans woven dress shirt). In near future more research can be done for different factory, different buyer different products, Workers with different ages and different working condition to make comparison between them.

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