

FAST RESPONSE ON LAYERS AT QUALITY ISSUES AS PART OF QUALITY MANAGEMENT SYSTEM IN AUTOMOTIVE MANUFACTURING

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Abstract:

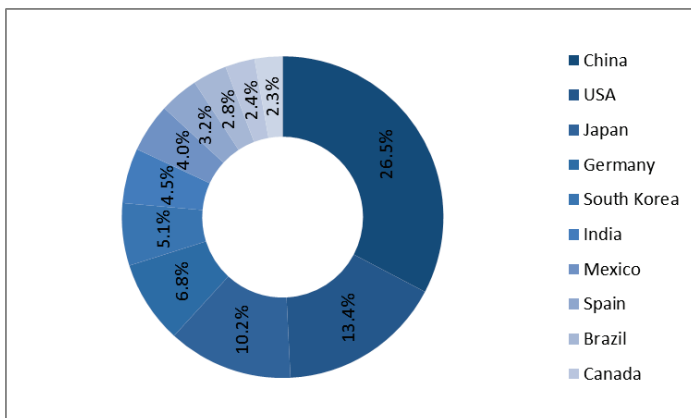
Today, the automotive market increased a lot its innovation of complex devices that are now included in the most of the car models. On the other hand, the car makers request to their suppliers to improve the quality level and to decrease the number of defects, the target being “zero defects”. Without a fast response on issues in the manufacturing processes of the automotive parts is almost impossible to reach the car makers requirements in terms of quality, cost, and quantity. This paper presents a new tool to be used as a part of quality management system in automotive manufacturing, Fast Response on Layers at Quality Issues (FRLQI) in order to become a part of organizational culture and to support management from top to down in daily improvements of the processes, but also the people development. The aim of the paper is to present a kit of instruments and methods to be used in implementing this new concept in automotive manufacturing organizations. A case study presents the analysis of the data concerning the implementation of fast response in an automotive Mechatronic device manufacturer, with three different methods: first method used was based on general knowledge of fast response tools, the second method took into consideration more details regarding problem-solving, but the same approach in terms of fast response, while the third one, FRLQI, has developed a fast response in a structure of layers in the same time to redesign of the problem-solving instruments, on layers too.

Keywords: quality management, fast response, operational management, problem-solving, coaching, improvements

1. INTRODUCTION

From year to year, the automobile exhibition shows new models of the cars and can be seen that more and more devices and gadgets are included in each car. The automotive suppliers are challenged to develop their processes and the manufacturing in order to supply these new technology devices to assure mobility and connection of the driver or passengers with outside world. On the other hand, the new car's engines assure more horsepower and less gas consumption, also reduced emissions and the hybrid construction are most visible in each exhibition. In the same time, the focus in the safety systems like active safety, pre-crash systems or crash avoidance are used more and more by the automobile makers, so a new technology used and more complex parts coming from the suppliers. Over 45 million of cars were produced in the first half of 2015 according with "Organisation Internationale des Constructeurs d'Automobiles" and 80% are produced in 11 countries distributed almost on all continents (Picture 1).

Picture 1: Graph with the countries with more than 1.000.000 cars produced, first half 2015



Source: authors inspired from Organisation Internationale des Constructeurs d'Automobiles, Statistics 2014

What does it mean? The suppliers need to improve their processes in order to assure the quantities requested, but also to have a very quick answer in their processes at quality issues to prevent the risks of bad deliveries and possible stops of customer lines. If we also consider the actual requirements of the customers "zero defect" strategy to be considered, then the problem-solving methodology should work with fast response at quality issues, also in all levels in the organization.

The paper presents the tools, methods and the other needs of the organizations that want to implement the fast response culture, or even for the organization that wants to improve their actual response at quality issues. Of course, today can be found more solutions available regarding the fast response used in the processes, and a multi-criteria analysis presents the comparison between this fast response on layers at quality issues and the quick response quality control.

The fast response on layers at quality issues should be a part of the quality management system, could be one of the processes like the others from the entire map of the processes, related to problem-solving methodology, or could be presented at each interface between key processes, management or support processes.

2. FAST RESPONSE ON LAYERS AT QUALITY ISSUES AS A TOOL OF THE ORGANIZATIONAL CULTURE

2.1. What means FRLQI?

Fast response, as the meaning of words, consist in the response of the organization at problems occurred in their processes or step of the processes. As the processes coming more and more complex ones, the development of the organizational structure being on layers, then the fast response is better also to be developed on layers too. FRLQI means all instruments, methods, templates,

database and visual management used to make the culture running daily by shifts, in the same time means the communication channel, meetings and reports, and people development too.

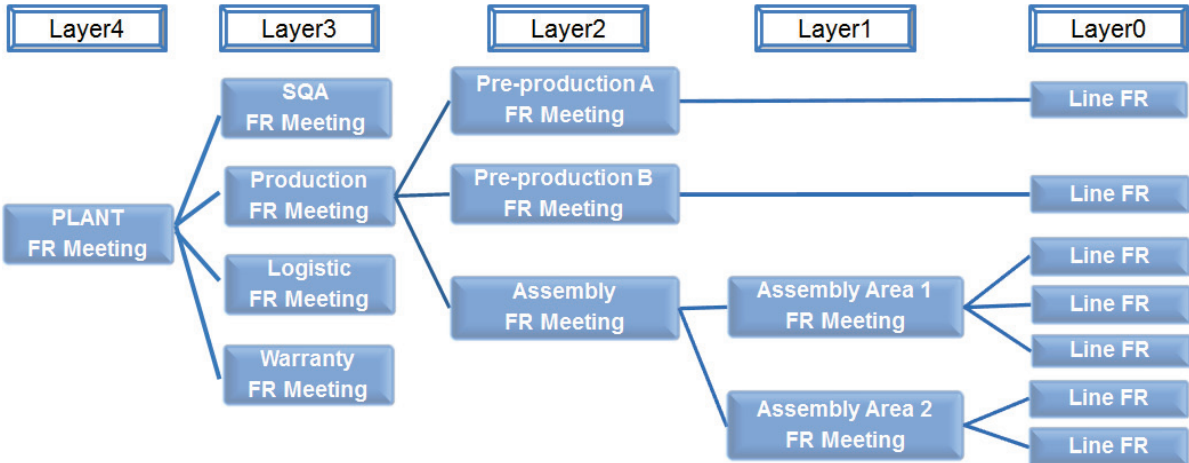
2.2. What’s new?

First advantage, consist in the fact that the fast response used in different types of processes, such as production processes, for instance, molding injection, electronic manufacturing, coating, painting and assembly, or transactional processes, like quality warranty and/ or supplier quality assurance, is very easily done, and the top management could see all links between all processes when issues arise, also increase the effectiveness of the visual management. The second main advantage, using layers at the deployment of fast response make it also possible to implement very easy the coaching sessions on levels, and the personnel will be quicker trained, leading to reduced implementation time of FRLQI.

The structure of the layers should be as simple as reasonable possible, since more layers in the low management structure or fewer layers in the developed management structure could make not so efficient the FRLQI. The layers it would be better to fold the organizational management, and should be updated accordingly when the structure is changed. And this will make the fast response be easy developed in the shortest time, but kept easy for a long time in the organizational culture.

An example of the development in layers of the fast response in an organization with three production area where the management structure is the same for two production areas, but different for the third one, and the leader and members of the meeting teams can be seen in Picture 2.

Picture 2: FRLQI - Layers for meetings at fast response



Source: Authors development

2.3. Why FRLQI?

The global production of the automobile is expected to continue its growth and this is the good news for the automotive manufacturing suppliers. But the bad news is that the automakers continue also to reduce the cost due to low margins in their budgets, and that will be transposed in the reduction of the price at the supplier level, but more at increasing of invoices related to warranty or bad quality of the delivered parts. A study focused on the five of the biggest automakers (VW, BMW, Daimler, PSA, Renault-Nissan) shows that all concentrate the efforts in saving money or reducing cost in the next years (Roland Berger study, 2014, p. 26), and obviously, the suppliers with low reaction in terms of quality issues will loose the competition.

The fast response on layers at quality issues will support the automotive manufacturing supplier to reduce also their cost, to prevent the risks that bad parts can pass the detection gates and will be delivered to customers. Will support also in development, maintaining and improvement of the problem-solving culture in the organization.

3. HOW TO IMPLEMENT FRLQI CULTURE, THE INSTRUMENTS AND METHODS USED

3.1. Evaluation of the actual response at quality issues and capitalisation of the experience

At the very beginning, a planning of the activities to be done should be elaborated, even is a draft one, including first steps in order to figure out the actual status of the response to quality issues, the resources in place and needed ones, the near future changes in the organization. The actual response to the quality issues could be not formalized but a culture and ways to do are there in place, and these thinks must be collected as current situation and represent the input data in the development of the planning. The instruments and the tools used actually in the problem-solving field are also needed to be capitalized, because will be used in the growing of the experience for all the teams at all levels. Then it is important that the processes indicators are verified and analyzed to know and understand the way to collect and how they are reported. At the end, the target will be to develop the system to collect and report these indicators in the daily base by shifts, in each level from each production area.

The project implementation of FRLQI could be monitored with the support of an excel file, and the first sheet will contain the input data as a name of the project, the leader of the project, estimated data for start and finish, the name of the team members from each department. It is recommended to use the hyperlinks in each sheet for quick movement from a sheet to the other, and the phases of the project implementation will be easier to follow up if are based on the Deming cycle, PDCA, PLAN being used for the activities scheduled, DO being used for the activities already implemented and first feedback collected, CHECK will be used for data and graphics to see the status of the implemented activities by date and ACT will support the team to adjust their efforts in order to increase the effectiveness of the activities.

In the first draft of the planning not all details and activities are known, more the duration of the activities could be adjusted after each phase analysis of the project, furthermore, it is recommended to develop the PLAN sheet with the activities, duration, and due dates with a conditional formatting cells or another kind of solution, could be formulas used, in a way that allows easy updated and easy visualisation of the milestones or status of each single task. A proposal for the structure of this kind of sheet is presented in the below Picture 3, the simplicity of the proposal took into consideration the task activities, owner of the task, start and end dates, percentage and counting of the days for the already done versus not yet done and the graph with the due dates, before and after to be implemented, in direct link with the percentage realized.

Picture 3: Project developed in the excel file by PDCA steps

Back to Input		of the evaluation)			Estimate date start	Estimate date finish	Completion (days)							
Project name		FRLQI	2/1/2015	9/30/2015										
No.	Phase/Task	Task owner	Start date	End date	%	in place	not yet	1-Feb-15	2-Feb-15	3-Feb-15	4-Feb-15	5-Feb-15	6-Feb-15	7-Feb-15
1	Implementation of FRLQI in production area	name	1-Feb-15	30-Sep-15	1.5	3.6	238.4							
1.1.	Evaluation of the actual training material, implementation and personnel knowledge	name	1-Feb-15	4-Feb-15	75	3.0	1.0							
1.2.	Evaluate the actual resources and establish meeting areas in production	name	2-Feb-15	10-Feb-15	40	3.6	5.4							
1.2.1.	Elaborate the first draft of the process instruction/ procedure	name	14-Feb-15	18-Feb-15	0	0.0	5.0							
1.2.2.	Elaborate the first draft of material training (used also the output of the evaluation)	name	21-Feb-15	28-Feb-15	0	0.0	8.0							
1.3.	Present the material for the Management level	name												

Source: Authors development

For the phase DO, a minimum to be considered in this phase should refer to the Kick-off meeting with all management team and top management, the training of all involved personnel, trials of the meeting

on each layer, problem-solving training and templates used and evaluation of each instrument or tool used for each layer. Are very known the tools like the 8D report (Rambaud, 2011) for problem-solving methodology or even the PDCA-FTA coming from Valeo QRQC (Aoudia - Testa, 2011), both are very good tools to support the teams in the finding of the root causes and their elimination.

One big advantage based on the layers development of the fast response is that the problem-solving methodology can be also developed on layers, so the problem-solving tools should be tailored for its team and level. It is proposed to be used the FRL, Fast Response on Line, the meaning of the line is the lowest level of the organization production structure as the machine in the case of the processes like molding injection or coating, for instance, or the production assembly line. And for this level, as we have learned from the experience of the 8D approach, the last step in the methodology is the rewarding of the team, the advice is to schedule and to implement an FRL competition to motivate the personnel to use and to learn more about this tool.

3.2. Development of the other sheets related to phases of the project and their implementation

In the sheet DO, based on the activities planned in the phase before, will be kept all the details regarding the implementation of each task, but also first feedback from the processes, the responsiveness of the people, what we have learned in order to adjust the timing and to assure the success of the project. This will be used to update the first draft of the schedule and to put the achievable dates based on the experience from the trials.

For a very good visualization to support the project team in the implementation of the fast response, but in the same time for the periodical report to the top management, the sheet CHECK will contain the graphs based on the planning from PLAN sheet and the realization percentage according to the report date.

The last two sheets will contain the decisions and the actions to correct and improve the project based on the first feedback from the tasks implementation (the CHECK sheet) and the lessons learned which will help in the phases for the other steps in the implementation of the FRLQI as Logistic, Supplier quality assurance or Quality Warranty.

3.3. FRL, an easy tool for the base layer of the fast response

This paper aim is not to describe the problem-solving methodology and the tools like 8D or PDCA-FTA, but will describe the proposal of the support instrument in the problem solving usable at the first layer by the lowest level of the coordinators from the organization. The 8D or PDCA-FTA is a tool stands for minimum 5 days of analysis and team working, and the coordinators of the first level are challenged by the issued raised and needed to be solved quickly, at least for the containment or interim actions. Nevertheless, the layer zero as was proposed by the paper need also to use fast response and the line leaders must work on solving for the issues, therefore, it is proposed the following A4 landscape template to be used in order to understand the issue and to solve it, at least, to not stop the line or process (Picture 4).

Picture 4: Template on an A4 landscape for FRL

Fast Response in Line / FRL								
Date open FRL:	Line:	Shift:	No. FRL					
Issue description		DRAWING / PHOTO / SKETCH	Parts sorted (qty.):	Re-occurrence:				
		Use bad part/good part	Bad parts (qty.):	Shift validation not re-occurred on 3 consecutive shifts = OK; if not = NOK - escalate on section level	Shift	1	2	3
What issue?	CAUSES FOR OCCURENCE:	Date of production (older):	Interim / corrective actions:		Responsible:	Validation		
Why is an issue?		Date of production (earlier):		Signature line leader				
Where was detected?		CAUSES FOR NON-DETECTION:	Date of escalation:	Verification of the lines / same processes:	Signature Quality			
When was detected?					Closing date FRL			
Who detected?	Signature:							
How was detected?								
How many?								

4. A CASE STUDY IN AN AUTOMOTIVE MECHATRONIC DEVICE PRODUCER

The paper presents the case study concerning the implementation of the fast response in an automotive mechatronic device manufacturer with three different methods. The first time, it was used a method based on general knowledge of fast response tools, after three years, the second time, it was used a method improved took into consideration more details regarding problem-solving tools and the monitoring system, but the same approach in terms of fast response structure. Two years later, has developed a fast response in a structure of layers and at the same time was redesign the level and the problem-solving tools and instruments, on layers too.

4.1. The first method - basic

The first method used on a base level the flip-charts and there were established two kinds of meetings: one of the meetings took place in the section areas and the leader was the section manager and the other one was on the facility managed by the general manager. Of course, on the line level or machine level in the processes as molding injection, even if no meeting were held, the bottom level management have had the responsibility to ensure the fast response at issues. Were collected 3 most important quality issues in that section area and containment actions and due date and responsible were established in the meeting, also, it was established the leader for the 8D to develop the root cause investigation and the actions to prevent the reoccurrence.

4.2. The second method – fast response

The second method improved the fast response in the organization and was based mainly on the General Motor customer specific requirements - ISO TS 16949 (IATF, 2015). The meeting structure was improved and more details support the team to make the analysis of the issues in the fast response daily meetings. The big advantage in comparison with the first method was the tracking sheet for monitoring the issues which give a possibility to collect all daily risks in the quality management system, also to apply better the lesson learned. The problem solving was improved and a new tool A3 based on Toyota managers approach (Shook, 2009) was added in order to be used by the team.

4.3. The third method - FRLQI

The FRLQI was developed in order to improve the communication between the different levels of the organization structure in line with the fast response, also to support development of the personnel through daily coaching by the top management to down, by checking the problem solving tools used and quick feedback in order to increase the knowledge and the skills. The big advantage of FRLQI is the possibility to grow up the bottom level management, line leaders, and those leaders of the teams that work direct in the processes and have the possibility to see and correct the processes just in time.

4.4. Comparative analysis between first and second methods, third one FRLQI and QRQC, Quick Response Quality Control

The multiple criteria analysis it was chosen to make a comparative analysis between all methods. The criteria chosen for this analysis are the following: P, R, E, D, I, C, T (Picture 5).

Picture 5: The criteria used for the analysis

P	problem solving used at all levels,
R	re-adjusting easy at organizational changes,
E	embedding in the quality management system,
D	development of the people at all levels by using the methodology
I	interference with the other risk assessment tools
C	cost regarding implementation and
T	time used at implementation on all levels.

Source: Authors development

The ranking of the criteria was established by a Latin grid with 3 values and the criteria were compared two by two regarding its importance: "0" when the importance is lower than comparison, "0.5" when is equal and "1" when the importance is bigger than comparison. The comparison is made by line when the criterion is compared with the ones from the column. When the criterion is compared to itself the result is 0.5. The weighting of the criteria (γ_i) is calculated based on an empirical formula known as "FRISCO" (Bobancu, 1998):

Where:

- Sum of the point calculated on the line of the criterion;
- The difference between the rank of the criterion and the rank of the last ranking criterion; if the criterion is last place ranking, this will be zero;
- Numbers of the criterion over fulfilled in terms of the points;
- Numbers of the criteria considered;
- The difference between the points of the criterion and the points of the first ranking criterion; if the criterion is first ranking, this will be zero;

The result of the points, rank, and weighting for the criteria is presented in Picture 6. Each criterion will be given a score from 1 to 10 and the score will be noted in the column N_i , then the score will be multiplied with the weighting of each criterion. The Variant 1 is the first method used, then Variant 2 is the second method used, Variant 3 is the FRLQI and Variant 4 is the QRQC.

Picture 6: Result of the points, rank and the weighting for each criterion, also final ranking

	P	R	E	D	I	C	T	Points	Rank	γ_i	Variant 1		Variant 2		Variant 3		Variant 4	
											N_i	$N_i \times \gamma_i$	N_i	$N_i \times \gamma_i$	N_i	$N_i \times \gamma_i$	N_i	$N_i \times \gamma_i$
P	0.5	1	1	0.5	1	1	1	6.0	1.5	4.71	4	18.86	8	37.71	10	47.14	9	42.43
R	0	0.5	0	0	0.5	0	0	1.0	6.5	0.18	4	0.71	6	1.06	9	1.59	7	1.24
E	0	1	0.5	0	1	0	1	3.5	3.5	1.42	7	9.92	7	9.92	8	11.33	8	11.33
D	0.5	1	1	0.5	1	1	1	6.0	1.5	4.71	4	18.86	6	28.29	10	47.14	10	47.14
I	0	0.5	0	0	0.5	0	0	1.0	6.5	0.18	4	0.71	6	1.06	9	1.59	8	1.41
C	0	1	1	0	1	0.5	0	3.5	3.5	1.42	9	12.75	7	9.92	7	9.92	7	9.92
T	0	1	0	0	1	1	0.5	3.5	3.5	1.42	8	11.36	7	9.94	7	9.94	7	9.94
Final ranking												73.15		97.89		128.65		123.41

Source: Authors development based on the course Creativitate si Inventica, Bobancu, 2015, p. 125

The final result present the first rank the variant FRLQI (128.65) and the second rank the variant QRQC (123.41), and then the second method (97.89) and the first method used (73.15).

5. CONCLUSIONS

The importance of the Kick-off meeting is the key to success in implementing FRLQI because of necessity gave by the authority and the involvement of top management. Training of the personnel according to the established layers and way to work, or details of the meetings, topic, time,

participation and communication and/ or escalation process, but also the problem-solving tools and instruments will be an activity scheduled from the beginning of the project, even this training is made by doing also in all the next steps of the implementation and running of the meetings. The trials of the meetings are necessary to understand the roles and to obtain the feedback in order to adjust properly the next needs of the training or timings.

The implementation of the FRLQI it is recommended to start first in the production areas because is more easy to be presented and to train the people with all the instruments and tools, and only after the capitalisation of the experience from this step is transposed in lessons learned the next steps areas like Logistic, Supplier quality assurance or Quality Warranty can be developed.

The authors' proposal to develop the fast response at quality issues on layers, and the tailored problem solving instrument used at lower level of management, the FRL template to support the fast response in line, will deliver the input data for the quality management system and its risks identification and will support, based on the analysis, assessment, treat, monitor and reviewed them, to prevent the reoccurrence and to improve the lines throughput. Also, FRL is a helpful tool to develop the skills of the involved people on this layer problem solving, through the analysis of the next layer in the fast response meetings and the feedback supplied properly by the leader.

Layer by layer, the information coming from the meetings and communications is valuable and the FRLQI become a system to monitor and collect the entire daily risks from the production areas and from the logistic, supplier quality assurance or quality warranty as well. And this system could be a part from the entire integrated management system quality-risk.

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