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PPAP Production Part Approval Process (PPAP) Explained

This article is the clearest explanation of the PAPP process I have seen. I am making this available on our web site with permission of FASTENER WORLD Magazine, where it was published in June 2003, and Danny Wu of QST, International, the author.

Best wishes,

Joe Greenslade
President

An Edge Tool Prompting for Growth in Taiwan's Fastener Industry – On the Practice of PPAP in Fastener Industry"

Why Taiwan's fastener industry is implementing PPAP (Production Part Approval Process), and why it is such a necessity:

In the trend of internationalization, the superior claims the victory, the inferior only being defeated; only those who fit can survive, those who don't only being eliminated. During the years between 1991 and 2002, the fastener industry created a golden age, with its exporting production value going up from around 0.65 billion US dollars to 1.7 billion US dollars, which is a composite growth rate of over 10% on the average each year. Looking over at the average export unit price, the unit price per kilogram dropped from US$1.44 down to US$1.37, showing that the unit price of the products not only didn't go up during these ten years, but rather kept going down. In the years of 2001 and 2002, respectively, the total export value came down to 1.46 billion US dollars and 1.56 billion US dollars, respectively, while the average export unit price went further down to US$1.35 and US$1.30; both the total export value and the average unit price came sliding down.

According to a market studying report by Freedonia published in year 2000, total amount of the global production value on fastener products was 35 billion US dollars, and the total value of those fasteners traded through the trade channels on international markets was 5 billion US dollars; with Taiwan exporting 1.7 billion US dollars worth of fasteners, Taiwan accounts for 34% of the market share. At a glance, these data may say well indicating that Taiwan is number one in the export of fasteners, but actually there are two facts behind these data that are worth noting. Firstly, the export unit prices of fasteners were way down very low. Take the export to the U.S. as an instance, although Taiwan ranks as the first among top 10 countries in terms of total value, yet in terms of the average unit pricing its ranking was the eighth (at US$1.41), only slightly higher than China (at US$0.92), and Thailand (at US$1.06). The second fact behind these data is that there is a portion of fastener business that is not replaced by international trade. These fasteners of about 30 billion dollars worth of value are produced and consumed locally. The reasons for these products not being replaced by those foreign traded ones are no more than factors regarding time, quality, pricing or others. The fasteners used in the application for automobiles in the U.S., for instance, account for one fourth of the total fastener consumption.

This definitely is a market that fastener suppliers in Taiwan should not neglect. Furthermore, regarding the factor of quality, QS9000 quality system has become more and more important for these recent years. Among the U.S. buyers, in addition to those buyers of automobile fasteners, more and more buyers even in other business sectors are requesting their suppliers to implement PPAP (Production Part Approval Process). In the near future, once ISO/TS 16949 becomes a general standard for automobiles, PPAP will become the universal standard for all automobile plants worldwide, and only those suppliers who are capable of the implementation of PPAP can be certified to make an entry to the supplying world of automobile fasteners.

I. Introduction on PPAP (Production Part Approval Process):

PPAP (Production Part Approval Process) is a process in which specific amount of production parts are taken out of significant production process as a basis, with certain form of documentation to prove that the materials, equipment, production techniques, molds and tools, and product characteristics of the production process by which said production parts are produced can be in conformity with the requirements of the customers. The purpose is for the customers to make sure, by means of said process, whether the suppliers understand all of their requirements and are exactly able to make the production of the products as per the process required.

1. The definition of production parts:

   The production parts of PPAP must be taken out of one time production at APQP (Advanced Product Quality Planning) pre-production stage. The one time production referred must be in an operation time frame from one hour to eight hours, with a production volume of at least 300 parts, and of a continuous production. According to the conditions of fastener production, if a nut forming machine is going to produce M6 x 1.0 nuts, and supposed the running speed of the forming machine is 300 parts per minute, then, the pre-production schedule should be set to produce at least 300 x 60 = 18,000 parts of the production. The samples used in the output document of the pre-production stage should be taken from these 18,000 parts of the production. Generally speaking, except extremely special fasteners that require special production process, almost all fasteners for the use on automobiles are in conformity to the definition mentioned above and the submission of the required PPAP documents to customers is mandatory.

Timing for the implementation of PPAP:

a) Producing entirely new production parts.
b) Proposing corrective measures for non-conforming production parts previously provided.
c) The changes on designing, specifications, materials or engineering, causing changes on production parts.
d) Upon customer's requests.

For fastener manufacturers, the practice of PPAP is almost centered on the entirely new production parts, because the situations of re-submitting production parts for approval are seldom. Sometimes, due to unfamiliarity with PPAP, there even occur situations as mentioned above with no action taken later on to seek for production part approval. This scenario will make customers complaints easily, particularly when the states of the changes on these products are rather obvious.

Levels of PPA documents to be submitted:

e) Level 1: to submit Certification Letter and Physical Appearance Inspection Report only (when physical appearance is the specification item for the production parts).
f) Level 2: to submit Certification Letter, samples of production parts and limited relevant supporting data.
g) Level 3: to submit Certification Letter, samples of production parts and complete relevant supporting data.
h) Level 4: to submit Certification Letter and other customer required data.
i) Level 5: to submit Certification Letter, samples of production parts, and to have complete relevant supporting data at the manufacturing plants of the suppliers, for submitting to the customers when necessary.

- Note: 1. In case when customers didn't provide levels as per regulated, Level 3 shall be observed for complete submission.
- For details on document requirements, see Table 1.

In light of the explanations on the submission table mentioned above, it says clearly that when production parts are designated with the requirement of production part approval, regardless of the level of the submission, any samples, records or documents that are achievable have to be made and kept at appropriate sites. In the

scenarios of S and R, the manufacturing site is also included, that is to say, not just making the samples, records or documents required for submission. The author of this article has seen many manufacturers only make the portion required for submission while ignoring the portion not required for submission, with a view to lowering workload. This is not the way it should be. Should the customers demand make-up submission later on, this would be regarded as faults.

Additionally, the documents and samples submitted as required by PPAP, ranging from materials, production process, molds and tools, manufacturing and inspection methods, production part samples, packaging, to label identification in the whole life cycle of the products beginning with order taking, pre-production, mass production till the end of the shelf life, should be regarded as the minimum standard. The level of the quality of all products, after the start of mass production, in light of the concept of continuous improvement, should not be lower than that of the documents or samples submitted as per required by PPAP. As for subcontractors for materials, heat treatment and surface treatment, the suppliers should request that the subcontractors practice PPAP, when deciding on the subcontracting of PPAP required production parts, so that the requirements ranging from materials, production process, molds and tools, manufacturing and inspection methods, production part samples, packaging, to label identification can all be passed down to the customers through PPAP, for review and confirmation by customers.

II. Relations between APQP (Advanced Product Quality Planning) and PPAP (Production Part Approval Process):

PPAP is just a process, and, in order to execute and generate samples and documents that are required by PPAP, it depends on the execution and output at each stage based on the specifications as stated in APQP. Therefore, prior to proceeding with PPAP process, it is necessary to do APQP planning, while obtaining necessary documents at each of the different stages.

Table 1　Document Level and Requirements for Submission

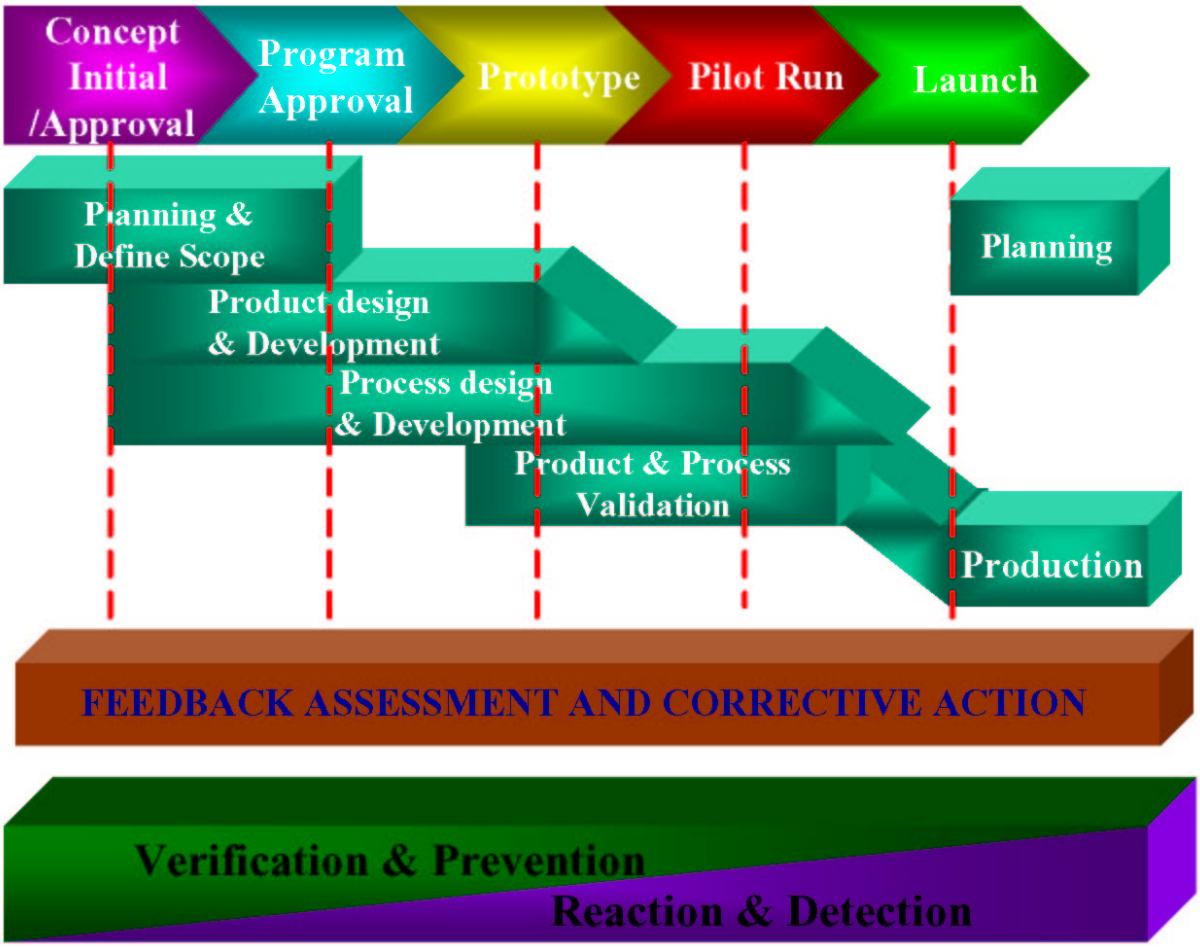
Documents Required	Level 1	Level 2	Level 3	Level 4	Level 5
1. Design Records	R	S	S	*	R
2. Engineering Change Documents, if any	R	R	R	*	R
3. Customer Engineering Approval, if any	R	S	S	*	R
4. DFMEA	R	S	S	*	R
5. Process Flow Diagram	R	R	S	*	R
6. PFMEA	R	R	S	*	R
7. Dimensional Results	R	S	S	*	R
8. Material, Performance Test Results	R	S	S	*	R
9. Initial Process Study	R	R	S	*	R
10. Measurement System Analysis Study	R	R	S	*	R
11. Qualification Laboratory Documents	R	S	S	*	R
12. Control Plan	R	R	S	*	R
13. Part Submission Warrant	S	S	S	S	R
14. Appearance Approval Reports	S	S	S	*	R
15. Bulk Material Requirement Checklist	R	R	R	*	R
16. Sample Product	R	S	S	*	R
17. Master Sample	R	R	R	*	R
18. Checking Aids	R	R	R	*	R
19. Records of Compliance with Customer-Specific Requirement	R	R	S	*	R

S：suppliers must submit such documents to customers, with a copy of documents or a copy of records kept at appropriate sites, including manufacturing sites.

R：suppliers must keep such documents at appropriate sites, including manufacturing sites, and make them easily obtainable upon the requests by representatives of the customers.

*：suppliers must keep such documents at appropriate sites, and submit to customers upon request.

Data Source：Chrysler Corporation, Ford Motor Company, General Motors Corporation, Production Part Approval Process, Third Edition, October, 1999.



Data Source：Chrysler Corporation, Ford Motor Company, General Motors Corporation, Advanced Product Quality Planning and Control Plan, Second Edition, June, 1995.

Figure 1　Product Quality Planning Timing Chart

III. The Stages of APQP for PPAP-related Required Documents:

The QS9000 quality system is normally not applicable to designing in the application of fastener industry, and, hence, the output documents in the process of APQP relating to the portions of designing (planning and field definition, product designing and developing), such as *Designing Record*, authorized *Engineering Change Documents*, *Engineering Approval* at time when necessary, *DFMEA* and so on need not be submitted when practicing PPAP. Besides, seldom are fastener product provided to customers merely for the purpose of physical appearance approval; therefore, no such parts are required to be submitted when practicing PPAP. Fasteners are not bulk materials, hence, needing no submission of *Bulk Material Required Testing List*. The *Inspection Assisting Tools* need not be submitted to customers unless upon customers' request. In this way, under the practicing condition of PPAP in

fastener industry, the number on the kinds of documents required for submission is reduced from 19 to 13.

The documents required by PPAP under the practice in fastener industry are mostly generated at the two stages of “Production Process Designing & Developing” and “Product & Production Process Confirmation” in the APQP planning. See Figure 2 for reference.

Note：As normal practice, the underlined italicized documents need not be submitted.

Figure 2　Relations between PPAP required documents and APQP stage output documents

The required documents as shown in Figure 2 are for normal practice, but it is recommended that suppliers seek for consent by the component approving division of the customers. In addition, if customers should have extra requests, suppliers should satisfy their needs.

IV. PPAP Document Requirements:

1. General Requirements:
    a. Requirements on Production Parts: Production parts must be parts taken out of a continuous production that has an mass production operation time frame from one hour to eight hours, with a production output of at least 300 parts. For manufacturers in fastener industry, nearly all customers comply with this requirement when making PPAP request; therefore, production parts are required for submission.
    b. Suppliers should satisfy all requirements as regulated. The inspecting lab must be a certified laboratory. Any test result merely generally describing its conformity is not acceptable. What is meant by “certified lab” refers to a lab that has been approved and certified to the standards of ISO/IEC 17025 of QS 9000. For fastener manufacturers in Taiwan, this is not a big concern. There are over 30 certified relevant laboratories for fastener industry in Taiwan that are authorized by the official certifying organizations such as CNLA, A2LA and NAVLAP, in addition to quite a number of business operating laboratories. In this regards, there should be no problem, normally, with the submission for PPAP.
    c. Any request that is an exception or deviates from PPAP requirements should seek for the consent by the product approving division of the customer.
2. Designing Records:
    Suppliers should have the designing records of the production parts, which can be records of CAD/CAM mathematic data, drawings, specifications, etc. Taiwan’s fastener manufacturers have always been making production based on customers’ drawings, without bearing the liability on the designing. Thus, fastener manufacturers in this position need not submit such documents when submitting PPAP documents.
3. Authorized Engineering Change Documents:
    Production parts or mold and tools that have shown engineering changes

which have not yet been written on the designing records should bear authorized engineering change documents for submission along with PPAP for customers' confirmation. Fastener manufacturers seem to have some difficulties in coping with this part of the document requirement. The reasons are to be discussed below.

4. When-necessary Engineering Approval:
   When this document is specified on designing records as a requirement, suppliers should have evidence of customers' approval on the engineering. Seldom are there such requirements stated on the drawings of fasteners, and, therefore, in the practice of PPAP, there are few cases when such documents are required for submission.
5. Design Failure Mode and Effects Analysis (DFMEA):
   When having liability in designing, in accordance with QS9000 requirements, suppliers should conduct DFMEA and submit to customers for confirmation. Practically, this document need not be submitted, as designing is not applicable to the fastener industry.
6. Production Process Flow Chart:
   Suppliers should adopt document formats for their own production process flow chart that clearly describes the procedures and flow path of the production process, while satisfying customers needs, requests, and expectation in appropriate manner. In practice, since the format for this document is left for the suppliers to decide, it is thus acceptable to use, instead, the production process flow charts of the products in the same series; if all the processes are all the same, then there is no need of doing the document over again; the old flow chart showing the same process will suffice for the submission.
7. Process Failure Mode and Effects Analysis (PFMEA):
   In accordance with QS9000 requirements, suppliers should conduct PFMEA and submit to customers for confirmation. To design this portion of the documents, follow QS9000 requirements on the FMEA handbook.
8. Full-scaled Measuring Results:
   Suppliers must provide the dimensions requirements on the designing records and controlling plans with the verification already completed for submission to customers for confirmation. Full-scaled measuring results include every value-added process and molding and tooling process. If the testing is performed by means of a projector, then, the full-scaled measuring

results need to include the tracing drawing.

9. Material / Performance Testing Records:

   When this document is specified on designing records or controlling plan as a requirement, the documents submitted should include material / performance testing records. According to the experience of this author, normally customers can accept the material certificates that the raw material suppliers provide, but yet there are some precautions that fastener manufacturers should notice when taking this practice:

   a. The selection of materials should always be in conforming with the requirements stated on designing records; when considering using any material which deviates from the requirements of customers designing records, be advised to seek for customers' consent ahead of time so as to prevent from any dispute. Meanwhile, after obtaining PPAP confirmation for the proceeding with mass production, make sure to use the kind of materials that is in line with what is described on the submitted records. Moreover, when reviewing contracts, be advised to pay attention to see if customers set any requirements on the performance of the raw materials. If they do, be advised to declare to material suppliers that the performance tests are required, when placing orders with them for materials; or, do include the performance test in the in-coming QC tests upon receiving the materials acquired, so as to prevent from any material performance problem.
   b. At times, the selection on the materials, or certified subcontractors for plating or heat treatment are specified in designing records or technical standards; in such cases, suppliers should choose the kind of materials or services of those certified subcontractors specified by the customers.

10. Initial process study:

    The particular characteristics that the customers or suppliers have designated should be examined to see if their initial process study is up to customers' acceptance. The general way of confirming the initial process study in PPAP is to use production process index to determine if such process study is acceptable. Due to the stage of pre-production being of short term nature, normally the process performance index Ppk is used, with the following criteria:

    a. Cpk/Ppk $\geqq$ 1.67: The initial process study meeting customer

requirements, and thus being acceptable.

b. 1.67 > Cpk/Ppk ≧ 1.33: Acceptable, yet some improvement may be needed.
c. 1.33 > Cpk/Ppk: Not meeting customer requirements, and thus being unacceptable.

Nevertheless, there are some precautions that need to be taken, when applying statistics in initial process study and PPAP submission:

a) The distribution of data needs to be the normal distribution towards both ends of the specifications.
b) Particular reasons for the variance in the process needs to be identified, evaluated, and eliminated, if possible.
c) Testing data needs to be based on a sample group of over 100 parts.
d) Prior to PPAP submission, if the process is still unstable, or if the process index still lags in meeting all the requirements, the suppliers should submit to customers a corrective action plan along with a control plan by 100% inspection, with the practice carried on till Ppk or Cpk reaching above 1.33, or till customers' complete approval.

11. Measurement System Analysis (MSA):
Suppliers should conduct MSA on all newly installed or improved measuring instruments. For the practice in fastener industry, it can be done by the analysis on the gauge repeatability & reproducibility, coupled with the study on bias, linearity, and stability. There are large portion of revision made to the third edition of MSA released in March of 2002, with more detailed explanations on the five characteristics of measurement system, and additional testing methods, such as quantitative, and numerical analysis, unrepeatable (destructive) testing, composite measurement system, along with further remarks on the measurement uncertainty, summing up a lot of improvements on the previous edition, and making it adequate for fastener manufacturers to exercise MSA.
12. Lab Certification Documents:
Suppliers should adopt the test reports that comply with the inspection range on the reports presented, and that have been presented by ISO/IEC 17025 approved laboratories. Same as stated in the first section of the 4th paragraph in this article, seeking for ISO/IEC 17025 approved laboratories should not be a problem.

13. Production Controlling Plan:
    Suppliers should have a QS9000-complying controlling plan for the application in defining all the controlling methods for production process control. To design the controlling plan, follow the requirements APQP handbook.
14. Component Certification Letter:
    Component Certification Letter is for explaining on the conformity of the production parts to customer requirements, the compilation of all required documents as per requirements for production part approval, and the certification that suppliers declare to customers by this document. Customers can return this document by counter-signing it as their declaration on the approval of production parts.
15. Physical Appearance Inspection Reports:
    When physical appearance is specified on the designing records as a requirement, suppliers should present a physical appearance inspection report adapting the same format as the one specified by Chrysler Group, or Ford/GM. Because fastener production parts are normally rarely classified into categories requiring physical appearance, it is not likely for this document to be required for submission. For reference, Part II in the handbook for QS9000 PPAP handbook is where the requirements are specified.
16. Bulk Material Required Testing List:
    Not applicable for fasteners.
17. Production Part Samples
    Production part samples must be submitted as per customer requirements, as well as the requirements of the submission requests. The sample quantity may vary depending on the developing progress of the customers or the switching condition of different products. Take the whole product developing process in a automobile plant as an example. There can be samples of prototype parts, 1PP (first pre-production parts), 2PP (second pre-production parts), 3PP (third pre-production parts), and PPAP parts. The quantities of samples submitted each time are different so as to match with the running of sample trial or pre-production trial. If suppliers are transferred suppliers for the development of the production parts, confirmation may directly start with samples before going straight to the stage of mass production, and the sample quantity required can be larger. According to requirements stated on

QS9000, suppliers should comply with all requests relating to sample confirmation.

18. Standard Samples:
    Suppliers should retain one standard part sample. With the fastener production mode, large majority of fasteners are produced by means of multiple press mold forming machines and thread rolling machines. According to the PPAP requirements, one standard part sample should be retained at each of the stations for forming and thread rolling. It is not adequate to keep just one sample of the finished parts.
19. Inspection Assisting Tools:
    When seeking for production part approval, suppliers must submit component assembly assisting tools or production part inspection assisting tools, upon customer requests. In terms of fastener production, there are more requests for the submission of production part inspection assisting tools, as customers may not necessarily have the kind of gauges or tools needed for the inspection or testing of the production parts. Therefore, for customer's convenience, customers may make such requests, and suppliers should keep their needs satisfied.
20. Records on Compliance with Customer Special Requests:
    There are quite a number of special requests listed in the section on Customer Requests in Part II of QS9000 PPAP handbook, which are mostly additional requests by individual automobile companies regarding PPAP submission, or the revision or amendments to Part I of the PPAP handbook. Suppliers should provide documents to meet the demands of these requests, taking into consideration the individual needs of different customers.

V. States of Customer Confirmation on Production Part Approval:

1. Complete Approval:
   Complete approval is granted in case that production parts fully satisfy all customer requests. At this time, suppliers will be allowed to proceed with the mass production process, according to the material demands scheduled on customer's production plan.
2. Temporary Approval:
   Temporary approval is granted in case that production parts fail to satisfy all customer requests, under some certain conditions which include:
   a. The time frame for mass production and production volume being very

limited, hence, allowing customer monitoring.

b. Full understanding on the cause of failing in satisfying all customer requests.

c. Having in possession customer temporarily approved corrective action plan; for reference on how to accomplish this in actual practice, see Part II of PPAP handbook.

3. Reject:

Production parts are rejected in case that they fails to satisfy all customer requests.

VI. Some difficulties that confront Taiwan's fastener manufacturers, regarding submission of production part for approval:

1. Concern over distance:

A large majority of fasteners made in Taiwan are exported through international trading channels to other countries, particularly to the U.S., and fasteners for automobiles are no exception. The sense of detachment over the distance often lead to the difficulties in knowing about customer needs. How could that be possible to produce production parts that meet customer satisfaction, if the manufacturers do not know what customers' thoughts are?

2. Concern over the tiers:

The automobile fasteners made by Taiwan's fastener manufacturers are mostly sold to distributors; only a few fastener manufacturers deal directly with the central plants or the first tier suppliers. The farther they are from the central plants, the more difficult it is for them to acquire information or get messages across. Besides, the more the information is relayed, the less the fidelity is left. When fasteners are at developing stage, having good communication with the customers and the transmission of messages are critical factors to the success of production part submission. Upon entering APQP stage, the designing record that the suppliers received indirectly from the customers, more often than not, is no more than a sheet of drawing. How can a drawing fully convey all of the customer's needs?

3. Concern over attitude:

PPAP, in fact, is just a production part submission process that proves that the production parts really comply with customer requirements, but yet what actually counts is that the products are made in such a manner that

they meet customer demands. PPAP, in itself, is a minimum kind of requirements, but what really matters is that the mass production needs to be carried out with production capability not lower than PPAP. Many manufacturers are often able of accomplishing and submitting the documents and samples in conformity with customer requirements at PPAP stage, but rather unable to keep up with their satisfactory production capability, or have to change the conditions for mass production due to some needs or circumstance, when proceeding with mass production. This is totally against the spirit of continuous improvement advocated in QS 9000 standards.

4. Concern over subcontracting:

   There exists difficulty in controlling the quality of subcontractors for fastener materials, heat treatment and surface treatment, etc. Talking of quality certification, subcontractors, no matter abroad or at home, seem very conservative, with only a few being accredited with ISO9000 certification, left along the number of those with QS9000 certificates, and therefore, in regards to the requirements relating to subcontractors in QS9000 standards, there are a great deal of difficulty. In addition, automobile plants usually regulate standards by listing the qualified subcontractors for the materials, heat treatment and surface treatment of fasteners used on automobiles, while the number of material, heat treatment or surface treatment companies that have acquired the accreditation in these fields are very rare, resulting in the production parts being often submitted as semi-finished parts, weakening the competition competence of our manufacturing companies.

VII Conclusion:

1. Turning PPAP from being an obstacle into an edge tool for business growth:

   Fastener products, by the types of the markets, can be divided into low-end, mid-end, and high-end products. Varying with different target markets, the corresponding supplying chain systems are different. Facing the low price competition brought by the competitors in China and Southeast Asian region, fastener manufacturers in Taiwan should gradually move from the price competition on low-end products to mid-end and even high-end products. During the transition, the requests of PPAP should not be regarded as an obstacle, but as an edge tool prompting for growth. Nothing can help easing your way up from low-end to mid-end or high-end products, except practicing PPAP precisely, and

grasping the pulsation of the markets and the customers.

2. Acquire in-depth understanding on the purpose of PPAP:
   PPAP is just a tool, through which customers get to understand the capability of the suppliers in meeting customer requests. PPAP itself is not the purpose; the purpose lies in the continuous improvement of products, and the lowering of costs as feedback for customers, to increase the extent of customer satisfaction for improving customer's confidence, while winning more orders to sustain the operation of the enterprise. Meanwhile, PPAP should be regarded as the minimum requirements of the products during the whole life cycle, and, after proceeding into mass production stage, the product quality should be kept up, while improvements on product quality, delivery, production costs should carry over, particularly the significant character of the products.
3. Implement PPAP precisely:
   To implement PPAP well, not only does it take the understanding on the processes of PPAP, but also considerable amount of knowledge and precise practicing on other core tools of QS 9000, including Advanced Production Quality Plan (APQP), Failure Mode and Effect Analysis (FMEA), Statistic Process Control (SPC), Controlling Plan (CP), Measurement System Analysis (MSA), and QS 9000 (or ISO/TS 16949). If the attitudes towards the practicing of PPAP and other core tools are just getting it over with, then the wish for PPAP doing PPAP well will be drifting away.
4. Ending words:
   To serve these purposes, manufacturers should have a full-scaled view on PPAP through the scope of QS9000, rather than looking at it as a way to get customer approval. The failure in keeping up with PPAP standards at mass production stage, thus failing in meeting customer demands, will do nothing good but bring more customer complaints, even lawsuits. The damage incurred as a result is even greater than having production parts rejected in the first place. The only way out, still, is to follow the spirit of QS9000 in practicing continuous improvement on quality, abiding by requirements for each APQP implementation stage for the accomplishment of PPAP, thus getting to grow with the customers.