Knowledge Acquisition Mechanisms during the New Technology Implementation Process of Malaysia's Automotive Engineering Support Industry

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Abstract—**Malaysia's engineering support industry is crucial in supporting the country's industrial development because it intergrates into other economic sectors which includes manufacturing, construction, transportation, and the primary industry. To fulfill the rigorous requirement of original equipment manufacturers (OEMs) for parts and components along with precision engineering service, the players/stakeholders in this industry have begun to upgrade their facilities and adopt new technologies. Besides technology adoption, knowledge is the main advantage of a firm to compete in the turbulence and increasingly complex new business environment. This research aims to explain the specific knowledge acquisition mechanisms used for three knowledge levels as proposed by a few reputable researchers in this field. The data was gathered from a semi-structured interview in two automotive tooling companies in Selangor, Malaysia. Thematic analysis was conducted using NVivo. The results of this study found that among the knowledge acquisition mechanisms for declarative knowledge mentioned by the interviewees are basic training, intellectual capital, pre-departure training, and instructor manual. The knowledge acquisition mechanisms for procedure knowledge includes external OJT, hiring external expert, related working experience, local training, benchmarking, and personal observation. Finally, the knowledge acquisition mechanisms for conditional knowledge include continuous improvement, learning by doing, project review, and trial and error.**

Keywords—knowledge sharing; new technology implementation; engineering support industry; declarative knowledge, procedural knowledge, and conditional knowledge

I. INTRODUCTION

According to the Malaysian Investment Development Authority (MIDA), Malaysia's engineering support industry (ESI) includes companies doing a wide range of activities including mold and die, machining, metal stamping, metal casting, surface engineering, heat treatment, and forging. Such industries are vital in supporting the country's industry development because it integrates into other economic sectors including manufacturing, construction, transportation, and the primary industry. To fulfill the rigorous requirement of original equipment manufacturers (OEMs) for parts and components along with precision engineering service, the players/stakeholders in this industry have begun to upgrade their facilities and adopt new technologies [1].

Notwithstanding, new technologies adoption and implementation are essential for companies to sustain their competitive advantages for both manufacturing and services industries [2]. In addition, [2] explain that new technology implementation may precede product and process improvement that create tangible competitive advantages. However, these advantages may be difficult to be achieve.

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Furthermore, knowledge is the main advantage of a firm to compete in the turbulence and increasingly complex new business environment [3]. Thus, many researchers suggested technological innovation [4,5,6,7] and organizational learning capabilities [8,9,10,11,12] are crucial for building a sustainable competitive advantage in the vibrant market environment [13,14]. Furthermore, [15] found that organizational challenges in terms of lack of knowledge and readiness, and satisfaction with the status quo appeared as the most frequently expressed challenge in adopting additive manufacturing among small and mid-size enterprises (SMEs).

Moreover, previous research found that innovative attempts in an organization are resulted from investment in the learning process and upgrading human resources management and knowledge management [16]. The accelerating the depth and speed of changes in today's business environment due to globalization, technological innovation, and the knowledge-based economy, jobs have become more complex, challenging, and empowering [17].

The idea of addressing the technology implementation process from the organizational learning perspectives was spark by a framework developed by [18] which includes both the sources of learning and the learning process. The focus on the mechanisms of knowledge acquisition in this research is an important extension of the technology implementation literature which tends to focus primarily on predictors and consequences of technology implementation [19].

Hence, the main aim of this study is to develop a different understanding of knowledge acquisition by the firms during the technology implementation process. The results of this study guide the company on how to plan and manage the knowledge acquisition activities of the end-users during the technologies implementation period. The need to have a deep understanding of knowledge mechanisms arises especially when there are many firms are still struggling with technology implementation [20,21,23,24].

The domain-specific knowledge typology developed by [25] distinguishes knowledge into three levels;

i) Declarative knowledge which consists of factual information,
ii) Procedural knowledge is a compilation of declarative knowledge dedicated to functional units, and
iii) Conditional knowledge is the individual understanding of when and where to look for certain facts or to apply particular procedures.

This research aims to explain the specific knowledge acquisition mechanisms used for three knowledge levels as proposed by [25].

II. LITERATURE REVIEW

There are two types of knowledge: explicit knowledge and tacit knowledge [26]. The explicit knowledge is tangible and identifiable [27] and can be expressed in formal and systematic language and shared in the form of data, scientific formulae, specification, manual, and standard operating procedures [26]. It is relatively easy to process, store, and transmit [26,27]. In addition, information and communication technology can facilitate the incorporation of this type of knowledge into an organization's strategy [27].

On the contrary, implicit or tacit knowledge is highly personal and hard to formalize [28]. It is laid in the minds of persons shaping their values, behaviors, emotion, commitment, routines, procedures, and actions [26,27]. It is hard to identify, quantify, record, and store [27]. Therefore, it is difficult to communicate with others [28]. Subjective insights, intuition, and hunches are some examples of tacit knowledge [26]. Nevertheless, it important to acknowledge that tacit and explicit knowledge are complementary and both are essential elements of knowledge creation since explicit knowledge without tacit insight will lose its meaning. Furthermore, the knowledge creation process is an interaction between tacit and explicit knowledge instead of tacit or explicit knowledge alone.

As a result of the tacit and explicit knowledge differentiation, [28] suggests four patterns of knowledge creation in any organization:

- From tacit to tacit: when one individual shares tacit knowledge directly with another such through apprenticeship or on the job training or socialization process. The apprentices learn the knowledge or skills by observation, imitation, and practice, then it has become part of his/her tacit knowledge base
- From explicit to explicit: The process of combining the discrete pieces of explicit knowledge into a new whole. However, this combination does not truly extend the organization's current knowledge base either.
- From tacit to explicit: The process of converting tacit knowledge into explicit knowledge to allow it to be shared with others.
- From explicit to tacit: When someone begins to internalize the explicit knowledge, that is when he/she uses it to broaden, extent, and reframe his/her tacit knowledge.

[28] indicates that the whole pattern will occur in complex interactions that create a continuum of knowledge within the knowledge-creation firms. Two essential steps in the knowledge circle are articulation (converting tacit knowledge into explicit knowledge) and internalization (using the explicit knowledge to extend one's tacit knowledge base).

Source of knowledge is characterized as the degree to which an organization tends to acquire new information internally versus the degree to which it is more likely to seek inspiration in the ideas produced from outside [29]. [25].

Accordingly, knowledge acquisition (KA) is defining as the development or creation of skill, insights, and relationships [30]. [30] suggested that KA's immediate production, the information, is a depiction of the real phenomenon at the level of detail and abstraction provided by the KA exercise intent. Most of the formal and informal activities in an organization are the means to acquire information and knowledge [31]. In fact, the company's success depends on how well it can develop its knowledge base by either creating new knowledge or obtaining new knowledge from external sources [32].

In addition, the internal learning process in the organization begins with the creation of knowledge by individuals [32]. They further explain that individuals come up with new ideas regarding the process and product improvement which are normally first circulated among the colleagues that form a 'community of practice' where they normally share a similar perspective and interpretation frameworks. [33] posited that internal learning improves the organization's strategic capabilities through the increasing of shared knowledge of organizational members. Individual learning, intra-functional learning, inter-functional learning, and multilevel learning are some forms of internal learning [33].

In contrast, the external learning process starts with the identification of new ideas by an outside source [32]. Their study among the companies operates in varieties of industry indicated that most companies rely on external learning during the early stage of new product development due to lower competitive success and during the later stage as a result of slower innovation speed. However, new product development costs tend to increase with a greater reliance on the external source of technology. Furthermore, [33] suggested that external domains of learning include customer learning, competitor learning, network learning, and institutional learning.

To summarize, the balance between external learning and internal learning tendency has a direct impact on the ability of the firm to integrate and apply its knowledge [32]. Both processes differ, therefore they face a different set of organizational barriers and rely on different facilitators.

III. METHODOLOGY

The engineering support industry for the automotive parts and components sector was selected because it is a knowledge-intensive industry. It includes routine and non-routine engineering activities that are project-based [34]. The knowledge restores mainly in the design professionals who have the opportunities and advantages of sharing and utilizing the new knowledge. Members can create specific knowledge and shared knowledge with various experienced professionals when designing a project [34,35,36].

This research-based on an arranged positivism research which involves questioning and enriching the existing framework developed by previous researchers such as [37], [19], and [38] through the explanatory study of the engineering support firms of the automotive industry. Firstly, the organization as a whole is considered before looking closely at how the organization makes use of organizational learning to facilitate the AMTs (i.e. CAD/CAM and CNC machine) implementation.

This research is designed as a multiple case study. The use of multiple cases underlines the complexities of the topic being studied and created the empirical evidence to support and revitalize the theory. Therefore, the two cases study chosen for this study hopes to provide a richer dataset that enriches the analysis and bring some variation due the different age and position of the two companies in the sector The sampling method used to select the cases was convenient sampling, which involved selecting those units of analysis that best guarantee the availability of information needed to understand the phenomenon being studied [39]. The unit analysis of this study is the organizations selected for the case study. The unit of analysis is selected based on networking (i.e.: friends and families) recommendation to get permission from the top management of the companies to conduct interviews and observation.

Three alternative methods may be used to perform qualitative content data analysis; the conventional content analysis, the directed content analysis, and the summative content analysis [40]. The main differences between the three methods are coding schemes, origins of codes, and threats to trustworthiness. The authors further explain that for conventional content analysis, coding categories are derived directly from the text data. However, in the directed content analysis approach, the analysis begins with a theory or relevant research findings as guidance for initial codes. Finally, the summative content analysis approach requires counting and comparisons, usually of keywords or content, followed by the interpretation of the underlying context.

This research follows the directed content analysis as an analysis starts by referring to relevant previous research findings and generally employs a deductive approach [41]. In addition, this research also utilizes the inductive method to understand the mechanisms used for the organizational learning process during advanced manufacturing technology implementation.

The qualitative content analyses were done using NVivo to meet the following objectives; to produce more systematic research findings and to re-specify and validate the prior model [42]. Validated and re-specified the prior research model is crucial because the relationships between dependent (endogenous) variables are uncertain [41]. In this case, identifying the relationship between knowledge acquisition mechanism, and advanced manufacturing technologies (AMTs) implementation success is vital before making any conclusion.

The explanatory approach was used to extract the information from the interview scripts and established the pattern of the information according to three main nodes [41]; knowledge acquisition, knowledge sharing, and knowledge utilization to identify and validate the mechanisms for the organizational learning process during AMT implementation based on these nodes. These mechanisms were identified based on three different types of knowledge; namely declarative knowledge, procedural knowledge, and conditional knowledge. It is crucial to identify the 'real' observed mechanisms because some of the mechanisms suggested by previous research might not work on the current contact. Further discussions on these three main nodes are as follows.

IV. RESULTS AND DISCUSSION

Knowledge acquisition is defined as the development or creation of skills, insights, and relationships [37]. In this study, knowledge acquisition mechanisms examined are based on three knowledge clusters: declarative knowledge, procedural knowledge, and conditional knowledge as shown in Table 1 below.

TABLE 1: KNOWLEDGE ACQUISITION MECHANISMS

	Mentions	Source
Declarative knowledge (Knowing-what)	82	21
1: Basic Training	37	16
2: Intellectual capital	30	19
3: Pre-departure training	9	4
4: Instructor manual	5	2
Procedural knowledge (Knowing-how)	179	25
1: External OJT	71	19
2: Hiring an external expert	36	14
3: Related working experience	30	14
4: Local training	27	13
5: Benchmarking	9	7
6: Personal observation	6	3
Conditional knowledge	111	20
1: Continuous improvement	40	11
2: Learning by doing	36	15
3: Project review	22	12
4: Trial and error	13	5

A. Acquisition of Declarative Knowledge

The result in Table 1 shows that the total number of mentions for declarative knowledge is 82 that were spread across five (5) sub-nodes; basic training, instructor manual, intellectual capital, management training, and pre-departure training. Basic training and intellectual capital sub-nodes have high mentions with 37 and 30 respectively. Instructor manual, management training, and pre-departure training have fewer mentions however these sub-nodes are still important mechanisms for acquiring declarative knowledge.

Basic Training

Basic training stands as the highest priority for declarative knowledge acquisition mechanism as there are 37 mentions (coding references) linked to this sub-node. A respondent has voiced his opinion on the importance of basic training.

> *[…..] I'm started from zero and no experience with CNC machine at all, so when I first joined the CNC team I was sent to Japan for training for two weeks and another 2 weeks training on the job training (OJT) here. So basically I undergo one-month basic training.*

Several respondents emphasize the importance of basic training for the new staff to inculcate the right working habit. In addition, basic training also is a critical means for junior staff to acquire basic knowledge of the die manufacturing process. These interviewees stated that:

> *[…] So currently we tried to do OJT meaning that we trained them from the basics. All the newly recruited staff has to go to the "driving range" (I'm talking about the making section), it is a place for them to learn how to grind, how to polish, etc. He was provided with a bench to work and he will be practicing it for about 3 months.*
> *[…] Normally for training, firstly when the new staff came, we will conduct training on safety; about the overhead crane and link, the forklift and may involve briefing on the fire extinguisher and first aid; it is the basic training.*

These quotes imply that providing basic training is critical to gain declarative or basic information about the whole die manufacturing process. This knowledge includes the safety measures, appropriate working habits, and how to operate the machines and technology being used in various stages of the die manufacturing process.

Intellectual Capital

Intellectual capital has the second-highest number of mentions (coding reference) under the declarative knowledge sub-node indicating strong evidence that intellectual capital is an important mechanism to acquire declarative knowledge. Several interviews have expressed the importance of having intellectual capital, especially for the senior staff. These respondents raised their concern, the problem occurs in training new staff because they don't have experience and intellectual capital about die manufacturing.

> *[…]we have to explain to them about the dies, go to the site to see those dies that have been used during production so they can understand better because they will have different experiences if compare to when they observe it during classroom explanation.*
> *[….]For those people, if he/she is fresh graduate, they are not familiar with the product, maybe they are good in the machine/software but they are not well versed with the product.*

Other interviews have also voiced the importance of intellectual capital especially for complicated projects:

> *[…] Since 1987/88/89/90 I had done the design work so I have the basic knowledge but I need more exposure on the method to make die and how they developed die from zero.*

From the findings, it is appropriate to say that intellectual capital is one of the main mechanisms to acquire declarative knowledge about the die manufacturing process.

Instructor manual and Pre-departure training

Three other sub-nodes (Instructor manual, Management training, and Pre-departure training) are categorized under knowledge acquisition for declarative knowledge node. These also are significant factors contributing to the declarative knowledge acquisition mechanism. Although they are fewer mentions (coding references), they are still important acquisition mechanisms for declarative knowledge.

Instructor manuals are the machines or software manual provided by the supplier as a guideline to operate any particular machine or software as highlighted by one of the respondents;

> *[…] we refer to the manual and check back all the functions and methods.*
> *[…] When I study the OKUMA instructor manual I found that there are a lot of things that we have not to explore.*

Pre-departure training is the internal on-the-training attended by the newly recruited staff to familiarise the product before they go for more advanced on-the-job training in Japan or Korea as highlighted by the respondents;

> *[….]Yes. At least one or two years but it is not enough. At least 5 years after they understand the work here then we send them there (Miyazu Japan) then only he can learn easily. Actually when they had worked for one year and we send them for training they don't speak/understand the Japanese language even though they will go for one-month language training but when they work on the shop floor they still have communication problems.*
> *[…] For a beginner, we have to study from the complete dies from scratch. So that is the reverse engineering concept. We look at the die and try to understand the concept; what are the components? How to do it? What are the processes involved? What are the factors that we need to consider to make it so that we can produce high quality die with less error and to minimize the cost, so we have to study/learn all the details? We will look at the sample of complete die then only we can imagine what are the process involves before the die complete.*

B. Acquisition of Procedural Knowledge

The codifying and analysis process revealed that procedural knowledge is the most mentioned (179 mentioned within 25 sources) for knowledge acquisition compared to other nodes. Findings indicate that there are six mechanisms (sub-nodes) to acquire procedural knowledge in the two companies with external on-the-job-training (OJT), hiring external experts, related working experience, and local training having the highest mentions (coding references). The other two fewer mention mechanisms (sub-nodes) i.e. benchmarking and personal observation are also important mechanisms to acquire procedural knowledge.

External OJT

The pattern matching analysis concluded that external on-the-job-training or normal known as external OJT was mentioned in most of the interviews. This sub-node derives from 19 sources (interviews) with 71 mentions (coding references) as indicated in Table 5.1. Indeed, external OJT is one of the most important knowledge acquisition mechanisms discussed in the interviews. Furthermore, some of the interviewees indicated that external OJT is important to update their knowledge and skills about the latest technology used in the tooling industry:

> *[…] For technical training, we can't find it locally and normally we went to Miyazu Japan.*
> *[…] For me, most of my learning process is through on-job training (OJT). I'm also among the first group sent for training in Miyazu Japan when Miyazu Malaysia was founded in 2003/2004.*

Other respondents highlighted the importance of external OJT in acquiring critical knowledge in using newly implement technology;

> *[…] when want to use it to do our work we need to know a lot more other information for example in terms of parameter setting. That information is not included in basic training therefore we need to go for further training like the training that I went for during OJT in Miyazu Japan. Then only they (the trainer) exposed us to the knowledge know-how plus process flow that we need to go through to prepare the CAE report.*
> *[…] At the same time, we will send 2 technicians to JAPAN to be trained on advanced HTM. It is a new technology.*

The major concern about external OJT is its criticality in ensuring better AMT implementation process;

> *[…] For example, my colleague (Mr. X) was trained to operate the H&K machine and I was sent to Japan to learn about the OKUMA machine because I already know about H&K, and the system is a bit different.*
> *[…] In my case, the first year I joined here I was sent to Miyazu Japan for training for 3 months. The training was on simulation analysis because when I joined in 2005 they just bought the software and when I joined I was immediately sent for training. Therefore, I learned a lot of basic skills on how to analyze panel, how to see the process during the 3 months training.*

The local automotive tooling industry required advanced knowledge in current technology to cope-up with the industry requirement due to market globalization.

Hiring external expert

Hiring external experts is also an important factor for the acquisition mechanism of procedural knowledge because the respondents believed that AMT implementation requires foreign expertise to manage various technologies to produce complicated and super-sized dies (Class AA) such as "finder" and "body-side outer". The external expert mentioned by the respondents varies in terms of specific knowledge field and country of origin;

> *[…] Secondly, I get involved with consultants from Korea or Japan. When they came we will form one team; conduct a meeting based on one part will discuss until we finish everything. Whatever improvement we can apply we will discuss it during the meeting. Therefore,*

indirectly I will get knowledge from them and will get knowledge from I had.

[…] But we have Japan technical advisor(TA) from Japan and he stayed at PHN for one year so he teaches us how to do the machining. At the moment we have one for design and the other one for manufacturing.

In this research context, the external expert is about facilitating the knowledge and technology transfer from a developed country to tooling shop operations within the Malaysian automotive tooling industry:

[…] We have a technical advisor (TA) from Miyazu Japan to facilitate the technology transfer process. For example, I'm the leader, so I'll list down all the problems that I faced and can't be settled by our team here. This means that when I had a problem in the machining and the designer also not able to give settled it. I will take notes and when I have a lot of problems on my list I will ask my boss whether TA will be coming soon or not? If the TA is not coming I will call him directly in Miyazu Japan. If my boss said he will go in February, so I will wait until he comes back and discusses the problems with him later.

[…] He (refer to the technical advisor) will join us in the trial-out. He will monitor the work process and progress. If my subordinates do things differently from my instructions, he will tell me like, "We should do it like this instead of like that, etc." Then he will continually monitor our progress from the beginning till the end.

[…] The Japanese TA also normally having the knowledge which we don't know and we never do it. They will teach us for example it's something that 1st times apply in Miyazu he will get some information/sources from Miyazu Japan and teach us.

Internal on the job training (OJT)

In this research context, local training refers to training attended by the staff within Malaysia. One of the respondents indicated the importance of local training in developing the procedural knowledge of the staff:

[…] After that the training is more to OJT internally. When we get a new project, it will be our training process to scale-up our knowledge. So it is more to the actual project and it became our experience for improvement.

Most mentioned patterns found under this sub-node highlighted the need to enhance specific knowledge on dies manufacturing process through internal OJT:

[…] We normally have a lot of OJT and less classroom training because during OJT we can train them based on the problem that they encounter and specific for a person.

[…] Then when we came back here (in Malaysia) we had to learn by ourselves because we had to understand what we had learned before and have to ask a lot of things that we don't know.

Internal OJT is important for the staff to deepen the knowledge of the technology that they have learned during the OJT in Japan or Korea.

Related Working Experience

In this research context, related working experience refers to the experience that the staff has acquired from their involvement in the tooling making industry. The 'mention patterns' indicating related working experience is one of the important mechanisms to acquire procedural knowledge:

[…] Yes before this I was a leader and I solved a lot of problems. When we send our staff to attend the trial-out outside when my job complete and other jobs are still not complete so I have to take over his job.

One of the interviewees mentioned the need to have related working experience to be able to operate the advanced machine in the die making process:

> *[…] After they have some experience and skill then only I transfer them to the biggest machines which have angle head and cutting using CAM technology. They have to have mathematical skills; cosine, sine, tangent so that is very advanced.*

Staff having related working experience is more capable to develop new tools:

> *[…] Go from different circles to another; one design, two designs, and many designing then we will understand this one like this, this and this. The experience is very useful for new tool development.*

Benchmarking and Personal observation

There are two more observed variables (sub-nodes) identified under the mechanism for acquiring procedural knowledge node, which includes benchmarking and personal observation. Table 13 details the number of mentions (coding reference) for these observed variables. Among the two observed variables, benchmarking is more mentioned compared to personal observation.

Benchmarking is the process of comparing the performance of the current operation to a certain standard that has been pre-determined based on the company or industry requirement. One of the respondents raised the importance of benchmarking:

> *[…] I also have to measure the current level of technology implementation which is the OJT activities; we have to review the performance before and after the OJT based on the criteria that we had set to become the SE engineer.*
> *[…] Yes, to set the benchmark and at the end of the trial stage then only we decide whether to apply the new technology or stick to the old one.*

Personal observation

Personal observation is the learning process by observing foreign vendors when they work together:

> *[…] For example, we made an observation when the Japanese and Korean came to do the dies trial here. Normally during the trial, some of their machining people came and he said "we want to do some cutting to the dies". So when we put the material into the machine he normally comments if we have done it wrongly "you can't cut it that way, you had to cut it this way" then we practice what he suggested when we do our job later.*
> *[…] But when Miyazu appointed them as a vendor, for example, LG to make our die, when the die arrived here, they do the trial out and for example, we have die accident my group (CAD/CAM) will handle it to repair; modeling, to scan, etc. so we will see why they do like this the modeling. There must be a reason, so we just analyze it through that way.*

Procedural knowledge is critical knowledge for the tooling plant staff to perform their daily job using the AMT in place. However, they may continuously develop their knowledge and skills because technologies for the tooling industry are evolving from time to time.

C. Acquisition of Conditional Knowledge

The domain-specific knowledge typology developed by [25] defined conditional knowledge as the individual understanding of when and where to look for certain facts or to apply particular procedures. Three main observed variables or mechanisms (sub-nodes) identified under conditional knowledge are learning by doing, continuous improvement, and project review. Learning by doing is the most mentioned (coding references) with 15 mentions, project review is second with 12 mentions and continuous improvement has 11 mentions as depicted in Table 4.1.

Learning by doing

Learning by doing reflects the staff learning process by performing their daily jobs. Previous research [43, 44] (Baumard & Starbuck, 2005; Levinthal & March, 1993) indicated the importance of learning by doing as a way to acquire knowledge to operate the new technology. Learning by doing has the highest mentions as compared to other conditional knowledge sub-nodes reflecting its' importance as a mechanism to acquire conditional knowledge. Some respondents stated that learning by doing is one of the most important mechanisms of their learning process:

> *[…] As a technician we also have to progress from Level 1 until Level 7. When we progress from the lower level to the upper level we had a different experience and performed different job functions. Therefore we can improve our skill level; for example from the conventional machine we will transfer into a CNC machine; from a small CNC machine into a large CNC machine. I observed in Proton previously we used the Mitshibushi machine with the FANAC system and I had been using the machine for quite a long time therefore my mind seems to be saturated with the system. Then now in Miyazu, we have an OKUMA machine with an OSP system. In the OSP system, it has many other sub-systems so we have to learn something new again. Therefore with the implementation of the new system, we can improve our skills)*
> *[…] So we learn from our current designing jobs to make sure we can do complex parts like finder and body site outer and also bigger parts.*
> *[…] …we normally learned through our involvement in a project. Every time we are involved in a new project we will give them exposure and they will follow the project and we also monitor them. For example, they will learn how to change the tools and how to control tolerance.*

Project Review

Under the contact of this research project, review refers to the process of formally reviewing the project by examining the lessons that may be learned and used for the benefit of the future project. Most respondents believed that project review is a very important mechanism for them to learn new knowledge and skill about the dies manufacturing process:

> *[…] Most of the time, for a designer, we have to involve in trial-out or to do the die testing to update our skill. After we complete the die and before we install it at the press line to produce parts we have to involve in the trial-out, we get information then we will use it as a post-mortem item. The designer must involve in the trial-out stage to update their skills. If he is not involved in that stage he will never know whether he is doing the right thing or not)*
> *[…]For example, for dies making after the first trial, we will come to know what is the accuracy level we got. Most of the time we will not be achieved the target accuracy level during the first trial. So the first trial is very critical because we will make improvements on the dies before the second trial best on the accuracy level we get during the first trial.*
> *[…]…if the standard has some mistake or the standard make us confused and make mistake in our dies so we review in term of that…so when we started our program […] we will look into those areas… we don't want to repeat the same mistake in the next model so those critical mistakes that we made during the previous model we try to avoid and not to make it (the same mistake) again… so we all call it "lesson learned"*

Project review is also important as one of the time-saving tools in the die manufacturing process:

> *[…] When they started the designing stage we will call for a B-meeting.*

> *B-meeting is to discuss the design, for example, we have 4 processes; for 1st process, we will display the design, then we will study the design and if there is any problem we will give our comments.*
> *[…] Meaning that we save time because previously we did not know the part will have a crack somewhere but when we use PAM STAMP we will know there will be a crack for example at the back angle so after we start the machining process; the surface we can rectify the problem in advance. Let say if we use radius 5 will crack so we change in advance to radius 7 so it will not crack.*

Continuous Improvement

Continuous improvement refers to initiatives to improve product quality. Both companies have been acknowledged by various organizations and received quality standard certification for their quality improvement initiatives to improve their product quality and to learn the necessary skills:

> *[…] 2011: Awarded Finalist of Quest for Continuous Improvement at FMM Excellence Award 2011.*
> *[…] 2010: Awarded 1st Runner-Up Category Vendor at PROTON Kaizen Convention 2010.*
> *[…] Sept. 2009: MMSB received certification for ISO-TS 16949 in Nov 2009 "further strengthening the company's quality assurance process.*
> *[…] Oct. 2008: Launch companywide TS16949 Certification preparation target for certification by Apr '2009.*

Continuous improvement initiatives also have become one of the important mechanisms to solve problems and to acquire knowledge and skill-based on the problem faced by various project team members during the project implementation process using AMT:

> *[…] Yes, because in PHN we use most of the Japanese system. For example 5S, Autonomous Maintenance, 6 Sigma, ISO MS9000, and QMS, so all these systems are practice every day in our daily life therefore the people have to know and learn about it.*
> *[…] They will give the idea, make some KAIZEN and changes, make the angle block, plan how to do it so they started to do the thinking process together. So if we had a problem why are the machining section is late they can start thinking about how speed-up the process. So after we create a program for them and the program will be able to speed-up the machining process and can save the cutter they feel so happy. Everyone will try to create their program and when one person can create a program successfully the other will be excited to do so.*
> *[…]Yes, about the problem because not everyone will face the same problem. Each person will face a different problem, so during the "beng kyu ki" session, we will share the problem, so it won't be a problem anymore in the future.*
> *[…]Internally we have weekly "beng kyu kai". "Beng kyu kai" is more to try to improve; the problem we face we shared in the group and look for the solution.*

Trial and Error

Based on the analysis, the least mention (coding reference) sub-node under conditional knowledge node is 'trial and error' however it is still an important mechanism to acquire conditional knowledge. In this research, 'trial and error' refers to the process of testing the new method to get the best results. Some of the respondents raised the importance of 'trial and error' in their learning process to use various new technologies in place:

> *[…] But for 3D we have to keep on trying...trial and errors, we have to use a lot of references, if we don't know anything we have to ask but for the feature; the features are kept on up-grade.*
> *[…] We still need to have a lot of trials and error. We have to look at the mechanical movement and other things that are still in the learning stage.*

In this study, knowledge is divided into three clusters including declarative or knowing-how knowledge, procedural or knowing-how knowledge, and conditional knowledge. Results of the study found that basic training, intellectual capital, pre-departure training, and instructor manual are the mechanisms used to acquire declarative or knowing-what knowledge. Mechanisms used to acquire procedural or knowing-how knowledge are external OJT, hiring of external experts, related working experience, local training, benchmarking, and personal observation. Finally, conditional knowledge is acquired through continuous improvement, learning by doing, project review, and trial and error.

V. CONCLUSION

The objective of this study is to explore knowledge acquisition mechanisms during the new technology implementation process of Malaysia's automotive engineering support industry. [37] defined knowledge acquisition as the development or creation of skills, insights, and relationships. The mechanisms for knowledge mechanisms in this study were further classified based on the types of knowledge involved i.e. declarative knowledge, procedural knowledge, and conditional knowledge. According to [25, 45] declarative knowledge which is also known as knowing-what consists of factual information, whilst procedural knowledge or knowing-how refer to a compilation of declarative knowledge which is dedicated to a functional unit, whereas conditional knowledge defined as the individual understanding of when and where to look for or to apply specific procedures.

Interestingly, the results of this study found that among the knowledge acquisition mechanisms for declarative knowledge are basic training, intellectual capital, pre-departure training, and instructor manual. Secondly, the knowledge acquisition mechanisms for procedure knowledge includes external OJT, hiring of an external expert, the staff related working experience, attending local training, benchmarking activity, and personal observation. Finally, the knowledge acquisition mechanisms for conditional knowledge include continuous improvement, learning by doing, project review, and trial and error.

The findings of this study hopes to add to the growing body of evidence that would significantly contribute to the body of knowledge in the organizational learning field particularly in terms of the knowledge acquisition process during new technology implementation. This illustrates one of many possible applications of the knowledge acquisition process related to organizational change due to new technology implementation. Despite the success demonstrated, a significant limitation is data for this study only limited to two engineering support industries for the automotive parts and components sector. Further work is foreseen also includes an extensive study on a larger number of companies in the automotive tooling industry.

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