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Impelling Innovation at a Canadian Automotive Plant

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Abstract

In industrialized countries manufacturing firms are facing significant change resulting from mass customization, shortening product life cycles, increasing technological change, and the entry of international competitors into their markets as witnessed by the automotive and electronics industries. 'Process Innovation' is one of the key areas where innovation is exigent. It pertains to finding better or more efficient ways of producing existing products, or delivering existing services. Making innovation a ubiquitous capability in manufacturing is fundamentally a leadership challenge. It needs a tangible organizational infrastructure that makes managers accountable at all levels for driving, facilitating, and embedding the innovation process into every part of the culture. This paper construes the process of 'impelling and managing innovation' at an automotive metal stamping plant in Canada, during the 2007-2009 financial crises in North America. The paper discusses the processes, psychological and physical environment, organisational culture, economic climate, and program content; rationale, significance and denouement. The paper concludes that idea management systems don't replace traditional departments and processes involved in new services, products, or strategies. They serve as an adjunct to them and provide a framework that can help organizations turn innovation into an enterprise-wide discipline-and a sustainable process that drives growth in good times and bad. Auto industry is going to remain important, for local, regional and national economies, as well as for the future of the planet if ecologically sustainable transport systems are to be developed; it will, no doubt, remain an important topic in academia.

Key Words: Process Innovation, Suggestion System, Manufacturing, Metal Stamping, Automotive Plant

1. Introduction

Looking back over the 20th century, one may regard the auto industry as a metaphor for capitalist development. The 20th century was dominated by the development and roll-out, globally, of mass production and consumption, described as the 'first revolution' in auto production; with large factories and Taylorist regulation of assembly-line speeds and techniques. That whole era, covering the first 80 years of the century, was often referred to as the era of 'Fordism', after Henry Ford's first production-line factory (Womack *et al.,* 1990). Much of this 'post-Fordist' literature was rather superficial, not least in its parochial view that developments in the industrialized economies typified a global development, whereas if anything the opposite was the case. To the extent that the large factories in Western Europe and North America were giving way to smaller scale facilities and service provision, this was mirrored by the rise of mass production in the less developed countries (Costello *et al*., 1989). In terms of production technologies, post-Fordism refers to the sort of lean production, just in time processes applied in Japanese industry, and in particular, Toyota production systems: again, it was indeed an auto company that appeared to exemplify this socio-historical–geographic shift, or 'second revolution' (Womack *et al.,* 1990). Since the mid-1990s, a so-called 'third revolution' has centred on improvements in flexibility, with implications for product creation, design, and manufacturing and life cycle (David *et al*.*,* 2010).

Though the Original Equipment Manufacturers (OEMs) currently prefer to locate near the final market, they have shifted assembly operations towards low-cost locations within major trade blocs—towards central and Eastern for example, within the EU. Similarly, in the USA, there has been a shift southwards and to Mexico, with auto production now located primarily in the 'auto-valley' (Klier & Rubenstein, 2010). This was driven by the of the 'Big Three' (GM, Ford, and Chrysler) producers and the setting up of transplant plants by foreign firms. The result has been a division of auto-valley into two subareas, a northern area dominated by the ‘Big Three’ and a area dominated by foreign-owned carmakers (David *et al.,* 2010).

The global financial crisis had dramatic impact on auto manufacturing worldwide. However, these were felt uniquely severely in North America, largely because of its asymmetric position within the geography of automotive globalization. North American automakers were already fragile due to one-way trade and foreign direct investment inflows. This history also shaped the nature of the North American policy response. Unlike other jurisdictions, North American governments needed to save leading regional producers from liquidation. Moreover, this rescue took on a unique anti-union tone, through government-mandated renegotiation of labour contracts. The measures taken in North America, while dramatic, are unlikely to resolve the continental industry's deeper structural weaknesses (Stanford, 2010). Financial crisis can be seen as laying bare a range of pre-existing vulnerabilities in the auto industry. Indeed, even before the global financial crisis unfolded, the ‘Big Three’ North American OEMs ran up total net losses of over $100 billion between 2005 and 2008, exhausting their equity base and questioning their viability (Stanford, 2010). In addition, the Big Threes’ efforts at generating profits before the crisis through ‘financialization’ strategies—in effect ‘auto banks’ financing sales, leasing and derivatives operations exposed them to an additional set of risks when faced with a ‘double whammy’ of shocks on both the financial and industrial side (Freyssenet & Jetin, 2009).

2. Magna International and Beta Auto Stamping Plant

Magna International is the most diversified automotive supplier in the world; they design, develop and manufacture automotive systems, assemblies, modules and components, and engineer and assemble complete vehicles, primarily for sale to OEMs of cars and light trucks in three geographic segments - North America, Europe, and Rest of World (primarily Asia, South America and Africa). They have 286 manufacturing operations and 88 product development, engineering and sales centers in 26 countries on five continents (Magna, 2012). Though Magna International had a healthy balance sheet and an adequate cash flow, it was still susceptible to financial volatilities that had gripped the automotive sector. Being the preferred ‘tier 1’ supplier to most auto OEMs, Magna was not immune to afflictions of the prominent OEMs including the ‘Big Three’; GM, Ford, and Chrysler.

These were desperate times for the North American automotive sector; with downsizing and plant closures, Magna initiated drastic cuts across the board. Beta plant, though profitable, was also handed over drastic budget cuts and its management was told to do more with less or else face plant closure; some of Beta’s equipment was already in transit to the ‘auto-valley’ in the south. Beta Industries, employing fewer than two hundred, is a small, automotive, metal stamping facility in southern Canada. It is tier-1 supplier of structural metal stampings to auto OEMs. Beta’s equipment comprised of eight 400-800 tons capacity mechanical stamping presses and several automated robot assembly units. 1500 ton capacity, mechanical stamping press (referred as ‘Press’ later in the article) was an exception; this was a newer press added to this 25 year old plant in 2005. In order to accommodate the five stories high Press, plant’s roof height had to be raised from 60 to 100 feet and the west side wall had to be knocked down to rig it in. This Press provided sixty percent of Beta plant’s revenues.

2.1 Metal Stamping

Progressive stamping is a metalworking method that can encompass: Blanking; Punching; Coining; Bending; Perforating; Piercing; Notching; Lancing; Embossing; and several other ways of modifying metal raw material, combined with an automatic feeding system. The feeding system pushes a strip of metal (as it unrolls from a coil) through all of the stations of a progressive stamping die. Each station performs one or more operations until a finished part is made. The final station is a cut off operation, which separates the finished part from the carrying web. The carrying web, along with metal that is punched away in previous operations, is treated as scrap metal. The progressive stamping die is placed into a reciprocating stamping press. As the press moves up, the top die moves with it, which allows the material to feed. When the press moves down, the die closes and performs the stamping operation. With each stroke of the press, a completed part is removed from the die. Since additional work is done in each "station" of the die, it is important that the strip be advanced very precisely so that it aligns within a few thousandths of an inch as it moves from station to station. Bullet shaped or conical "pilots" enter previously pierced round holes in the strip to assure this alignment since the feeding mechanism usually cannot provide the necessary precision in feed length (MetalForm, 2012).

TPM was actively implemented at Beta plant; in particular, the autonomous maintenance was contributing significantly to the efficient and profitable manufacturing operations. However, in these hard times the Just in Time (JIT) strategy was hurting Beta’s performance. Ever smaller badges of parts ordered by OEMs were placing tremendous pressure on the operational efficiency of the plant. JIT gains were hitting the law of diminishing returns

(Samuelson & Nordhaus, 2001). With 10-12, 50 minute long, die changeovers per day, the operational availability of Press had dropped below 60 percent. It was crucial for Beta management to promptly address this issue, a question of survival. For deliverance, Beta management turned to its most valuable asset, its workforce; through impelling innovative explications.

3. The Innovation Imperative

Innovation is the creation of better or more effective products, processes, services, technologies, or ideas that are accepted by markets, governments, and society. It involves deliberate application of information, imagination, and initiative in deriving greater or different value from resources, and encompasses all processes by which new ideas are generated and converted into useful products. In business, innovation often results from the application of a scientific or technical idea in decreasing the gap between the needs or expectations of the customers and the performance of a company's products. To be called an innovation, an idea must be replicable at an economical cost and must satisfy a specific need (Smith, 2005); end-user innovation is, by far, the most important and critical. Innovation in manufacturing covers wide areas including, but not limited to, the introduction of new processes, practices, technology, equipment, and new materials. Businesses, with proactive or reactive approach, could resort to innovation in manufacturing for several reasons. In addition to productivity and quality gains, innovation also results in improved responsiveness to customer demands, lower turnaround times, reduced waste levels and downtime, higher product quality, better designed products, capacity for a wider product range, and streamlined relationships with suppliers and customers (Udhas, 2007).

There isn't a business that doesn't want to be more creative in its thinking. An established company which, in an age demanding innovation, is not capable of innovation is doomed to decline and face extinction (Smith, 2005). Innovations had better be capable of being started small, requiring at first little money, few people, and only a small limited market (Drucker, 2007). The single most important factor, to igniting creativity, joy, trust, and productivity among employees is a sense of making progress on meaningful work. However, creating an environment that fosters progress necessitates a careful effort. Despite resource-constraints an organization managers can help employees see the meaning in their work. People have to understand what they're doing and why; it's important that the goals be reachable in a realistic time frame-owing to the idea of small wins. People need to know what goal they're trying to reach, but they have to have autonomy in order to get there; it's a delicate balance. People should understand what their mission is. However, micromanaging them shuts down their creative thinking and the value of their unique talents, expertise, and perspectives is lost (Nobel, 2011).

At Beta plant, 'Process Innovation' is one of the key areas where innovation is exigent. It pertains, primarily, to finding better or more efficient ways of producing existing products. Steady incremental innovations made by employees every day give an organization the sustained growth it needs. Sustained innovation comes from developing a collective sense of purpose, from unleashing the creativity of people throughout the organization and from teaching them how to recognize unconventional opportunities. Incremental innovation evolves within a known framework according to the rules of "systematic design" (Karlsberg & Adler, 2005). Innovation based on process need is perfecting a process that already exists, replacing a link that is weak, or supplying a link that's missing (Drucker *et al.*, 2008). Making innovation a ubiquitous capability in manufacturing is fundamentally a leadership challenge. It needs a tangible organizational infrastructure that makes managers accountable at all levels for driving, facilitating, and embedding the innovation process into every part of the culture. Corporate culture has the most important role in the development of innovation (Tellis, Prahbu & Chandy, 2009). Embedded innovative culture in Magna's workforce afforded unprecedented success to the last 50 years of its superb performance. Beta plant was the vanguard of innovative achievements in Magna's group of companies.

4. The Challenge: To Minimize Die Changeover Time

This was an extraordinary goal. Besides, reducing the number of die changeovers, the challenge was to curtail the die changeover time by 75 percent, demitting it to 12 minutes, or lower. The daunting question facing the 'Die Improvement Steering Committee' (DISCO), and Beta plant employees was "how to reduce the die changeover time by 75%, in two suggested phases, each targeting a reduction of 50 percent, while keeping rest of the plants' business running as usual?" DISCO comprised of professionals from production, quality assurance, engineering & design, & die, maintenance, finance, customer relations and sales. For tapping into creativity pool of plant employees, decided to launch the, tried and tested, suggestion system; it also adopted '50-50', a suggested acronym, for two time reduction process targeting 50 percent reduction at each stage. Both the acronyms, 'DISCO' and '50-50', corroborated to be catchy and infatuating. It is essential to choose captivating names for the suggestion system that people, ideas and innovation could be associated with. It should be "smooth on the tongue", not too long and easy to handle in publicity. Employees must have a conceptual understanding of the system and the name linked to it (Buchanan & Badham, 2008).

Inadvertently, DISCO's two phase, 50-50, approach, somewhat, mimicked 'phase-gate process; it is a project management technique in which an initiative or project (e.g., new product development, process improvement, business change) is divided into stages (or phases) separated by gates. At each gate, the continuation of the process is decided by, typically, a manager or a steering committee. The decision is based on the information available at the time, including the business case, risk analysis, and availability of necessary resources including money and personnel with appropriate competencies (Cooper, 1986; Hine & Kapeleris, 2006).

5. Suggestion System: An Effective Tool for Idea Management

Creativity is a basic human capability. Employees have ideas regardless of whether or not the environment is conducive but the employee will not submit them if the environment is not seen as supportive (Fairbank and Williams, 2001; Stone, 2008). However, in a civilized society, ideas cannot be forced out of people, they themselves need to volunteer them (Pluskowski, 2002). Suggestion systems primarily consist of administrative procedures and infrastructure for collecting, judging and compensating ideas, which are conceived by the employees of the organization (Van Dijk & Van Den, 2002). In addition, suggestion systems have the capability of being all inclusive by being able to focus on capturing ideas from all workers, and not just ideas from identified few smart ones (Fairbank & Williams, 2001).

It is the creativity of employees that forms a source of new ideas, a starting point for innovations; capitalization, involves the transfer of these ideas into innovation. From a perspective of knowledge development and diffusion in the firm, suggestion systems aim at capturing good ideas, the first part of the 'knowledge brokering cycle' (Hardagon & Sutton, 2000). The importance of feedback to employees must not be underestimated. There is a correlation between the number of suggestions submitted and the time taken to give feedback to the suggestor (Du Plessis & Paine, 2007). Two discouraging elements in the suggestion system are the length of time taken to evaluate a suggestion, and the delay in recognition through, sometimes, poor communication channels. The longer the time to give feedback and recognition, the fewer the suggestions submitted (Nel, 2008).The success of the suggestion system depends in the organisation's commitment and involvement, proper policies, procedures and rules, affective administration and process, objective evaluation of ideas and a fair recognition or rewarding system.

A common aim of a suggestion system is to achieve greater employee involvement which eventually leads to greater tangible benefits. Suggestion system should be integrated with the organisation culture (Crail, 2006; Darragh-Jeromos, 2005; Hamel, 2000).

Organisational culture is the pattern of basic assumptions, values, norms and artefacts (the highest level of cultural awareness) shared by the organisation's members (Waddell, Cummings & Worley, 2007). Corporate culture has the most important role in the development of innovation. It plays an important role in the attitude and behaviour of employees and is also an important consideration for recognition (Tellis, Prahbu & Chandy, 2009; Du Plessis, 2007). At Beta plant employees were afforded encouragement, organizational support and committed resources. These have the most direct influence on idea extraction, idea landing, and idea follow up, as avouched by the 'Creativity Transformational Model' which encompasses the main factors that influence the functioning of suggestion systems (Dijk & Ende, 2002).

Suggestion system guidelines were provided to the employees that aimed to answer the six fundamental questions: why were the creative ideas being asked for; what type of ideas were being looked for; who could submit the ideas; how to submit the ideas; how the ideas would be evaluated; and what would happen when the ideas are accepted. Employees were made aware of the award system for accepted suggestions. Recognition and rewards are linked to the psychological contract. Employees want to be recognised or awarded for their efforts and achievements under the psychological contract, if their suggestions are accepted (Holland, Sheehan, Donohue & Pyman, 2007). It is through involving various stakeholder constituencies from the onset of the initiative, creating ideas, the pre-implementation stage, and during the diagnoses of generating ideas that psychological ownership for the suggestion program is established (Van Tonder, 2006). Methods to generate ideas should be clear, straight forward and open to all participants, teams and individuals.

Press operators along other production employees were encouraged to consult maintenance and tooling technicians ensure technical viability of their ideas. This provided them the much needed assurance that their ideas were and doable. Suggestion Boxes were kept available at strategic locations for four weeks and every employee had easy access to them. Suggestion boxes were placed in production facilities, corridors and cafeteria, providing a cost-effective means of collecting paper-based suggestions. Their importance as a tool for collecting suggestions is immeasurable (Du Plessis & Marx, 2009). Suggestion boxes allow a wide range of employees to make their contributions, especially if they do not have access to computers. Despite four weeks of cut off time for submitting, suggestions deposited by the employees were collected every week. DISCO, at their weekly meetings evaluated the suggestions, the posted results showed which suggestions had merit for further assessment and eventual implementation. Some of the suggestions did not directly impact the die changeover time, nevertheless, helped to Beta manufacturing operations proficient and safer. Toyota launched their 'Creative Idea Suggestion System' in 1951. It was largely a copy of suggestion systems that were in place in U.S. companies at the time, namely the Ford Motor Company. Toyota made some notable innovations to it over the years, but most importantly, they stuck to it. The suggestion system is one aspect of a Lean management system and is embedded in the TPM axioms.

5.1 Suggestion Analysis and Implementation: A Short Cut via Experimentation

Senge, De Bono, Basadur, IDEO, Christenson's 'Strategos' and Hamel's 'Innosight', each supplies a distinct component of the operating system for innovation; thinking tools, work practices, culture, market analysis, strategy, education, training and knowledge management. However, experimentation, simulation, discovering options, evaluating alternatives and problem solving, all these exist at the heart of innovation in virtually every discipline (Smith, 2005).

At DISCO meetings, the innovation process, was a blend of methodology, work practice, culture and infrastructure, and analysis method that was guided by five maxims**;** one conversation at a time, stay focused on the topic, encourage wild ideas, defer judgment, and build on the ideas of others. Beta plant innovators solved problems by focussing upon the useful parameters of a system that, if increased, would enhance it substantially, but also, the harmful aspects that, if left unchecked, would lead to a contradiction. Contradictions are significant, for if eradicated or reduced, directly or indirectly, they contribute to the development of a breakthrough solution. Avoiding compromise is central to innovation. Tradeoffs; strength versus weight, reliability versus cost, service quality versus resource and output versus input, are not the same as an inventive solution that creates new value. Inventive solutions emerge by exploiting useful effects and eliminating harmful effects (Smith, 2005).

Problem solving is a generic skill and can be applied across many different domains. Teams solve problems with science guided experiments that lead to valuable innovations using systematic methodologies. Examples include: the Theory of Constraints (TOC); Critical Chain; Design for Six Sigma (DFSS); Quality Function Deployment (QFD); and the Taguchi Method. To these plethora of strategies is now added something that may be a way of thinking, a set of tools, a methodology, a process, a theory or even possibly a deep science, but which may be gradually shaping up as 'the next big thing.' It's called TRIZ, pronounced 'trees' and is an acronym for the Russian words that translate as "The Theory of Inventive Problem Solving" (Smith, 2005). At Beta plant TRIZ axioms are, ubiquitously, applied in daily operations. TRIZ is the brainchild of Russian scientist and engineer Genrich Altshuller. In TRIZ, learning on the job is a good thing, not a shortcut. TRIZ cannot be studied in any meaningful way unless it is applied to solve problem. To get a sense of TRIZ, think of the theory of constraints but taken to the extreme. TRIZ has been applied in the solution of thousands of such problems, from improving truck fenders at Ford to optimal planning of complex production lines and processes in the oil and fuel industry at AMOCO (Smith, 2005).

DISCO's preliminary meetings availed of de Bono's 'lateral thinking' and adopted his 'Six Thinking Hats' strategy. The term is also used to describe the tool for group discussion and individual thinking. Each hat has a different meaning. Combined with the idea of parallel thinking which is associated with it, the thinking hat tool provides a means for groups to think together more effectively, and a means to plan thinking processes in a detailed and cohesive way (Birdi, 2005). Because everyone is focused on a particular approach at any one time, the group tends to be more collaborative than if one person is reacting emotionally (Red hat) while another person is trying to be objective (White hat) and still another person is being critical of the points which emerge from the discussion (Black hat). Using a variety of approaches within thinking and problem solving allows the issue to be addressed from a variety of angles (de Bono, 1985).

It is not possible to manage what you cannot control and you cannot control what you cannot measure (Drucker, Preliminary die changeover stop-watch data revealed that the average time being taken for die changeover was 50 minutes, time on hand between last part off to first part off the Press. Bulk of the time was spent in removal of the coil, setting up the new, and getting the first part off press. Rest of the time was spent swapping and securing the die and setting up lube lines and spray nozzles. DISCO decided to implement its, two phase '50-50' improvement plan. Workable suggestions were specifically articulated, for the 1st phase, in three areas considering time expended; material coil set up, die swap, and lube lines connections. 1st phase '50-50' target was to bring the die changeover to 25 minutes. Details, of the amount of resources and time expended at each step involving die change over were lucidly recorded. This was in addition to the auto-recording of working of the Press and was critical in finding out at what stage the operation was in. Apart from four weeks dedicated to suggestion collection and selection process; DISCO allocated four weeks, each, for 1st and 2nd phase. This allocation included one week, each, for phase end assessment. Entire project was spread over 12 weeks. First and foremost, Job runs were consolidated and with successful negotiations with OEM customers, the number of die changeovers was curtailed to 7-8 per day, three Focus now shifted to reduce die changeover time, synchronic on all three segments; coil change, die swap, and lube line settings.

6. Realizing 1st Phase - Progression

With last part off the press, lube lines were disconnected; carrying web was severed from the partial coil strip, dislodged from the die, and moved to the nearby scrap bin. Operator, using standby 30 ton crane, unloaded the partial coil and placed it in the coil loading/unloading spot to be strapped. Picked up the new coil and loaded it onto coil dispenser's mandrel, ready to be fed to the die for next run. Strapped partial coil was then dropped in the coil bay for storage, and the coil for the next run was brought in and placed in the coil loading/unloading spot. Die was closed - 'shut'; newly installed 'quick' hydraulic die clamps helped to isolate the die from the press and bolster was ready to be rolled out. Operators, pushed the operating platform out, used new, hand held, 'Magnetic Sweepers' to clear the bolster rails of metal scrap and rolled the bolster out. Bolster weight would flatten, thin, the scrap slugs, if left on the rail, altering the shut height in the next run. Though removal of the last run die, from the bolster, did not affect the die changeover time, nevertheless, afforded more time for next die inspection. New, 'Hydraulic Roller Die Lifters' facilitated die lift. These lifters required a force of approximately one percent of die weight to move the die.

While the north bolster was being rolled out, the south bolster, with new die in place, rolled in. Embedded lube lines were already connected to the lower part of the 'quick connect' lube line distribution block; ready to be coupled with the upper part of the 'block' that held the main lube supply lines. The centerline of the pilots in the progressive die runs parallel with the coil feed direction. To ensure smooth feed, tooling technicians ensured that the edge of the new coil was in alignment with the side rail of the die. Precision key stock, which fit in both the die and bolster, are used for die alignment; the die must be parallel to the coil feeder. These activities were carried out in the pre-staging time. A dedicated die-setter along a tooling technician worked on the die. Die was aligned with the bolster, flexible lube lines adjusted and connectors verified, and the snap-on lube block was pre-tested for hook-up. A, new, custom made pressure washer was installed in the mobile die wash station. It ensured that a washed, clean, die was available for transfer to the bolster; part of pre-staging operation.

6.1 Die and Feed Setup

Setting Feed Line Height - To keep the feeding material straight and flat, tooling technicians ensured the feed line height was set correctly for the die's feeding level and material was properly fed up to the correct first-hit line. It is critical as most die damage occurs when material is introduced into the die. Starting strip in the wrong location could result in half-cut or -formed parts or unnecessary loose scrap; cutting less than half of a hole or forming less than half of a part will result in unbalanced forces in the tool, resulting in poor die alignment, shearing, or severe die damage. Both the lower and upper dies, after each hit and progression, were inspected and all loose scrap was manually removed. Small pieces of scrap often have a tendency to stick to the faces of cutting punches, pads, and strippers; failing to remove loose scrap in the die results in double metal thickness being fed through it causing severe die damage.

After setting the feed line height, tooling technicians set the 'Pilot Release'. The pilot release function on a coil allows the strip being fed into the die to be released so that the pilots in the die can properly locate and register the in the die. For the pilots to position the strip correctly, the feed rollers must unclamp the strip before full pilot entry. The feed release must be timed so that the bullet nose of the pilot enters the strip but the full pilot diameter does not. When this point is established, degrees on the press's stroke are noted and the pilot release is set to let go of the strip this point. Pilot release is programmed or adjusted so that the material or strip remains fully unclamped until all of work has been performed in the die and the strip has been brought back up to the feed line height. When the strip is feeding level, the feed rollers can clamp the strip and feed it forward one progression. This procedure is critical, especially for progressive dies that are making deep-drawn parts and require a great deal of vertical lift to feed

Incorrect setup of the feed release can cause: miss-feed; elongation of the pilot holes in the strip; bent, broken, or pilots; and poor part location and gauging.

Final Shut Height Calibration - With the die fully loaded, final press's shut height was calibrated, primarily because presses deflect when loaded with a great deal of force. Tooling technicians, at this stage, ensured all scrap removal methods such as slug belts and shakers were in place and functioning properly; gas springs and manifolds were fully charged to the recommended level; all lubrication methods were in place and functioning properly; and die inspected before and after running - check for loose dowels, screws, and debris. Press was run manually to get first part off, part specs were verified and the tooling and quality assurance technicians' signed off the start of production run. Newly installed, better die cushions, aided the process.

Overall time for each die changeover was recorded over three weeks. Individual and overlapping die changeover activities were also timed and data was logged in computer for final tally. Plant employees were rewarded, die changeover time averaged 20 minutes; better than the set target of 25 minutes. However, bulk of the time was still being taken by the coil change. It was time to, critically, assess the 1st phase accomplishments and move to the 2nd.

7. Realizing 2nd Phase: Actualization

While 1st phase implementation was in progress, 2nd phase prelusive remodeling activities set the stage for 2nd phase negotiation. Newly, enlarged 'coil holding area' was re-arranged in two parts purveying to crane capacities; heavy coils were pre-staged in the western side of the coil bay, closest to the Press feeding line, particularly for the higher ranges of strip thickness. Adjustable metal strip bed, equipped with quick clamps, helped secure the strip. Newly installed, ergonomic, laser guided, pneumatic nibbler, moved smoothly to afford a square cut. Its travel was well supported by the overhead guide rail and suspended air-hose caddy. Square cut strip coil was easier to strap, and feed the die in its next run, a time saver. Slug pulling problem was revisited. In case the slug pulls out of the matrix (button) and falls off the punch face, it might cause double metal to be introduced into the die, resulting in die shearing, broken punches, broken die steel, surface defects, and numerous other problems (Hedrick, 2004). Die shoe scrap holes and scrap removal chutes were modified. Occasionally, if the scrap holes or chutes' missed the operators' unclogging, the slugs, from the scrap cumulus, would slip into the tool causing double metal.

Steel tubing lube lines were embedded in all dies. Half nozzles were installed in the confined die spaces and snap on lube distribution blocks were installed at the lube lines die junction. To address its lubrication concerns in the plant, recently inaugurated 'Central Lube System' (CLS) was connected to press line. Beta plant's stamping press line runs the same lubricant, a synthetic mixed with water in two different compositions, one for light jobs and other for heavy. CLS ensured dies consistently receive well-lubricated parts and, therefore, won't prematurely wear. Programmable controllers were modified to include individual nozzle spray quantity control. Newly installed lube low pressure and low level alarm was connected to maintenance control desk/dispatch. With lube process automated, operator involvement was reduced to minimal. Downtime was reduced by 20%, for heavy gauge material. Overall, very little attention now was required of plant operators to the lubrication process and equipment. It is imperative to have dependable, repeatable lubricant application. Beta plant stamped as much as 1 million lb. of steel per week. Press at augmented line speed of 18 strokes per minute (SPM), at times, generated a lot of heat. Any lubrication failings could quickly lead to galling and other premature die-wear issues caused by overheating. However, experimentation of DC-53 tool steel, instead of D-2 for arduous die sections, tremendously improved die performance. Hourly consistency check of lube mix was also included in the modified stamping procedure and a Lube boundary film monitoring process was set up for critical points. CLS afforded 30% savings in lube cost (bought less) and substantial savings in disposal cost (environmental cost). DISCO team discovered seepage into the waste lube underground pit, rain water was getting in. This was discovered while monitoring the quantities consumed, there were noticeable dissimilarities among volumes in and out.

Projecting 2nd phase prelusive remodeling activities, a modified die-set up procedure was introduced that ensured no half-cuts and -forms were made causing the die to misalign and shear, there was no start-up scrap left in the die causing double metal to be introduced into the tool, and no pressure, stripper, and draw pads were half-loaded and/or unbalanced. Parallel activities pertaining to modification/fabrication of scrap chutes, installing lube lines and spray nozzles, did not subvert the die changeover time window. Given the time constraints, some of the work on dies was outsourced. Stamping job runs were assessed for quantity and frequency on JIT basis and each die was allocated a specific, marked, floor space. JIT bins arrival was re-organized. Bins, in which the Beta plant sent its parts to customers, were sent back; bins were customers' property.

Most needed spare parts were stored in proximity to the Press. Jigs for spec check were moved next to the Press work station. Vertical carousel storage for each die was sorted out and re-arranged. All pneumatic appliances and hoses for emergency use were lifted off the floor area surrounding press and elevated, retractable caddies were installed. Light weight pendent control units with boots were provided for Press operation. Newly installed laser pointers to position the die on bolster locator pins cinched the die setting operation. Light curtains were isolated from the press frame, lowering set up time. Reduced number of die changeovers extended run time and provided sufficient time to the die-setters and tooling techs for efficiently pre-staging die for the next run. It gave them ample time for inspection of: die plates (foundation for mounting die components); guide pins and bushings (align the upper and lower die shoe); heel blocks (contain wear plates to absorb side thrust); screws, dowels, and keys (to fasten and locate die components); stripper (pull metal off cutting punches); pressure (hold down metal in wipe bending process); draw pads (control metal flow during the drawing process); spools, shoulder bolts, and keepers (to fasten pads to the die shoes while allowing them to move up and down); retainers (hold the cutting-forming components' to upper and lower die plates); and springs (coil, urethane, or gas - supply the force needed to hold, strip, or form metal). Adjustments that emanated from these inspections, not only reduced, considerably, the time taken for 'first part off press'; it tremendously improved the, overall, dies' performance. Small incremental gains in time accumulated to substantial reduction in die changeover time.

Catwalk platforms were modified. Slimmer, upper part - the actual walkway, replaced with aluminum alloy expanded metal plates, rendered it considerably lighter while newly installed casters ensured its quick removal. Fitted with new magnetic sweepers, the catwalk while being hauled, picked up scrap pieces from the rails; making the bolster exit smoother and quicker. To ensure safe and secure coil storage, improved 'Roll-Blocks' were installed in the coil holding area for heavy coils. To enhance coil storage capacity, and for close stacking of coils, a motorized, C-hook was installed. C-hook is a, below the crane hook, vertical lifting device that enable operators to handle vertical coils in a safe, efficient, and economical manner. Its automatic latch assembly enhances efficiency by requiring just one person to operate it. With C-hook one operator could now, proficiently, position the heavy metal strip coil on de-coiler. C-hook use replaced slings and reduced end coil scrap. To avoid crane crash in an accidental load swing, beeping 'Proximity Sensors' were installed around north-east and south-east corners of the Press. Considering, 30 ton crane's availability, production runs were planned to accommodate die changes so that crane was not pre-occupied with any other job.

Additional lighting was added to focus on the problematic areas. Non vibrating light fixtures were added to illuminate die stations. Coil pre-feed check alarm was added. Banding apparatus was located close to the coil feed, inside the coil cage; and self locking, banding strip rolls dispensers were provided. In addition to the new coded buzzer system for, maintenance and tooling, service calls, dedicated tooling and maintenance technicians were at stand by – it reduced service call travel time. All the modifications and alterations paid off. Die changeover time, recorded over three weeks, averaged 10 minutes, right on target. However, bulk of the time was still being taken by the coil change. It was time to, critically, assess accomplishments of both, 1st and 2nd phase, and devise procedures that would help sustain this expeditious die changeover.

8. DENOUEMENT

A total of 72 suggestions were implemented during the entire program. 48 of the suggestions directly induced improvement in the die changeover time, 22 in the 1st and 26 in the 2nd phase; while remaining 24 suggestions, though not directly pertaining to die changeover, enhanced Beta plants' manufacturing operations and improved plants' safety. In DISCO's concluding meeting, all the process of impelling innovative ideas, suggestions system performance, number of suggestions solicited and implemented, were analysed. A workshop of 'lessons learned' was held and procedure for sustaining the die changeover improvements was formalized and adopted. For the future, the process was linked to the 'continuous improvement' strategy. As per Betas' rewards policy, all innovators whose suggestions were implemented were rewarded generously and fairly. It is essential for the firm's success to reward innovators for their contributions. At Magna, reward system is an important integrant in managing innovation. Although, appropriate, cultural values and norms are a powerful means of stimulating creativity and innovation; a system of prizes is the best possible mechanism for eliciting innovation, provided the size of the prize could be linked to the social value of the innovation (Price, 2007; Gallini and Scotchmer, 2001).

9. DISCUSSION

Whole process of effectuating innovations, from idea to reality, is fraught with applied theoretical underpinnings and TPM axioms. As the article progresses the reader would notice inter twined nature of real life situation where theories, models, and frameworks overlap and complement one another; the problem solver/innovator moves seamlessly from one domain to another in pursuit of solution.

Experimentation of tool steel DC-53 for arduous die sections, turned efficacious: because of the steel's ability to withstand compression and shock, die could make up to 5 times more hits, double to triple the tool life, 30% less machining time, much faster grinding time and 30% less downtime when used in progressive dies. The steel sharply reduced cracking and chipping and provided better hardness after heat treatment. Welding and general repair was much easier with DC-53 than with D-2 (Cummings, 2001). This, along with new die set up procedure, and modifications to the coil feed system, enabled press to make higher strokes - from 14 to 18 SPM.

Digital imaging of the repairs done by die technicians exposed various skill deficiencies. They needed training. A repair standard was introduced to verify the quality of repair done by the technicians and keep them abreast with the latest developments in die materials, manufacturing, and repair technologies. Consequently die repair procedures were standardized.

Managers should know when to compel silence and listen, and dispense the four nourishers necessary for a healthy inner work life; respect and recognition, encouragement, emotional support, and, finally, affiliation. Any action that serves to develop mutual trust, appreciation, and even affection among coworkers is conducive to affiliation. Companies that successfully foster an innovation culture design rewards that reinforce the culture they want to establish. Implementation of ideas creates synergies and opportunities for more ideas. Besides impeding progress, shifting goals can drain work of its meaning; when people perceive that their hard work will not amount to anything, they come to feel that they are wasting their time, and that their work is without value. Goals can shift for many reasons, but the consequences for inner work life are almost always negative (Amabile and Kramer, 2011).

Management cannot deliver the change on its own. The best source for the idea-generation and creativity needed for innovation is the team within the organization. The process of finding creative solutions is something that can be built into the culture of the organization. This is done by techniques, methods, workshops and a pervading attitude of encouragement for radical ideas. The innovation process involves the generation of many ideas in response to a given issue or challenge. Businesses that are fast to market carry out quick pilot tests rather than spending months in "paralysis by analysis" (Sloane, 2003). Tried-and-true methods such as suggestion systems that promote cost-saving ideas and continuous-improvement task forces that look to make processes more efficient, can certainly improve organization's bottom line. Innovation is not a one-time exercise. It involves continuous efforts in re-inventing the firm's products, services and processes in the light of market and technology developments. Sustained growth and profitability can be achieved through the integration of three critical levels; People, processes and tools (Constantinides, 2012)

10. CONCLUSION

Idea management systems do not replace traditional departments and processes involved in new services, products, or strategies. They serve as an adjunct to them and provide a framework that can help organizations turn innovation into an enterprise-wide discipline-and a sustainable process that drives growth in good times and bad (Tucker, 2003). Projects will always require a significant investment in materials, personnel, and adequate time; keeping projects resource-poor, will impede creativity. Employees will feel inhibited if they don't feel comfortable asking for support or, worse, if they feel that others are deliberately blocking necessary information from them. Solution through innovation is a learning process, from both failures and successes. Managers and co-workers should not punish or ridicule someone who tried and failed. Instead, the experience should be turned into a sense of progress; having learned something.

Innovation is a risk. Employees won't take risks unless they understand goals clearly, have a clear but flexible framework in which to operate and understand that failures are recognized as simply steps in the learning process. Auto industry is going to remain important, if ecologically sustainable transport systems are to be developed for local, regional and national economies, as well as for the future of the planet; it will, no doubt, remain an important topic in the academic literature (Bailey *et al.,* 2010).

REFERENCES

Amabile, T., and Kramer, S. (2011). *The Progress Principle: Using Small Wins to Ignite Joy, Engagement, and Creativity at Work*. Boston: Harvard Business Review Press.

Bailey, D., Clark, I., De Ruyter, A., "Private equity and the flight of the phoenix four: the collapse of MG Rover in the UK", Cambridge Journal of Regions, Economy and Society 2010; 3.

Birdi, K. S., 2005, “Evaluating the effectiveness of creativity training”, Journal of European Industrial Training, Vol. 29 No. 2, 2005, pp. 102-111, Emerald Group Publishing Limited

Buchanan, D. A., and Badham, R.J., (2008), *Power, Politics and Organisational Change*. Sage Publications, London.

Clegg, S., Kornberger, M., and Pitsis, T., 2008, “Managing Organisations”, Sage, London

Constantinides, C., 2012, “Product innovation: Unifying people, processes and tools”, retrieved from: http://www.innovationtools.com/Articles/EnterpriseDetails.asp?a=744

Cooper, R. G., 1986, Winning at New Products, Addison-Wesley. ISBN 978-0-201-13665-4.

Costello, N., Michie, J., Milne, S., 1989, “Beyond the Casino Economy”, London: Verso.

Crail, M., 2006, “Fresh Ideas from the Floor”, *Personnel Today*, June 20, 2006, pp.30

Cummings, C., 2001, Canadian Machinery and Metalworking, retrieved from: http://www.imsteel.com/pdf/is_it_tough_enough_for_you.pdf

Darragh-Jeromos, P., (2005), “A suggestion system that works for you”, *Super Vision,* Vol. 66, Issue 7, p. 18.

David B., de Ruyterb, A., Michiec, J., and Tylerd, P., 2010, “Global restructuring and the auto industry”, Cambridge Journal of Regions, Economy and Society, Volume 3, Issue 3, Pp. 311-318

de Bono, Edward (1985). Six Thinking Hats: An Essential Approach to Business Management. Little, Brown, & Company. ISBN 0316177911 (hardback) and 0316178314 (paperback).

Dijk, C. and Ende, J. 2002, “Suggestion systems: transferring employee creativity into practicable ideas”, R&D Management 32, 5, 2002, Blackwell Publishers Ltd., MA, USA

Drucker, P. F., (1994). The theory of business, *Harvard Business Review, September-October*.

Drucker, P. F., 2007, “Innovation and Entrepreneurship”, Butterworth-Heinemann, MA, USA

Drucker, P. F., Collins, J., Kotler, P., Kouzes, J., Rodin, J., Rangan, V. K., et al. (2008). The Five Most Important Questions You Will Ever Ask About your Organization, p. xix (2008), retrievable from: http://info.emeraldinsight.com/drucker/index.htm

Du Plessis, A. J., 2007, “Change, Organisational Development and Culture: Human Resource’s Role in a future SA”, International Review of Business Research Paper, 3(1), March: 1- 10

Du Plessis, A. J., Pain, S., (2007), Managing of Human Resources and Employment Relations in New Zealand’s Retail Industry, *The International Journal of Knowledge, Culture and Change Management,* 7(2): 83-91

Du Plessis, A., and Marx, A., 2009, “Suggestion system as perfect tool for entrepreneurs to be successful in New Zealand: some empirical evidence, ASGE New Zealand

Engelberger, J. F. (1982). Robotics in practice: Future capabilities. Electronic Servicing & Technology magazine.

Fairbank, J.F. and Williams, S.D. “Motivating Creativity & Enhancing Innovation through Employee Suggestion System Technology”, Creativity and Innovation Management, 10 (2): 68-74 (2001).

Freyssenet, M., Jetin, B., 2009, “Big Three: Le Piege de la ‘Liberalisation’ Salariale et Financiere se Referme”, La Lettre de GERPISA, January–March, 9–14.

Gallini, N., S. Scotchmer (2001) Intellectual Property: When is it the Best Incentive Mechanism?, Innovation Policy and the Economy, Vol. 2, p. 51-78.

Hamel, G. (2000) Leading the Revolution, Boston MA: Harvard Business School Press

Hardagon, A. and Sutton, R. I. (2000) Building an innovative factory. Harvard Business Review, 78, May-June, 157-166

Hedrick, A., 2004, “Eliminating slug pulling during piercing operations” retrieved from: http://www.thefabricator.com/article/toolanddie/eliminating-slug-pulling-during-piercing-operations

Hine, D., and Kapeleris, J., 2006, “Innovation and Entrepreneurship in Biotechnology, An International Perspective: Concepts, Theories and Cases”, Edward Elgar Publishing, p. 225, MA, USA, ISBN 978-1-84376-584-4.

Holland, P., Sheehan, C., Donohue, R., and Pyman, A., 2007, “Contemporary issues and challenges in HRM”, Tilde University Press, Australia

Klier T., and Rubenstein J., 2010, “The changing geography of North American motor vehicle production”, Cambridge Journal of Regions, Economy and Society: 3 (3); 311-318.

Magna, 2012, retrieved from: http://www.magna.com/about-magna

MetalForm, 2012, at: http://www.metalformingmagazine.com/magazine/article.asp?aid=5590

Nel, L., 2008, "The usefulness of corporate ethics programmes in integrating ethics into an organisation's culture", unpublished Master of International Communication Thesis, Unitec New Zealand

Nobel, C., 2011, "How Small Wins Unleash Creativity", Harvard Business School, Working Knowledge Paper Published: September 6, 2011

Pluskowski, B., 2002, "Dynamic Knowledge Systems", White Paper- 0602- 1 Imaginatik, available at: www. imaginatik. Com

Price, R. M. (2007) Infusing innovation into corporate culture, Organizational Dynamics, Vol. 36, no. 3, p. 320-328

Samuelson, P. A., and Nordhaus, W. D., Microeconomics. 17th ed. page 110. McGraw Hill 2001.

Sloane, P., 2003, "Innovation: Creating the best practices of tomorrow", retrieved from: http://www.innovationtools.com/Articles/EnterpriseDetails.asp?a=78

Smith, H., 2005, "What Innovation Is", A CSC White Paper, European Office of Technology and Innovation, retrieved from: http://www.ideationtriz.com/what_innovation_is-v25.pdf http://www.stage-gate.com/knowledge.php

Stanford, J., 2010, "The geography of auto globalization and the politics of auto bailouts", Cambridge Journal of Regions, Economy and Society, (2010) 3 (3): 383-405.

Stone, R. J., 2008, "Human resource management", 6th edition, John Wiley and Sons, Australia Ltd

Tellis, G. J., Prabhu, J. C., Chandy, R. K. (2009) Radical Innovation Across Nations: The Pre-eminence of Corporate Culture, Journal of Marketing, Vol. 73, p. 3–23.

Tucker, R. B., 2003, "Driving Growth Through Innovation: How Leading Firms Are Transforming Their Futures.", retrieved from: http://www.innovationtools.com/Articles/EnterpriseDetails.asp?a=75

Udhas, P., 2007, Innovation in Manufacturing, KPMG, India, retrieved from: http://www.kpmg.de/docs/innovation_in-manufacturing.pdf

Van Dijk, C. and Van Den Ende, J., 2002, "Suggestion Systems: Transferring Employee Creativity into Practicable Ideas", R&D Management, 32(5): 387-395.

Van Tonder, C. L., 2006, "Organisational Change", Van Schaik Publishers, Pretoria

Waddell, D. M., Cummings, G. T., and Worley, C. G., 2007, "Organisational Development and Change", Thomas, Melbourne, Australia

Womack, J. P., Jones, D. T., & Roos, D. (1990). The machine that changed the world. New York, NY: Rawson Associates

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