PROCESS IMPROVEMENT USING QUALITY TOOLS IN DISTRIBUTIVE SUBSIDIARIES OF ELECTRICPOWER INDUSTRY

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1. INTRODUCTION

Board of Directors of the Serbian Electric power Industry brought a decision at the end of 2005 to embark upon implementing Integrated Management Systems in all of its distributive subsidiaries. This is a chance for distributive subsidiaries to improve their business processes. Ongoing business processes offer enormous opportunities for simplification, reduction of cycle times, elimination of non valued added activities, optimization of resource usage, and reduction of costs of defects.

Process defects registered so far show that business processes are at the 3 sigma quality level, meaning that they produce 67.000 defects per million opportunities (DpMO). 3 sigma defect level extent leads to a loss of 25% to 40% of organization's gross income. On the other hand, processes at the 6 sigma quality level produce only 3.4 defects per million opportunities, which leads to losses of less than 1% of organization's gross income. A natural conclusion that pops up is that we are talking about enormous wasted funds that largely overwhelm overall human resources compensation.

This paper presents the process improvement methodology in the electric power distributive subsidiaries by implementing quality tools and methods. A process named: "Sale of Electric Power" will be presented as an example, and will help us understand the power of process mapping using software tool Visual Processes v2.0 .NET, usefulness of detecting "Vital Few" elements by applying the Pareto method (using Pareto Analysis v3.0 software tool), indispensability of detecting root causes using Ishikawa method (Ishikawa Diagram v3.0 .NET), as well as of reduction of variation by implementing Statistical Process Control (SPC v3.0) and control charts. Applied methodology allows organizations to initiate a journey towards the world class level, meaning towards excellence. Throughout the journey companies are capable of realizing highly noticeable Returns on Investment (ROI). There are numerous examples of companies that achieved ROI of even $350 per every single dollar invested in the initiative. The very same opportunities exist for the electric power distributive subsidiaries, and this paper has an aim to provide an overview of how to achieve benefits from them.

2. PROCSS MANAGEMENT

Practically all managers face challenges that need to be responded to:

- How to reduce costs of operations?
- How to reduce inefficiency and to better utilize investments in human and other capital?
- How to improve quality of products and services that my organization delivers?
- How to become more flexible in today's business environment?
- How to establish excellent business processes in my organization?
- How to become more responsive towards my partners, customers, and employees?

The answer to all these questions lies in business process improvement. Process improvement leads to reduction of defects, improvement of human and other resource management activities, improvement of IT system, and ultimately to increase in profits. This further helps managers to achieve real advancements in the business conduct approaches, to realize the mission, and to move in the direction of bringing the vision closer to reality. It was Deming, the biggest quality guru of the 20th century (responsible for the Japanese miracle), who summarized these principles in his book: "The New Economics", published in 1993. The major goal of Deming's book was to **help experts living under the tyrant regime of the mainstream management approach, to initiate process improvement efforts thought process management, and alter the existing management stile** (Deming, 1).

As a part of their efforts to conduct the change and improve quality, some leaders rely on problem solving. Extensive reliance on problem solving is usually followed by urgent actions realized by assigning duties to associates. This is the case when managers say to their subordinates to "work as they think is appropriate", without concrete changes and resource controls. What remains is the hope that these isolated efforts will be combined to achieve a critical quality improvement. Such an approach mainly relies on luck, but not on leadership.

Due to existing management attitudes that do not promote multifunctional thinking, it is usually assumed that one activity, or one activity characteristic, adds critical substance to product/service quality. Such an assumption neglects the impact of any preceding activity, as well as of any subsequent activity. It means that it misses the chance to perceive the whole extended system, and process interactions within it.

In order for management to initiate process improvement efforts, they first need to understand that company processes are "ill", that they contain "viruses" – special and general variation causes. The best way to grasp "a big picture" is to establish a process map. Process map is a tool used to depict the process flow from its beginning, until the very end. Process map is a diagram comprised of standard graphical symbols mutually interconnected. Each symbol represents a process step, whereas connections depict order of their execution.

All managers know that people may become ill. In order to cure them, a doctor or a team of doctors has to establish a diagnosis and prescribe therapy and medicines. During the establishment of the diagnosis doctors need to conduct certain analyses based on existing information, but not based on their intuition.

The very same scenario can be applied for processes. Managers need to form a team of experts that poses knowledge and skills to diagnose the process, to measure Critical to Quality Characteristics, to identify causes and propose corrective actions that will lead to process improvement. All these sound reasonable. However, what remains open is whether responsible managers have the same perception of the things. Mostly it is not the case. They are obsessed with other problems and do not see where enormous opportunities for improvement of the "health of the organization" are located. Therefore, one needs to show them the opportunities. In what follows we tried to depict the opportunities in electric power distributive subsidiaries though an example of one of their core processes.

1. Process improvement in electric power distributive organizations can achieve great financial results that come as a result of decrease and elimination of defects, shortened cycle process execution cycle times, and optimization of usage of material resources.

   An example can illustrate the statements from the paragraph above. Throughout the process "Sale of Electric Power" organizations officially register a thousand of reclamations per month. Feigenbaum, another quality guru, pointed out a long time ago that one should multiply information from the official registries three to five times, since this is the approximate number of customers that do not complain for existing miscalculations or alternative defects. However, if they have an alternative they move to another supplier (Feigenbaum, 2). If we go in line with the Feigenbaum's way of thinking, we end up with 4,000 reclamations in the "Sale of Electric Power" process. For checking and acting on reclamation many person hours need to be invested, electricity usage consumption level re-checked, possible mismatch eliminated and re-entered in the information system, a bill needs to be re-printed and distributed again. Process improvement teams in some of the distributive subsidiaries in Serbia estimated that costs of a single defect/reclamation go up to 400 to 600 dinars. If we assume a reclamation costs 500 dinars, (and neglect vested time by the person who re-checks the consumption level outside on the location) we end up with the conclusion that a monthly cost of reclamations in a distributive subsidiary with 100.000 customers is approximately (4.000 x 500) 2.000.000 dinars. Annually it would be 24 million. If we do not want to accept Feigenbaum's conclusions and guidelines regarding official numbers, the overall cost of registered reclamations would be 6.000.000.

   Furthermore, if Serbian Electric Power Industry has three million customers, it means that costs of reclamations in one distributive subsidiary with 100.000 customers need to be multiplied by 30. The overall cost of poor quality that we arrive at, for the whole company, goes up to (30 x 24) 720 million dinars (the official, registered version equals to (30x6) 180 million), which is more than 8 and 2 million euros, respectively. It is quite obvious that we are talking about funds that the company needs to "collect with spoons" and invest in different programs or initiatives – increase of salaries, equipment modernization, or alternatively.

2. It seems that today is the very moment for top management to collect the funds we elaborated on in the paragraph above, since distributive subsidiaries are already deep in the process of implementing Integrated Management Systems. As Integrated Management Systems dwell on the process model, it is an outstanding opportunity to map processes, "clean them up", and improve, in order to eliminate root causes that lead to errors and defects.

3. By doing so, top management will realize its strategic goal assigned by Board of Directors and will simultaneously collect money "that floods" from processes that aren't systematically organized.

4. Realizing process improvement process in Serbian Electric Power Industry poses no risk. Process improvement teams are already in place. Organization needs no additional cadre, whereas the project playability is guaranteed.

The question is why organizations do not embark upon realizing such initiatives and achieving obvious benefits. The answer lies in inability to fulfill three process improvement program characteristics.

1. Involvement of senior management and cooperation in the direction of changing organizational culture thought the specific information exchange. For achieving the largest effect, management needs to explain, validate, and encourage improvement efforts. At the same time, in order to collect and ensure collaboration, people in the organization need to be informed by the top management about the usefulness that process improvement activities bring, as well as about the negative implications if the change does not take place.

2. The second critical issue is to select the core process for improvement. Core process is a process that largely impacts the customer and brings substantial share of profits to the company. In the distributive subsidiaries it was relatively easy to figure out that the "Sale of

Electric Power" process is a core process. Therefore, we decided to use it as a guideline for this paper.

3. The third source of defects lies in business inability, resistance, or unwillingness to define the current state of the process before acting on arriving at the preferred state of the process – Six Sigma quality level process. "Sale of Electric Power" has a potential to arrive at Six Sigma quality level, meaning to make only 3.4 defects per million opportunities. It further means that losses of such a process would be less than 1% of the company's gross income, compared to the current state where these losses can go over 20%.

3. CORE PROCESS – "SALE OF ELECTRIC POWER"

The first step in the process improvement direction is process mapping based on the (Supplier Input Process Output Customer) SIPOC model (Stoiljković, 3). This step allows organizations to get the process model as a graphical representation of the information and materials flow throughout the business. Each and every activity is a part of the process and as such it can be modelled, simulated, and improved.

For process modelling purposes CIM College d.o.o. developed software tool Visual Processes v2.0 .NET. The first version of the software was developed eight years ago, whereas the latest version fully relies on the innovative .NET technology (4). Using Visual Processes v2.0 .NET consultants from CIM College d.o.o. mapped the "Sale of Electric Power" process in five different distributive subsidiaries with 110.000 to 700.000 customers. In each and every subsidiary we formed "Sale of Electric Power" process improvement teams. Teams have comprised of experts that have the best process knowledge in different parts of its flow.

A macro process map of the "Sale of Electric Power" process is depicted below.

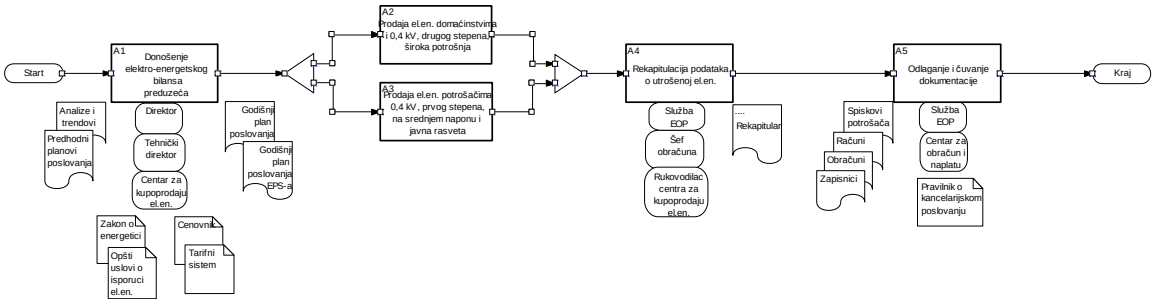

Figure 1 Macro Process Map of "Sale of Electric Power" Process

Activity (Process) A2 from the macro process map can be further expanded with the micro level process maps where one can see particular activities that it comprises of (Figure 2). By moving through the micro level process map, form the activity A2.1 – Information Update, to the very last activity, A2.10 – Identification and Control of Customers with Illogical Consumption Patterns, one can identify opportunities for improvement. The first issues that teams were able to identify were the following activities: A2.6, A2.7, A2.9 i A2.10. Existence of these activities in the process (they consume 40% of the process lifecycle) tell that "we know in advance that the process will create defects". Namely, if the organization has verified and validated software development process according to the requirements of the ISO 15504 standard, activities A2.6 and A2.7 would not be necessary. These activities do not add value, and their existence tells us that the prevailing philosophy in the organization is "who works must make mistakes". This philosophy is not appropriate for a long time already. It was exchanged with the new principle that suggests that "whoever works can work with no mistake".

Activity A2.9 actually serves the purpose of solving defects that occurred earlier in the process. By improving the process there will be less and less defects, meaning that the activity A2.9 will lose its current importance.

Improvement of the activity A2.10 sends a clear message that something is incorrect in the process. This activity is a consequence of the existing process “virus” as well. By eliminating the root cause, we eliminate the “virus”, which further eliminates the need for the activity A2.10 itself.

A prior discussion shows that there are opportunities to eliminate 40% of the process activities that currently exist. These activities are accomplished by people; they waste resources, and do not add value. It is obvious that their elimination would simplify the process, which further means that it can be realized faster, making more profits and customer satisfaction.

The remaining six activities can be further analyzed and opportunities identified for their improvement. Activity 2.1 – Information Update can be significantly improved. The first step is to define which data is really necessary. Once it is done, data needs to be reviewed and brought to the highest level of accuracy. Consequently, we eliminate the need to have Information Update as an activity (it is out of question whether the organization needs to do it; the question is when will it be done). The new customer will be directly entered and deleted from the preceding process dealing with the supply of electric power.

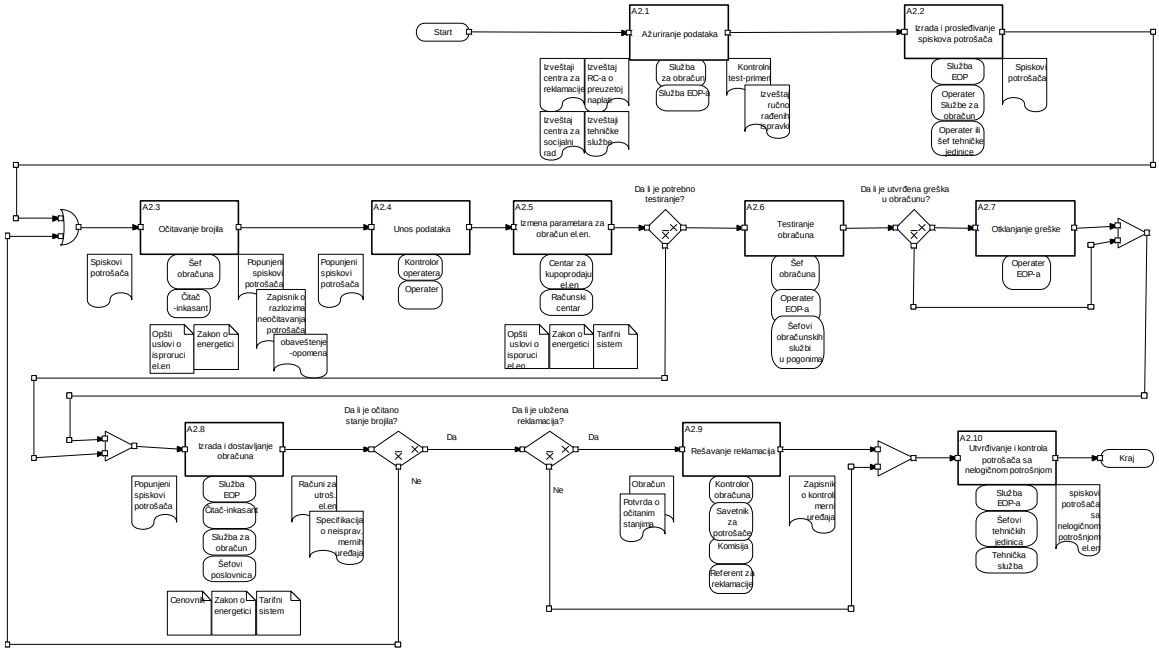

Figure 2 Micro Process Map "Sale of Electric Power to Households"

If the software development process used for developing the software support for the “Sale of Electric Power” process complied with the requirements of ISO 5504 standards, this would mean that the activity A2.2 – Generation and Distribution of Lists, creates no defect.

Activity A2.3 – Checking Consumption Level, as a part of the practice utilized today poses a number of opportunities for a defect. These defect opportunities are the following:

- Consumption level not checked;
- Consumption level wrongly checked;
- Consumption level wrongly entered in the system.

Occurrence of listed defects within Activity A2.3 can vary from person to person, but statistically they have to occur whoever does the job, since there are enormous opportunities for them. In order to eliminate defects, one needs to eliminate opportunities for defects. This further means that the activity has to go through reengineering, and to alter the mechanism of realization of the activity. One alternative would be to implement measurement devices with remote checking functionality. In case such a system is verified and validated all opportunities for defects are eliminated.

Another opportunity is to use the psion. This allows exchanging the paper customer list with the device. However, we do not eliminate opportunities for defects. The very same defects as the case with the paper-based list can still occur. The only activity that will be altering the process is Data Input, which will be automatic, meaning that data will be entered as it is read.

If the remote checking is still not achievable, one can embark upon the third alternative which eliminates the reader as a defect generator. This means that consumption level checking is delegated to another machine – digital camera – for picturing the consumption level from the measurement device. This eliminates the opportunity of false consumption level checking and data input in the customer list. Simultaneously people involved in consumption level checking are monitored, meaning that one can always check whether he/she was at the location as well as when (date and time on the picture). In case the reader was on the location, but was unable to check the level of consumption on the device due to positive reasons, he/she will have a picture as a proof (a picture of a dog, locked door, etc.). Accordingly, the responsibility for checking the consumption is delegated to the customer, in addition to a proof that the reader was unable to realize the activity. Ultimately, there is no defect – Unchecked Consumption Level – any more, meaning that the process is being realized in this activity with no defect.

Activity A2.4 – Data Input, poses a set of opportunities for defects. These are:

- Customer ID missing;
- Inaccurate data transfer from the customer list or psion;
- Incomplete customer list
- Inaccurate customer classification
- Input of wrong (e.g. nonexistent) customers
- Distribution of wrong customer lists
- Late customer list distribution

A defect “Customer ID missing” can be rooted in the activity “Generation and Distribution of Customer Lists”, in case the activity was not realized in the manner specified earlier, before implementing process improvements. The same holds for the defect “Incomplete customer list”.

There are also opportunities for other defects to occur as well. Incomplete data transfer from the customer list or psion, as well as inaccurate customer classification, are defects that can be decreased or eliminated by introducing the procedure and strictly implementing it by the personnel responsible for data transfer.

Distribution of the incomplete customer list or late customer list distribution are the defects that the consumption level reader can make. These defects can be decreased or eliminated by implementing the procedure to be strictly applied by the readers.

Opportunities for incorrect data input occur when data is to be entered from the customer list because the person that is responsible for it can misinterpret a digit in the software. In the very same manner, if the data is wrongly entered in the psion, the same incorrect data will further flow to the software.

If we use digital images for picturing the consumption level opportunities for wrong data input are eliminated. Software automatically loads the pictures and interprets digits from them using OCR modules. The following data are recognized: measurement device number and consumption level for the tariffs 1 and 2. Measurement device number allows establishment of a direct connection with the customer, whereas, whereas consumption levels allow usage calculations for the respective customer.

By applying the new input approach, one eliminates opportunities for occurrence of the other defects as well. It means that the process can also be improved in this activity and that it can flow with no defect, or

with substantially lower frequency of defects compared to the current state. Simultaneously, process cycle time becomes drastically reduced, which further means that less human resources are needed.

For identification, processing, and separation of the vital few defects we utilize Pareto method (5), (6). In distributive subsidiaries experts were trained for application and implementation of this method. In one of them it was applied to the “Sale of Electric Power” process. The process improvement team, alongside with “the owner of the Pareto method” (a responsible manager for the Pareto method in the company) collected data on defects from the process in a longer time interval. Afterwards, data was processed.

Pareto method processing and analysis of defects was realized by the software tool Pareto Analysis v3.0 which automatically generated needed results. If the user wants to get the frequency of occurrence Pareto analysis, it is enough to select the intended process in the program, a period for which the analysis is conducted, as well as any other filtering criterion. The figure below illustrates the frequency of occurrence Pareto analysis for the “Sale of Electric Power” process.

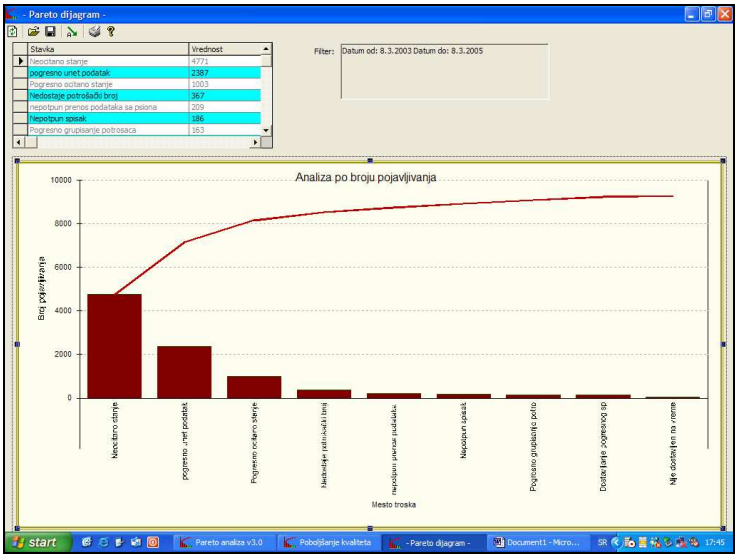

Figure 3 Frequency of Occurrence Pareto Analysis for the “Sale of Electric Power” process

A diagram shows that the defect “Unchecked Consumption Level” most frequently occurs, whereas “Mistaken Data Input” and “Mistaken Consumption Level” are defects that follow. The first three defect categories constitute the vital few elements (20% of defects) and are responsible for 80% of occurrences of all the defects in the process. Therefore, the next step that the process improvement team embarked upon was training for the Ishikawa method aimed at enable people to identify root causes of defects. With root causes on hand, the team was able to define corrective actions. Realization of such actions enables a dramatic process improvement.

Frequency of occurrence of defects can mislead a team to wrong decisions. Namely, a defect can occur frequently, but can involve minor costs. On the other hand, another defect can occur much less frequently, but can incur enormous costs. Therefore, a team needs to conduct a cost-based Pareto analysis, and identify the vital few defects that incur the biggest costs for the company. In principle, the company should first eliminate theses defects. However, in practice it does not have to be the case. For elimination of a certain defect category a huge investment might be needed, the results of which are uncertain. Therefore, one needs to establish “playability of a corrective action”, or a Return on Investment (ROI). It is clear that organization first need to realize corrective actions with the largest ROI.

Following our example of the “Sale of Electric Power” process, Figure 4 illustrates cost-based Pareto analysis.

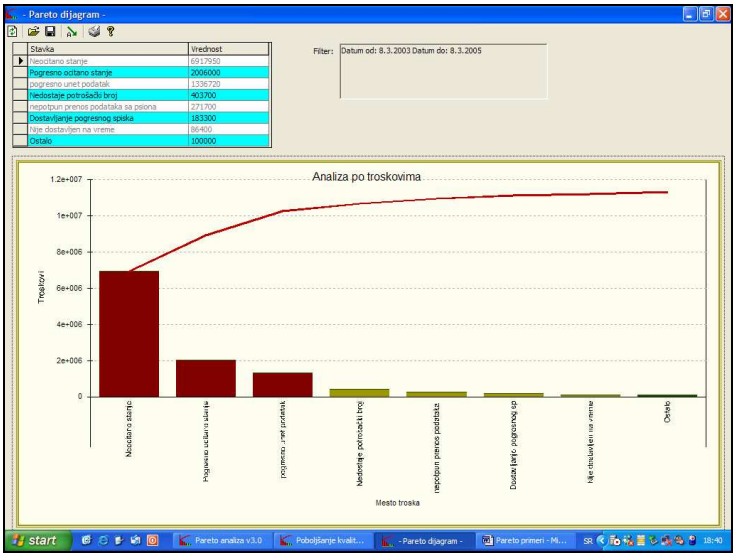

Figure 4 Cost-based Pareto Analysis

The analysis shows that the defect "Unchecked Consumption Level" incurs the biggest costs as well. The defect "Mistaken Consumption Level" that was on the third place in the frequency of occurrence analysis is now ranked second. The defect "Mistaken Data Input" has, on the other hand, moved from the 2nd to the 3rd place, in the cost-based analysis.

The extent of this paper does not allow presenting of the universal Pareto analysis conducted based on the customer related data: location based electric power consumption, location based income, location and customer based debts, etc. Such analyses can help distributive subsidiaries focus on vital few 20% in their process improvement efforts. This means to identify 20% of the vital few customers that owe 80% of overall dept to the distributive subsidiaries, and to focus on collecting these funds first. This would lead to substantial decrease of the remaining receivables.

Once process improvement is conducted, organizations need to monitor stability and capability of the Critical to Quality Characteristics, within certain activities. If these activities are stable, the process will be stable as well, and this further means that the change develops in the right direction. For process stability and capability monitoring above mentioned distributive subsidiary uses Statistical Process Control method, fully software supported.

4. CONCLUSION

Process improvement is a path to the companies' sustainable development and their survival on the market. This is the reason why process management represents a critical criterion in all the excellence models, in the Japanese, American, and European models. By applying such an approach, with a support of quality tools and methods, worldwide known companies realized multibillion dollar savings.

Steps taken by the Serbian Electric Power Industry are the steps in the right direction. This huge system offers enormous opportunities for improvement. If we judge according to what organization of similar size already realized in the world, we are talking about savings in the range of 20% of gross income (The American Act, "Malcolm Baldrige National Quality Improvement Act of 1987" says that American companies lose over 20% of gross income due to poor quality (7)). Achieving such goals asks for top management commitment and their readiness to invest in knowledge of their people.

5. LITERATURE

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