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Change Management in Maintenance

Feasibility Study: From a Decentral Controlled Maintenance Organization to a Central Managed Maintenance Structure

Master Thesis

For the acquisition of the academic degree

Master of Science

Master program Production Science and Management

Submitted to

Graz University of Technology

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Graz, February 2018

In cooperation with:

AUDI HUNGARIA Zrt.

Acknowledgement

This thesis was written at the institute of Mechanical Engineering and Business Informatics, under the supervision of Univ.-Prof. Dipl.-Ing. Dr.techn. Siegfried Vössner in cooperation with AUDI HUNGARIA Zrt, in Györ within a six-month lasting internship from September 2017 to March 2018. The purpose of this thesis was to analyze the feasibility to chance the actual decentralized structured maintenance organization to a centralized controlled structure for the CEO of engine production, Herbert Steiner. I want to thank my supporters, especially Károly Hevesi my mentor and Balogh Balázs my supervisor at Audi. Furthermore, I would like to give a special thanks to Nikolaus Furian and Clemens Gutschi for my supervision and support during the time at Audi for create my thesis. The biggest thank goes to my family, my brother Simon and my mom and dad. “Danke, dass ihr immer für mich da wart und an mich geglaubt habt, jetzt beginnt das nächste Kapitel!“ Last but not least I want to thank all my friends, for accompanying me and making this time so great and memorable.

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Abstract

One of the key success factors in industrial practice is the constant rationalization and innovation that serves to increase labor productivity, reduce overall costs and maximize profits. Constant adaptations and changes are necessary to ensure that a well-functioning system remains successful in the long term. In this age of digitization and networking, Industry 4.0, the increasing automation and thus the increasing complexity of plants, the pace of change has increased tremendously. The importance of well-organized maintenance is becoming more important due to the continues automation of the producing industry. This work is based on a simulation model of the University of Technology Graz for the evaluation of different scenarios in the maintenance organization of engine production of Audi Hungaria Zrt. The essential part of the work includes the feasibility analysis of the restructuring process from decentralized maintenance to a centrally controlled maintenance organization. This change-management topic deals on the one hand with technical and social challenges and on the other hand with potentials that such a structural change can bring in a large corporation.

Kurzfassung

Einer der ausschlaggebenden Erfolgsfaktoren in der industriellen Praxis ist die ständige Rationalisierung und Innovation die zur Erhöhung der Arbeitsproduktivität, Verringerung der Gesamtkosten und zur Gewinnmaximierung dienen. Ständige Anpassungen und dementsprechend Veränderungen sind notwendig, dass ein heute gut funktionierendes System auch langfristig erfolgreich bleibt. In dieser Zeit der Digitalisierung und Vernetzung, Industrie 4.0, der zunehmenden Automatisierung und dadurch auch der zunehmenden Komplexität der Anlagen hat sich das Veränderungstempo, um wettbewerbsfähig zu bleiben, um ein Vielfaches erhöht. Mit der Optimierung der Organisationsformen, hinsichtlich Flexibilität, Reduktion der Bestände und Produktionszeiten sowie Durchlaufzeiten gewinnt eine effiziente und effektive Instandhaltung immer mehr an Bedeutung. Diese Arbeit basiert auf einem Simulationsmodell der Technischen Universität Graz zur Evaluierung verschiedener Szenarien in der Instandhaltungsorganisation der Motorenproduktion der Audi Hungaria Zrt. Der wesentliche Teil der Arbeit befasst sich mit einer Machbarkeitsanalyse zur Umstrukturierung von der dezentral organisierten Instandhaltung auf eine zentral gesteuerte Instandhaltungsorganisation. Dieses Change-Management Thema befasst sich einerseits mit den technischen aber auch mit den sozialen Herausforderungen und Potentialen die eine solche Strukturveränderung in einem großen Konzern mit sich bringen kann.

Contents

Abbreviations

AH	Audi Hungaria
Elek.	Electrical
IH	Maintenance = German for “Instandhaltung”
IH-ING	Maintenance-Engineer
IH-M	Maintenance-Employee
ING	Engineer = German for “Ingenieur”
Mech.	Mechanical
Mess.	Measurement = German for “Messung”
NC	Numerical Control
OEE	Overall Equipment Efficiency
OEM	Original Equipment Manufacturer
PLC	Programmable Logic Controller

1 Introduction

"*Everything flows, nothing stays*" (Heraklitus), and "*nothing is more permanent than the change*" (Heine).

These two quotes stand for many others, found in world literature. Changes are something completely natural in lives of people ore those from human formed organizations. Structural change is therefore not a phenomenon of the present. The continuous adaption to changed environmental conditions is the only way to secure the survival of an organization in the long term. As Scharfenberg (1993) describes, changes would be nothing special, if not the changes in the recent years have become mandatory. Due to the interconnection evolution of Industry4.0 and the enormous speed of digitalization it is inevitable to act rapidly to ensure competitiveness and continued existence.

To raise the awareness of the upcoming challenges for an organizational change intended in a large company like AUDI, this thesis tries to cover the most crucial issues for a successful change management. The challenges for executives and management includes factors like: globalization, flexibility security, staff loyalty, and demographic change. Based on the organizational simulation of the Technical University of Graz, the main focus of this work will be laid on the raising challenges for the technical and social feasibility of an organizational change in the maintenance structure of the largest automotive engine production side in terms of produced engines of the world.

Tarlatt et al. (2005) emphasizes in his work "*Change Management für Konzerne*" to enforce changes in large corporations is a herculean task. The awareness of need for action to engage everyone involved in a common goal and to agree on the way to move people and structures is a big challenge due to the special rules of big companies. The goal to successfully implement the change remains often unrealized for many managers. The danger of really implemented changes, by full-bodied announced projects in large corporations is relatively low.

Throughout this thesis, the generic masculine which includes male and female persons is used for a better readability. This is done solely for the purpose of making the text easier to read, and no offense or sexism is intended.

1.1 Goal of this Thesis

The main goal of this thesis is to evaluate the feasibility of a change management process for an organizational structure in maintenance in the engine production of the Audi Hungaria Zrt. As a general basis for this feasibility study is the outcome of a simulation model of different forms to organize and control maintenance operations performed by the Technical University of Graz 2017. Goal was the evaluation of different possible scenarios from centralization-decentralization regarding control but also the physical placement of the maintainer. The result showed a tendency of central control due to the harmonization of maintainers utilization and a physical decentralized placement. Within this thesis also the qualitative factors and most crucial issues such as effort of change and the different motivation form affected parties will be considered. The outcome of this thesis should support the decision making of the managers for a successful change.

1.2 Field of Research

The main focus of this work will be laid on the change management, with deeper insights in organizational culture regarding to the relation between national and corporate culture. Furthermore, general management and organization, maintenance management and some slight insights about the psychological and economical aspect of incentives will be discussed.

1.3 Structure of the Work

This thesis is divided into two main parts. It starts with the relevant theory from literature and will be concluded by a Use Case with Audi Hungaria Zrt. in chapter 6.

Firstly, an introduction in the theory of change management will be done following the change management model from J. P. Kotter. Afterwards the most important change management related issues of corporate culture, power structures, fear, incentives, generation change and employee loyalty shall be examined in a greater detail. The following chapter gives a brief overview about relevant organizational structures, ensued by a general introduction of maintenance considering the maintenance

philosophy, their potentials and closing the chapter with the importance of the human resource in maintenance strategies.

Closing this thesis, in chapter 6 a Use Case will be introduced, that demonstrates the most important topics to analyze the conditions for a successful implementation of an organizational change in the maintenance organization of the engine production of the Audi Hungaria Zrt.

2 Change Management-Theory

The following chapter attempts to demonstrate the importance of Change-Management. The problem of reorder is the subject of a century-old debate. Many important philosophers like Kant, Locke, Rousseau, Hobbes or Machiavelli have dealt with. Forming a new order repeatedly presents itself as a difficult and challenging task. Up to two-thirds of the planned change processes in organizations are cancelled, fail or do not achieve the desired result. Change-Management models and theories aim to depict a simplified picture of a complex reality and their interdependencies. On the one hand, they serve to reduce complexity and on the other, they try to generate an information gain. (Zelesniack and Grolman (2017))

In the following chapters the change management theory starts with a general introduction. Subsequent the emotional phases shown in the change curve and furthermore on the change management model according J. P. Kotter.

2.1 Change-Management

There are a lot of different models of Change-Management. Phase models of change try to give a framework of action and show at the same time what can be observed in the individual phases. Some of these models differ considerably in terms of methods, tools, time-intensity, backgrounds, etc., but they have in common that they formulate intermediate goals in processes, reflect what has been achieved, and plan next steps. In short, they help with order, orientation and communication in the change management process and largely act as decision support. As Zelesniack (2017) describes, there is a general agreement on the basic ingredients for a successful change in the literature:

- Communication with those affected
- Goal and vision development
- Participation of all concerned employees, as early as possible and holistically
- Motivation, will, ability and qualification for the change on the management level, as well as the employees

2.1.1 Change Management Ingredients

If time and resources become scarce and at the same time the complexity of the fast changing world increases, one can't operate in the same way as in the past. The challenge for the single enterprise is to be faster and more economical efficient coping an increasing diversity rapidly changing tasks. (Doppler and Lauterburg (2014))

In large-scale enterprises, the trend leads away from the classic functional structure based on the division of labor. Who wants to survive, according to Doppler and Lauterburg (2014), has to create following conditions:

- **Proximity to the market and to the customer**, by shortening the ways.
- **Quick response and high flexibility** by shifting operative decision-making powers to the front or base.
- **Increasing productivity and quality through motivation**, communication and cooperation.
- **Optimization of costs by streamlining the product range**, reducing the administrative superstructure, simplification of processes.

The following Figure 1 describes the different driving forces which imply the need of a major organizational change. These forces include technical, economic and social issues.

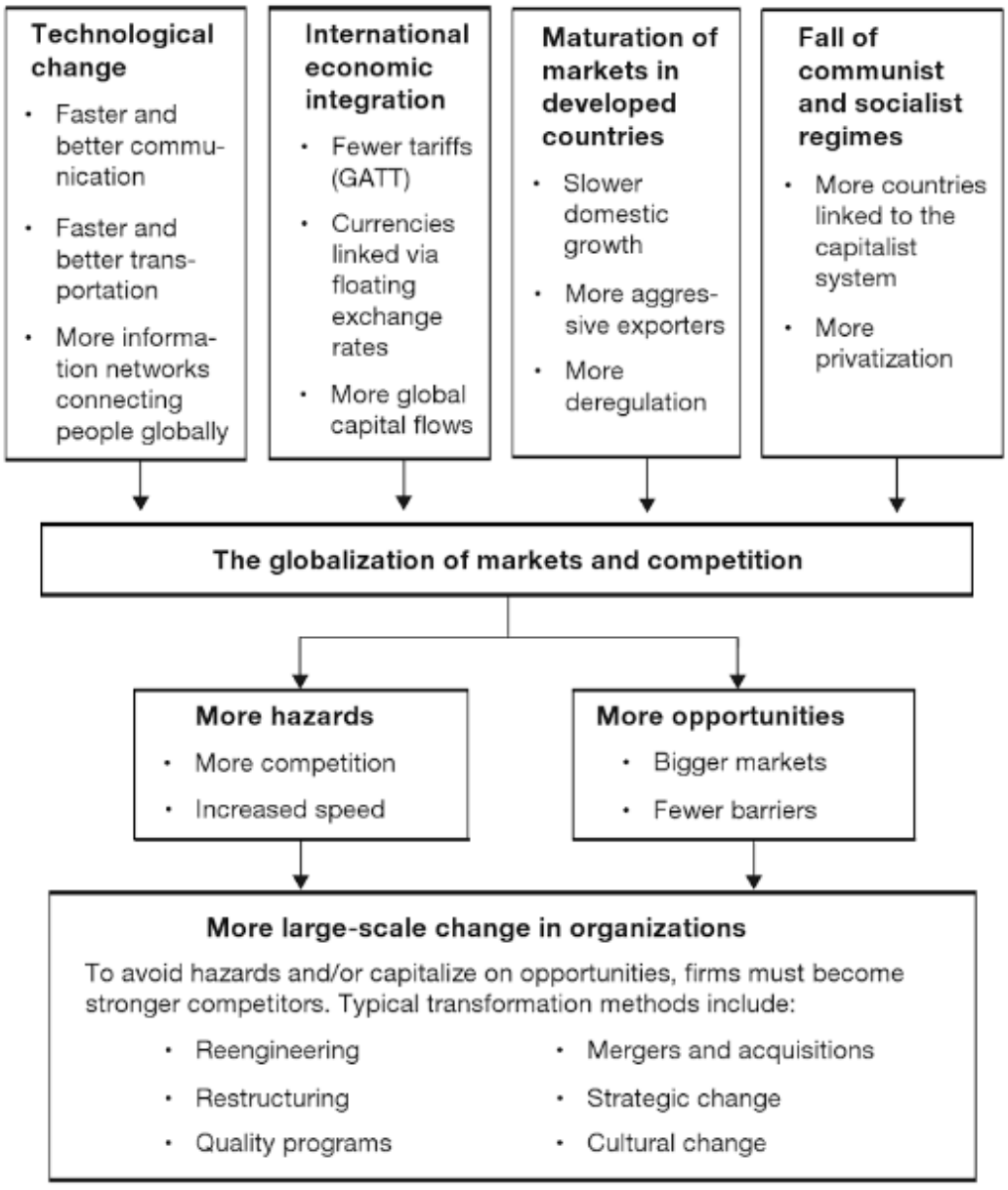

Figure 1: Economic and social forces driving the need for major change in organizations according to Kotter (2013, p. 21)

2.2 The Change Curve

The Change Curve is a powerful and well-known model used to understand the different emotional phases of personal transition and organizational change. With the knowledge of the change curve, one can adapt the change in a more efficient way by minimize the negative impact, help accelerate change and increase the likelihood of success. In the following Figure 2 the change curve represents a major change, which often is genuinely traumatic for the involved people. For changes with less intense, an appropriate adjusted change curve course can be more representative.

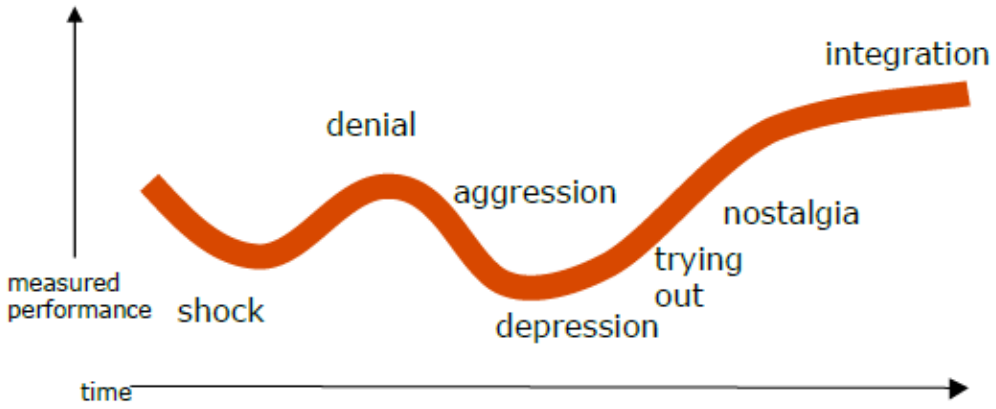

Figure 2: The assimilation of change shown in the "Change Curve" (Doblhofer (2016))

All the different emotional phases that occur passing throw a company's change process, will be explained according to Doblhofer (2016):

Every change process is like an emotional ascent and descent, which can be described with seven emotional states.

It starts with the status quo of the existing situation where the world is still in order. The emotional path through the process of change already begins when the project is still being discussed behind closed doors, because in the same time assumptions and rumors are already circulating. If the project is then officially communicated, news of radical change is often perceived as a **shock (1).**

The state of holding culminates in negation, resistance or **denial (2).**

If the affected person realizes that the initiators are serious about the project and it will also have an effect on their person, fear will initially follow, it is searched for ways out and haggled and negotiated. This is where bitterness, anger and rage appear. There are allegations against the management of the company, others inside or outside of the company. It may end in very **aggressive (3)** confrontations. This is the beginning of the release phase. Mostly this happen behind the doors, slowly but surely this will end in a rationally acceptance.

Once the lowest point is reached, the realization matures that all the previous efforts to avert the change were unsuccessful. This realization plunges those affected into **depression (4).** This depression phase can last a long time. Furthermore, listening understanding and empathy are important measures to keep the day-to-day business of the company going on.

Those who leave this down phase behind and accept change, see change as a new future. They now **trying out (5)** some of the new changes. This mostly happens when the majority is still in active resistance and they feel guilty towards them for their “treachery”.

Now the **nostalgia (6)** sets in, the more the routine returns, the more the self-confidence of those affected increases and the integration of new tasks and forms of the organization follows. Even if it all seemed better in the past, the process of change has passed through emotionally and a new status quo is reached.

A team only fully **integrates (7)** the change process, if they are dealing with the question of which are the most important points that can be learned from it. Review like this are rare in practice, but it’s recommended to do it before trying to lunch the next radical change package for the company.

The curve shown in Figure 1 above is a simplified representation of the reality. In practice, not only the individuals in the company running through change at different speed, but there is also a cascade caused by the top down communication effectuating a time delay of the integration of the companies change, as shown in the Figure 2 below.

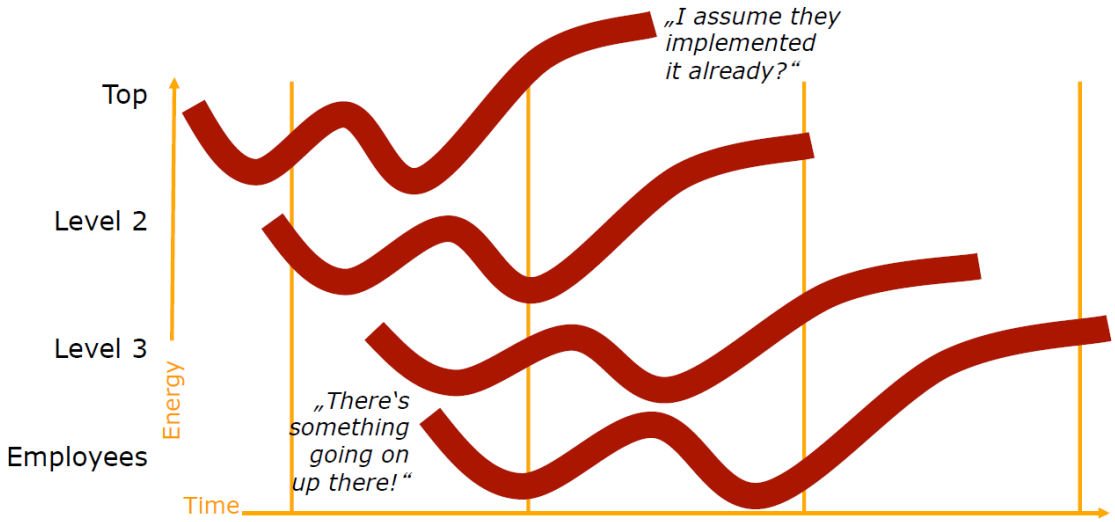

Figure 3: Time delay of the integration of change caused by the top-down communication (Pühl (2000))

2.3 Eight Steps towards Change

The 8 steps model by John P. Kotter is an evolution of the popular 3-phase model by Kurt Lewin. Only when all eight stages of change are undergone and intensively accompanied by executives, a change can be successfully implemented in a company.

The eight Stage Process according Kotter (2013):

Step 1 - Establish a sense of urgency

Raise awareness of the urgency of change, both among managers and among employees. For example, develop scenarios that could occur if there is no change. Discuss with their leaders and employees and bring convincing arguments.

- Examine the market and the competitive realities.
- Identify and discuss crises, potential crises and opportunities.
- Central challenge: Rousing and moving people.
- Targeted behavior: The people start talking to each other: Let's change something, it's necessary!

Step 2 - Create the leading coalition

Build a good leadership team by attracting people to your idea and bring them together under the flag of change. Make sure you have a good mix of employees from different departments and with different competences.

- Find a group with enough capability to bring about change.
- Motivate the group for team work.
- Central challenge: Find the right people with the necessary confidence, commitment and team spirit for a genuine change project.
- Targeted behavior: A team that also works like one and is powerful enough to manage a major change.

Step 3 - Developing a vision and strategy

Create a strong vision and concrete strategies to help you reach your goal. Communicate these in a well-prepared and strong speech. A higher-level goal for the company helps to implement change.

- Create a vision that points the way for the change project.
- Develop strategies that implement this vision.
- Central challenge: A team that finds an action-guiding vision/strategy for the next steps and overcomes nitpicking to address the emotional and creative aspects of a vision.
- Targeted behavior: The guiding team develops the right vision and strategy for the project.

Step 4 - Communicating the vision

Constant dripping cuts the stone: Do not be afraid to communicate the vision over and over again to the executives and employees. This creates trust and strengthens motivation.

- Use every possible element to communicate the new vision and its strategies.
- The role behavior within the guiding coalition conforms to the expectations of the employees.
- Central challenge: Move as many people as possible to realize the vision.

- Targeted behavior: People begin to accept the change, which can be seen from their behavior.

Step 5 - Broad-based empowerment

Are there structures in your company that slow down change? Take a close look at the status quo and clear out unfavorable organizational structures, workflows and routines.

- Overcome obstacles. Change systems or structures that corrode the vision of the change.
- Encourage risk-taking, unusual ideas and actions.
- Central challenge: Identifying and overcoming core obstacles that stop people from realizing the vision.
- Targeted behavior: People

Step 6 - Short-term aims and successful breakthrough projects

Do not set time-consuming and cost-intensive goals for the beginning, but define quickly achievable intermediate goals. Employees who achieve these goals should reward you.

- Plan visible performance improvements or "successes".
- Emphasize these successes. Give significant recognition and praise to the people who enabled the successes.
- Central challenge: Achieving success as quickly as possible in order to energize the advocates of the project, win over pessimists, take the wind from the sails of cynics and give the process dynamism and power.
- Targeted behavior: More and more dynamism builds up during implementation of the vision. Resistance constantly diminishes.

Step 7 - Consolidating improvement and generating more change

After each goal, analyze what went well and what could have gone better. Always develop new ideas and goals and bring new people into your leadership.

- Use the growing credibility to change all systems, structures and procedures that do not fit and do not conform to the vision

- Recruit, promote and develop people who can implement the vision. Constantly invigorate the process with new projects, topics and impetus for change
- Central challenge: Regardless of the obstacles, continue with one wave of change after another until the vision becomes reality.
- Targeted behavior: The people have the energy and work with motivation to implement the vision until it is achieved.

Step 8 - Embedding new approaches into the culture

Anchor your goals firmly in your corporate culture. Only when this has succeeded can be talked about a successful change management process.

- Highlight the relationship between behavior and corporate success
- Ensure management development and succession
- Central challenge: Creating a support structure that secures the new behavior/work from the roots up.
- Targeted behavior: The new successful behavior is continued despite the strong impact of tradition, change of bosses etc.

2.4 Mission to Failure

A lot of mistakes can be made during an organizational change effort. According to Kotter (2013) this are the eight most common errors in change management:

- Allowing too much compliancy
- Failing to create a sufficiently powerful guiding coalition
- Underestimating the power of vision
- Under-communicating the vision by a factor of 10 (or 100 or even 1000)
- Permitting obstacles to block the new vision
- Failing to create short-term wins
- Declaring victory too soon
- Neglecting to anchor changes firmly in the corporate culture

Followed by consequences:

- The new strategies aren’t implemented well
- Acquisitions don’t achieve expected synergies

- Reengineering takes too long and costs too much
- Downsizing doesn't get costs under control
- Quality programs don't deliver hoped-for results

2.5 Key Factors for a Successful Approach

The most important thing is to be aware of the initial situation and to be able to select the right procedure for the process of sensitization. As Doppler and Lauterburg (2014) pointed out: You have to pick up the listener right there were they are.

The most significant points according to Doppler and Lauterburg (2014) are:

- **Clarity of goals**: Have the affected person understood, what is the real intention of the change?
- **Level of information**: What is the real level of knowledge about the upcoming topic? What do these affected persons know about the way how the project originated or from whom the idea emanated?
- **Problem awareness**: Do the affected feel the situation as a problem at all? Is there significant psychological strain, and is it widespread? How openly discussed is the topic?
- **Credibility**: How plausible are the initiators, that they really care about these things? How common are assumptions, it is a mare exercise or a manipulation attempt?
- **Energy and commitment**: All this is added up to the amount of energy, by which involved people help or prevent solving problems.

Only when involved people recognize the urgent situation and they add their creative participation, one can take the next step toward to concrete problem solving.

In the following subsections, the frequent underlying issues in change management will be described.

3 Critical Issues for a Successful Change Management

The following chapters visualize the most critical issues which are correlated with the process of an organizational change. These issues include besides the corporate culture, the leadership style and power structure of a company, also the incentives and fears of the employees affected. Due to the cooperation of different generations issues of generation change in world of employment have to be handled with increasing importance.

3.1 Organizational Culture

Culture is the sum of beliefs, behavioral rules and habits, from who are in a group or a community that have formed during development, for solidarity inside as well the enforcement to the outside. (Doppler and Lauterburg (2014, p. 494))

Geert Hofstede (2001) has defined culture as followed: *“The collective programming of the mind that distinguishes the members of one group or category of people from others.”*

Short and simple, corporate culture can be defined as the totality of norms and values that are the spirit of a company channeling the behavior of the people working in it to regulate the way of their interaction.

3.1.1 What is Organizational Culture?

Similarly to culture, in literature one can find many different definitions of the term corporate or organizational culture. Smircich (1983) points out in her study on the development of the term in sociology, that there are many possible definitions depending on the concept of the author. Organizational theories undergo permanent development process. Therefore, there will be a continuous adaption of corporate culture models.

In following part of the chapter, three widespread cultural models will be explained more in detail. First the three-level model according Edgar Schein, then the 7S-model of Tom Peters and afterwards the onion model according Geert Hofstede.

The three-level model according Edgar Schein:

Schein and Hölscher (2010) define corporate culture as the sum of all common, self-evident assumptions that a group has learned in their history. It is the precipitate of success. He breaks these assumptions into three levels:

- Artifacts - visible and perceptible patterns of action and symbols
- Publicly propagated values
- Basic, unspoken assumptions.

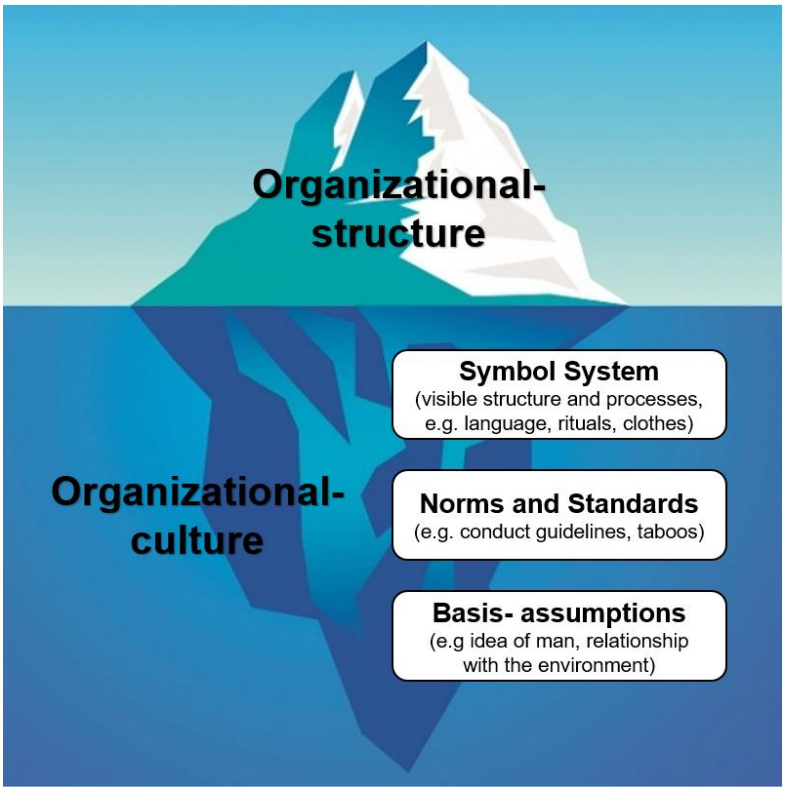

Figure 4: Relation between organizational-structure and -culture (Seufert (2013))

7-S Model according Tom Peters

With the three hard factors strategy, structure and systems and the four soft factors shared values, skills, staff and style the 7-S model is described by Peters and Waterman (1986). In this model, they go far beyond the limits of the pure corporate culture and allow a holistic and comprehensive look at organizations. This makes it precious for diagnosis and planning of interventions in the context of cultural change projects. They point out that efforts to optimize internal processes is often based sole on hard factors – strategies, structures and systems. Furthermore, they point out that, this is a very dangerous approach for the success of the company if the soft factors – corporate culture, people, skills and visions – are not considered equally.

Onion model of corporate culture

In conclusion Hofstede (2001) defines corporate culture as a kind of "software of the brain". He assumes that culture is a collective phenomenon in which there are always several people involved with their identities, experiences and values. Therefore, the community process of cultural development is constantly updated. Hofstede illustrates the concept of culture with the model of an onion with four layers.

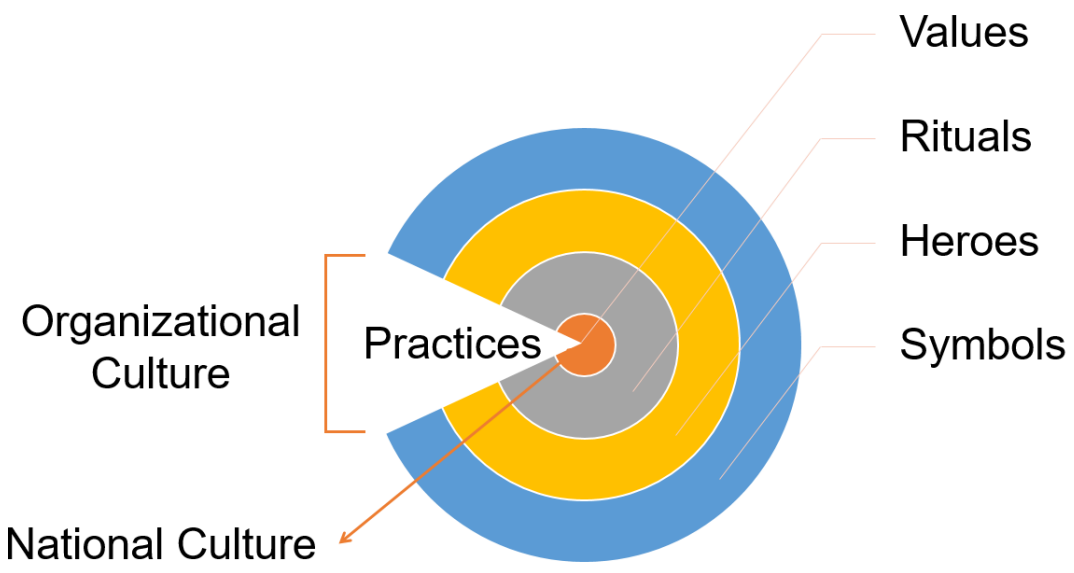

Figure 5: Onion Model – the different levels of culture (Hofstede (2001))

Hofstede (2001) characterizes following layers:

- Symbols: Gestures, objects, images and words that have a specific meaning only for the members of a particular culture (clothing code, etc.).
- Heroes and role models: Dead, living, real, or fictitious persons who possess qualities that are highly regarded in a culture - they therefore serve as behavioral models.
- Rituals: Collective activities that are superfluous for the achievement of desired goals, but are considered socially necessary within a culture (greetings, etc.).
- Values: Feelings and tendencies with an orientation to the plus or minus pole, often unconsciously (because acquired early in life and not directly perceptible to outsiders) and visible by the way people act in different situations.
- Practices integrate symbols, heroes or role models and rituals into everyday life (Christmas, Hanukah, Ramadan, etc.)

The onion core can only be understood through the visible components of culture due how members of a culture interpret certain cultural aspects (often leading to misunderstandings). The core value is also very hart to change. All other three layers can be trained and learned throw practices.

3.1.2 Six Cultural Dimensions

A very helpful tool for comparing different cultures and their characteristics Hofstede et al. (2010) categorized in his studies six cultural dimensions, for the work-related values and attitudes of different countries. For this he collected between 1967 and 1973 copious amounts of survey data from IBM employees in 40 countries, which by factor analysis have been reduced to the following six dimensions. According to Ternès and Towers (2017, p. 17) the Table 1Table 6 shows what differences the dimensions in practice mean:

1. **Power Distance Index** (PDI) describes the acceptance of the status quo of people what less power. Hierarchy is tolerated at high power distance and considered legitimate. Low power distance shows the desire for equality and justification in case of a power difference.

Table 1: Power distance

Small power distance	High power distance
Employees expect to be involved in decisions	Employees expect the supervisor to give them clear instructions
Employees find it easy and normal to contradict their supervisor	It is very unusual to the supervisor too contradict

2. **Individualism and Collectivism** (Individualism versus Collectivism - IDV) defines, to whom extent individual self-determination or collectivistic integration is important. A high value in this continuum speaks for a focus on an own, self-determined life, while a low value describes a we-feeling within the organization.

Table 2: Individualism and collectivism

Individualism	Collectivism
To express his opinion is normal	Employee initiatives are not supported
proactive employees are welcome	You should keep harmony
	The group is important

3. **Uncertainty Avoidance Index** (UAI) explains whether an insecure future is generally seen as negative with the desire for more rules and security (high value) or whether it is rather easily accepted and thus major risk appetite.

Table 3: Uncertainty avoidance

Low uncertainty avoidance	Strong uncertainty avoidance
Deviant and innovative thoughts and behaviors are tolerated Task activities are less strongly structured	Suppression of deviant thoughts and behavior Strong structuring of task activities
Supervisor may say: "I do not know."	Executives are also involved in detailed questions
Executives are mainly involved in strategic considerations	The supervisor needs an answer to every detail

4. **Masculinity versus Femininity** (MAS) characterizes the prevailing value system of both sexes. A low value describes dominant feminine values such as cooperation, caring or equality, while a high value the supremacy of male values describes such as dominance, achievement and recognition.

Table 4: Masculinity and femininity

Masculinity	Femininity
Supervisors are determined and decisive	Consensus is important
Competition and performance among colleagues is an effort wanted	Equality and the quality of working life are not ignored
Money and symbols of success are important	Intact interpersonal relationships are important

5. The Continuum **Long or Short-Term Orientation** (Long-Term Orientation – LTO) was supplemented in the second edition of Hofstede and describes the benchmark schedule planning, whether long term thought (thrift and perseverance) or short-term (flexibility and selfishness). The former is defined by a high value, the latter through a low one.

Table 5: Long- and Short – term orientation

Long – term orientation	Short – term orientation
Long-term plans are created	Short-term planning more important than long-term planning
High importance of traditions	Expect short-term profits
Perseverance and perseverance in the persecution of goals	Propensity to consume
Economy	Avoid loss of face
Adapting traditions to modern conditions	Respect for social status obligations without consideration of costs

6. The Last Dimension **Compliance and Control** (Indulgence versus Restraint – IND) was adopted in 2010 by his colleague Minkov. Here the crucial question is, whether one pursues one's own wishes and impulses (higher Value) or rather tries by control due to supervision (low value).

Table 6: Compliance and mastery

Low compliance and high mastery	Strong compliance and low mastery
Personal discipline to achieve the goal	Relaxed attitude to work, thrift and economy deviations
Low prioritization of leisure	High prioritization of leisure

3.2 Leadership and Power

As Doppler and Lauterburg (2014) describe, wherever substantial changes happen, interests are affected. Position and privileges fine established networks and spheres of influence are threatened.

However, the current roles and interests may be distributed, in the end everybody´s general interest should be constructive for building up a great future. All you have to do is declare your interests and concede the others interests as equal as yours. in a fair negotiation, there should be found a solution that takes all interests into account.

But this social-utopia faces reality, powerplay according to the motto: Everyone is himself the next.

Who wants to change something, has to deal with two main questions: Why are things the way they are? Why is the existing so difficult to change?

The key factor is power. The questions are, who are the stakeholders that are not interested to change something, how much power do this stakeholder have and in how is this power used.

Above all, only those who know the game of power and its rules, have a chance something and not ending like Don Quichotte fighting against windmills.

3.2.1 The Issues of Traditional-Hierarchical Organization

The strictly hierarchical securing of power at all levels in traditional organizational structure causes big problems and is limiting the overall efficiency. These following list shows the crucial points according Doppler and Lauterburg (2014, p. 157) which inhibit a traditional hierarchical structured organization being flexible and more efficient:

- The cult of individual responsibility – the consequence of a strict division of labor leads to more competition than cooperation.
- Information, overview and influence – the personal commitment decreases from the top to the bottom, in a time where entrepreneurial spirit would be needed urgently.
- Thinking in positions – instead of tasks, this supports inflexible process chains and prevents dynamic processes.
- The distance between “above” and “below” are too long, too much information getting lost on the ways from top to bottom and vice versa.
- Too many leaders in field office and line management – to justify their existence, they keep the productive employees from their work, which leads to an inflexible structural organization.
- Due to insufficient networking and unequal distribution of power, individual personal weak spots become a high intolerable risk for the organization.

3.2.2 Comparison: Classical Power to Social Skills

The range of possibilities to exert influence is extraordinary diverse. It ranges from the brutal exercise of brute violence through to the legitimate authority of a leadership position to more fruitful persuasion. The social competence is a not to underestimate attribute in a successful leadership style.

The following Table 7 compares the hierarchical to the social skill leadership.

Table 7: Two ways of influence following Doppler and Lauterburg (2014, p. 159)

Classical hierarchical power intends…	**Social skill leadership intends…**
Use information and knowledge as a means of power and distribute it selectively only for completing tasks	Open and extensive communication as the basis for partnership management and corporate culture
Directive leadership	Self-guidance and self-responsibility
Adaption and subordination	Autonomy
Enforcement of hidden goals and secret interests	Transparency of goals, intensions and interests
Obedience – “loyalty”	Independent thinking, critical analysis and open feedback
Clear and unambiguous regulations	Logical processes
Standardization	Diversity of situational solutions
Division of work, delimitation and competition	Integration, cooperation and cross-linking
Demonstration of courage and strength based on enforcement	Permit insecurity and fear of early problem detection
Conflicts end by arbitration	Conflict resolution through negotiation
Control due to fundamental mistrust	Trust not just for human appreciation, but as a basis for higher efficiency

3.2.3 Difficulty to Change Power Structures

Those people who know only the conventional hierarchical power are resistant to change to organizational forms where social skills are required. First, because they do not believe to get the necessary influence within such an organization – and second, they don’t believe such an organization will work in practice. A company´s change, covers not only a change of the structure, but also a fundamental change of its culture. It's all about values, internal attitudes and standards of factual behavior and also the way in which influence is exercised. This human behavior is one of the most difficult things to change in practice, especially these persons, who are used to control others. And it is precisely those, who should guide the change. Another thing which is change

resistant, is the factual distribution of power. It is not possible to inevitable the fact that new organizations distribute the power within the company more. Power tends to sustain itself. (Doppler and Lauterburg (2014, p. 159))

3.2.4 Core Elements for Power Creation

According to Doppler and Lauterburg (2014, p. 160) this are the core elements of the power forming:

- Eroticism of power: Power has for the powerful and those who want to become, an almost erotic attraction. In order, not to tarnish your own appearance, the attraction becomes systematic denied or displaced. However, this does not change anything about the straight instinctual force of power as a motivator of human action.
- My right – your right: Powerful people protect their power, inter alia, by giving each other confirm in their "right" to be in power. If you have something to offer each other, the solidarity is obvious. “My rights” (income, possession, title, position) becomes with “your rights” to “our rights” – therefore justified.
- Strengthening by demonstration: The powerful reinforce their power with status symbols or labeling like titles, company cars, size of office or other separate benefits.
- Self-debasement of powerless: this demonstrated self-evident of possession of power effects the subordinates. You may feel envy, may also like to belong to this circle of the chosen, but does not dare to question the existing distribution of power.
- Incapacity of the “have-notes” to organize themselves: May the common lack be a minimum of willpower to change actual conditions. But the unexplained future and the incalculable risks prevent as a rule the solidary merger, which is necessary for a joint action.
- Power offers security and order to everybody: If the power is clearly distributed an order is made. Even if the system is not unfair. But those people who want to change the conditions, jeopardize the existing security.
- Strategy of the partial participation of power: With the so called “embrace strategy” people with a contrary mindset can be muzzled. Give the troublemaker some little benefits. From now on also they try to defend the balance of power.

3.3 Incentives and Motivation

Motivation is a term commonly associated with the words will, drive or pleasure. It is to distinguish from the term motivating, which means starting, moving or driving. People are motivated all the time, therefore set in motion, but not always in one for the company sensible direction. Those leaders who want to motivate in the sense of "pushing" his employees, often effects the opposite. This means for effective leading to control the moving forces of the employees to bring them in the for the company desiderate direction. This is shown in the Figure 6, the atom-model of leadership. Condition for successful leadership is, when the employees essential needs can be fulfilled by the themselves. (Berger (2018, p. 92))

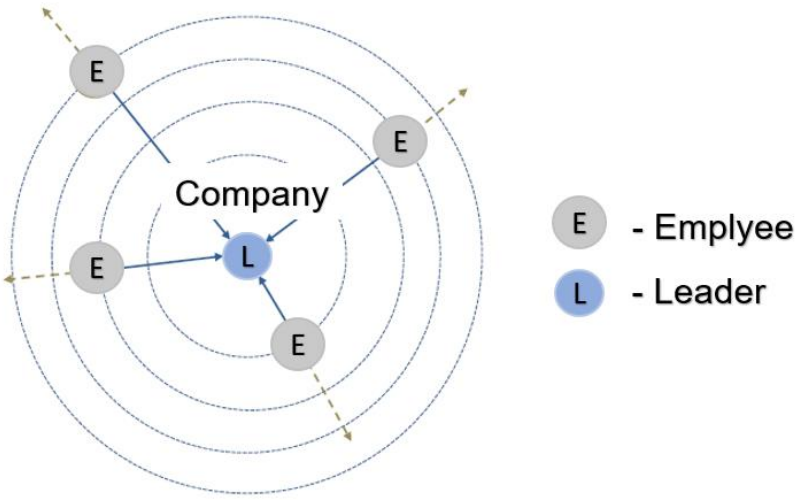

Figure 6: Atom-model of leadership (Berger (2018, p. 92))

According to Berger (2018) in relation with the social system the model of human behavior is purposeful. With their behavior people try to reach individual goals to satisfy their needs. The activated needs controlled from our decisions for certain behavior are called motives.

The interaction of different motives if the motives are activated by incentives, can lead to motivation.

In the following chapters a more detailed explanation of motivation according different theories will be done, beginning with the differentiation of intrinsic and extrinsic

motivations, closing with two well-known motivation theories from Maslow and Herzberg.

3.3.1 Intrinsic vs Extrinsic

Motivation can be classified into two different theories, known as intrinsic and extrinsic motivation. Intrinsic represents the internal and extrinsic represents the external incentives.

Intrinsic motivation:

The intrinsic motivation is based on self-determined factors that everyone considers important for itself. The intrinsic behavior, the "from the inside" motivated behavior, belongs exclusively to the person concerned. Responsible and important activities, freedom of choice, personal development opportunities and interesting work content can help contributing to feel motivated for a productive work behavior. The intrinsic motivation leads to independent, from the environment of the individual at most indirectly controllable rewards and punishment by the person concerned. (Berger (2018, p. 93))

Extrinsic motivation:

The extrinsic motivational factors are often used by third parties (supervisors, human resources department) with the goal of induce someone to the desired behavior. These extrinsic factors include, for example bonuses, salary increases, commendations, promotions, but also punishments such as salary reductions or disciplinary measures. (Berger (2018, p. 93))

3.3.2 Maslow´s Hierarchy of Needs:

Motives are the basis of motivation. They are activated by incentives and lead to actions that we hope to satisfy our needs. A systematic categorization of motives is shown in Figure 7, the pyramid of needs according Maslow (2016). It is a double hierarchical model in which the basics of need-oriented motivation theories are shown. Maslow's pyramid of needs is hierarchically structured in two ways:

- From bottom to top: Only when the needs of the current level are fully satisfied the needs of the higher level become relevant
- From top to bottom: If the needs of a level are action-relevant, the needs of the underlying level are not relevant to action.

Maslow´s hierarchy of needs is one of the most common models for explanation of motivation. The strength of this model is not scientific substantiation, but in the simplicity and heuristic benefits of the model. (Berger (2018, p. 94))

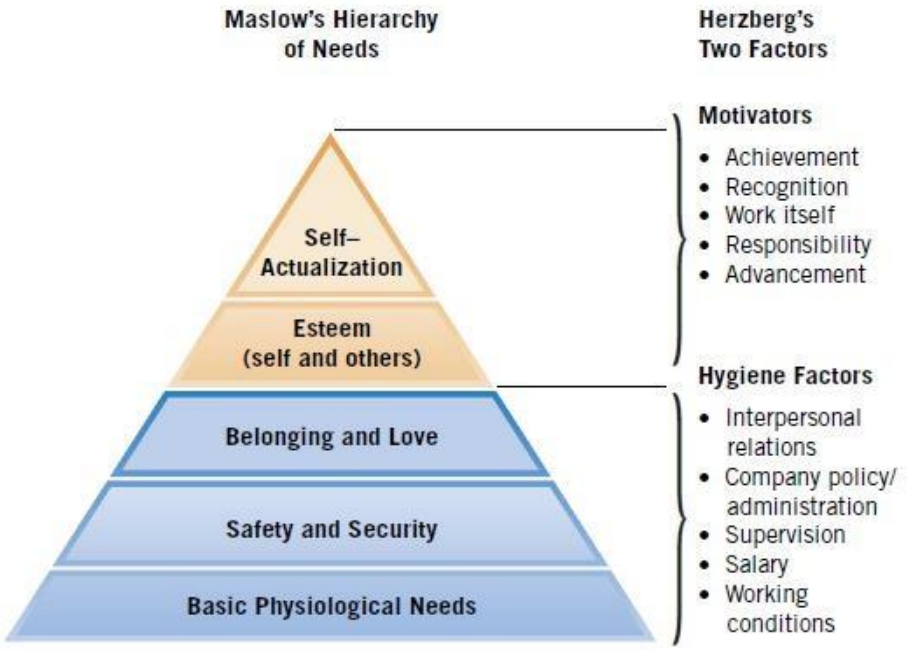

Figure 7: Maslow – hierarchy of needs (MASLOW (1954))

3.3.3 Herzberg's Two-Factor-Theory: Motivation-Hygiene

In the theory that the American psychologist Herzberg (2017) set up in 1959, he distinguished factors that trigger satisfaction and dissatisfaction. He interviewed employees according to the circumstances and duration of events in their working world, which had made them satisfied or dissatisfied. Herzberg came to the conclusion that certain factors are contributing more often to satisfaction as to dissatisfaction. These include sense of achievement, recognition, the work itself, sense of responsibility, promotion and development. Accordingly, there are also factors that are leading more likely to be dissatisfaction than satisfaction, such as company policy and administration, competence of supervisors, personal relationships with supervisors,

working conditions, income, relationships with colleagues, personal life, relationships with subordinates, status and security.

Figure 8: Herzberg´s motivation hygiene theory (Berger (2018, p. 103))

The Model

According Berger (2018, p. 102) the evaluation of Herzberg´s studies showed that two factors can be distinguished:

1. Motivators: These are factors that promise to satisfy needs and motivate the individual to a certain behavior. For the most part, these are factors associated with successful personal development, such as recognition, success, responsibility and work content.
2. Hygiene factors: Just as hygiene in the hospital does not make anyone healthy, but prevents disease, hygiene factors do not create satisfaction, but if they will be neglected, they cause dissatisfaction. Hygiene factors are usually factors that are related to direct job design such as work equipment, wage, monitoring and control and the administrative process.

Herzberg further observed that the hygiene factors after a short time are taken for granted, when they are satisfied. Therefore, they do not cause motivation but only a "non-dissatisfaction". If "motivator needs", as success, recognition, personal growth, etc. are not satisfied, this leads not to dissatisfaction, but to a "non-satisfaction".

3.3.4 Payment Systems

As described, it is an important task for managers to keep their employees happy. The scientific theories of motivation showed, people in general are already motivated, that is why in practice motivational strategies based on the salary have a lasting demotivating effect. Extrinsic incentive systems often cause that work is done just to obtain the reward. The need to provide meaningful performance, finding acceptance

and being socially involved is a major driver to work. Making money has a mediating role. Only with a reasonable income can the human needs be fulfilled in our society - housing, food, mobility, status, future-proof education, cultural participation. For a manager, it is important to create optimal performance conditions in business and to increase and maintain the performance of people in company. (Berger (2018, p. 91))

Many signals point out – beyond all constantly new theses on the change of values – that money is no longer sufficient in an increasing meaning deficit, lack of freedom and compensate a demotivating corporate culture in the long term. If a company fail to live up to the desire for meaningful and effective, fun-doing work, there will be a fluctuation of the well experienced employees. The most valuable people are often the ones who could change at any time to another company. On the other hand, those who have people who are paid well for what they are able to do will remain in the company, cause no other company will ever pay the same. (Reinhard K. (2014, p. 98))

3.4 Fear

Handling fear is perhaps the most difficult and at the same time most important aspect of process-oriented work – the approach with your own fear and with that of others. If people are not afraid, they will become comfortable, when people are afraid too much they become paralyzed. Controlling the level of anxiety is therefore one of the essential tools of the leadership management as well as in education.

Anxiety strategies work with the form of dramatization, manipulating people with covert motives to release their energy. But this strategy can also lead to paralysis of the overall system.

Who starts with the injection of anxiety in the indispensable foundations of human well-being – security, safety and recognition – without real hardship, produces a lot of problems to deal with later on. Anyone who does not know what to expect is naturally protecting and defending oneself. Who absolutely doesn't know what awaits him in the future, who doesn't know how far he even plays a future role at all, is hardly applying energy to creatively shape this new future. (Doppler and Lauterburg (2014, p. 111))

3.4.1 Anxieties – Learning and Survival

In Change Management, we must deal a lot with anxieties, anxiety can inhibit learning, but the right dose is important if learning is necessary. The learning anxiety is related to the motivation of people to un-learn what the know and to learn something new. According Doblhofer (2016) related fears can be:

- the new can be too difficult
- to be ashamed of participation
- renounce successful habits

In addition, learning of something new can brand people as outcasts. There can be an imminent danger for our self-esteem or even our identity. the learning anxiety often forms the basis of the change resistance. To conquer this resistance, the survival anxiety is important people have to change in order to survive. People are willing to change caused by their hopeless anxiety. Further to purposeful learning concepts, learning happens when the survival anxiety is higher than the learning anxiety. This can be caused by:

- Threatening people with job loss or valued rewards, is a way of increasing the survival anxiety.
- Decreasing the learning anxiety by creating a safer environment for unlearning or new-learning and therefore creating a so called psychological safety net is very difficult when you are pushing for a higher productivity or a major change in the company.

Figure 9 shows the motivation to change related to the two types of anxieties. The motivation to change with a survival anxiety is much higher compared to the learning anxiety.

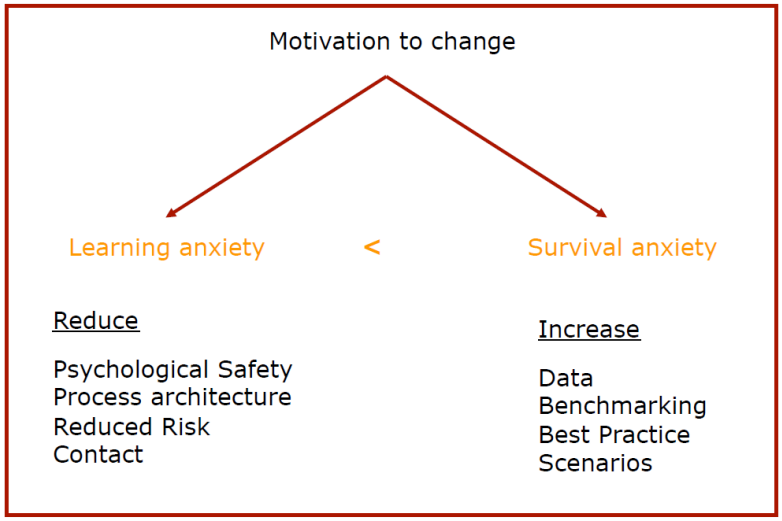

Figure 9: Motivation to change by learning and survival anxiety (Doblhofer (2016))

3.5 Employees and their Loyalty

Motivated employees strengthen the company and its competitiveness. Employees are probably the most valuable resource of a company. When people's values are reflected in those of the company, employees tend to be more productive, more loyal, and see their work as meaningful.

One factor of Steve Jobs success with Apple is related to his philosophy of staff recruiting. He tried winning over and retaining the best staff. Jörg Knoblauch (2013) defines this type of employees as A-staff. In the following chapter is explained a theoretical way how employees can be characterized. This classification should help to support the different employees in the best possible way and to increase their employee loyalty in the most efficient way.

3.5.1 Classification of Employees

According Jörg Knoblauch (2013) employees can be grouped in three different classification. There are A-, B-, and C- employees working in each company, characterized by the caricature in Figure 10. These employees differ over performance and motivation to work. This can be also significant to find the right incentives related to each group of employees, to understand their company related loyalty.

Figure 10: A-, B, C- employees according Knoblauch (2016)

A – Employees:

- Always set goals and tasks by an unusual level of commitment and success,
- think ahead and act proactively,
- are flexible in terms of workplace and time,
- run the business as if it were theirs,
- have a great interest in continuing education,
- have excellent ideas,
- shoot the goals for their boss,
- consider their colleagues and supervisors as customers and deliver therefore fast and courteous.

B – Employees:

- Mostly reach the given goals and fulfill the corresponding tasks in all areas.
- In the US, B employees are also called "Nine-to-Fiver". They are coming at 9 o'clock and leave at 17 o'clock. In between, they do their work, without having to be controlled. They won't provide unannounced overtime.
- For some tasks, B employees certainly reach results of A-forces.

- B employees also cause occasional questions like: "Did you think about that?" "Can I see it again before it goes out? "and" why did not you catch up here? " That's the way sometimes slow down other colleagues.

C – Employees:

- have internally terminated,
- show little or no customer orientation,
- have little or no willingness to further education,
- are against any change, behave destructively in the event of change,
- do not bear the corporate philosophy,
- do a lot of tasks properly, but there is at least one area where the quality of their work is poor,
- make mistakes which must be corrected by colleagues.
- If you look closely, you can see that with the behavior of the C-employee the clientele is crumbling away.

The following Figure 11 describes the potential of the different employees for a company. The matrix classifies the employees according skill level and motivation doing their work.

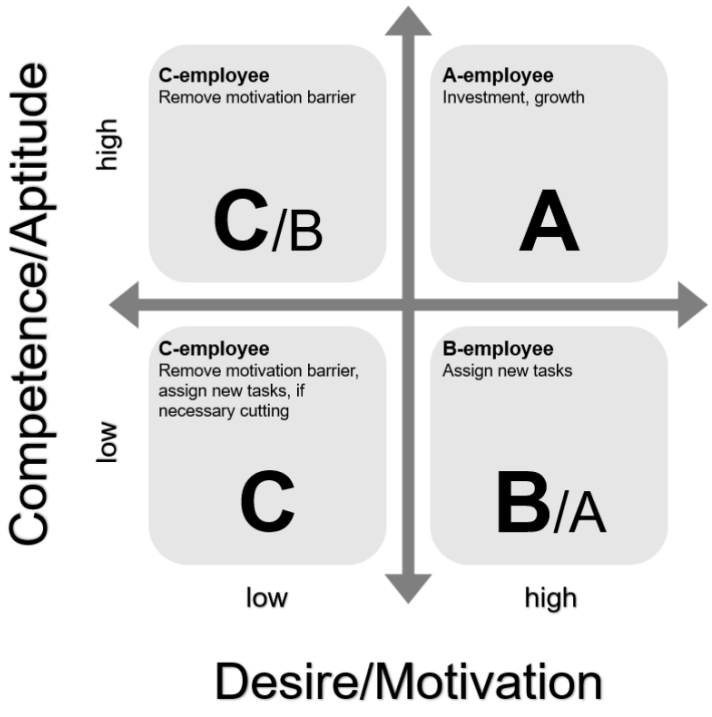

Figure 11: Classification of employees (Knoblauch (2010, p. 104))

According to the Gallup Organization in 2011, in Germany there are about 14 percent A, 63 percent B and 23 percent C working in each company. Generally, we can speak also about the 20-60-20 distribution. Whoever is constantly crying for more salary is definitely a B- or even a C- employee. These employees love the money. A-employees, on the other hand, love their job. For them, money is a subordinate. They are looking for freedom to make their own decisions and want to become involved in higher-level corporate strategy decisions. And finally, they want to develop personally. All these things are much more important to them than money. Of course, also for an A-employee the salary is important. (Knoblauch (2010))

A quote from James Goldsmith (2018) says: "*If you pay peanuts, you get monkeys*".

In big group companies due to their structures and pronounced hierarchies, A-employees often find neither the desired participation nor the desired freedom and certainly not the necessary information. It is not the question of whether an employee wants to or is able to bring achievement, but if the employee is allowed to bring it. And if an A-employee has to listen again and again, that the information he would like to have to advance his project, is only accessible to the next hierarchical level, then his level of enthusiasm will be reduced significantly. Therefore, it can happen that he will look for more attractive options. No matter how much money he gets, and regardless of whether the company is giving him as benefits. Transparency, abolition of hierarchies - all critical issues. It is precisely this transparency and permeability that not only motivates their A-employees to peak performance, but also to commit to the company in the long term. (Knoblauch (2010, p. 16))

3.5.2 Definition of Employee Loyalty

According to Kanning (2017, p. 192) a high level of employee loyalty is based essentially on three psychological phenomena:

- The **job satisfaction** of the employees,
- the degree of **social identification** with a particular professional role
- and **commitment**

define the solidarity of employees with their employer. All three variables are mutually compatible connected as shown in Figure 12. Who is satisfied with his professional reality, normally is also able to have a stronger identification with his professional role.

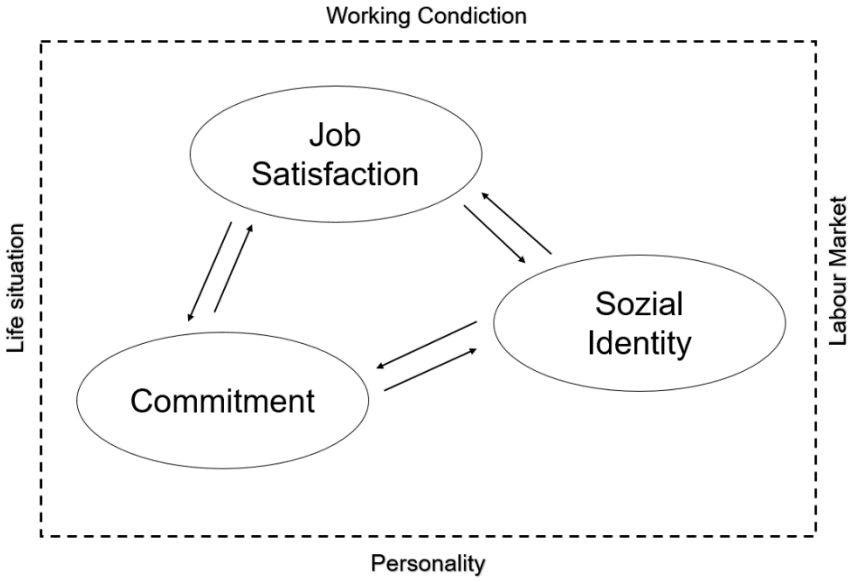

Figure 12: Connection between job satisfaction, social identity and commitment (Kanning (2017, p. 193))

Job satisfaction

Job satisfaction expresses a basic attitude of employees to their professional activity. A distinction is made between the general job satisfaction and several specific satisfactions. As shown in Figure 13, she specific satisfaction refers for example to the salary, the contents of one's own work activity, the leadership behavior of one's supervisor or the organization. While the general job satisfaction corresponds to an overall rating (For example, "How satisfied are you with your employment with the company?". (Kanning (2017, p. 193))

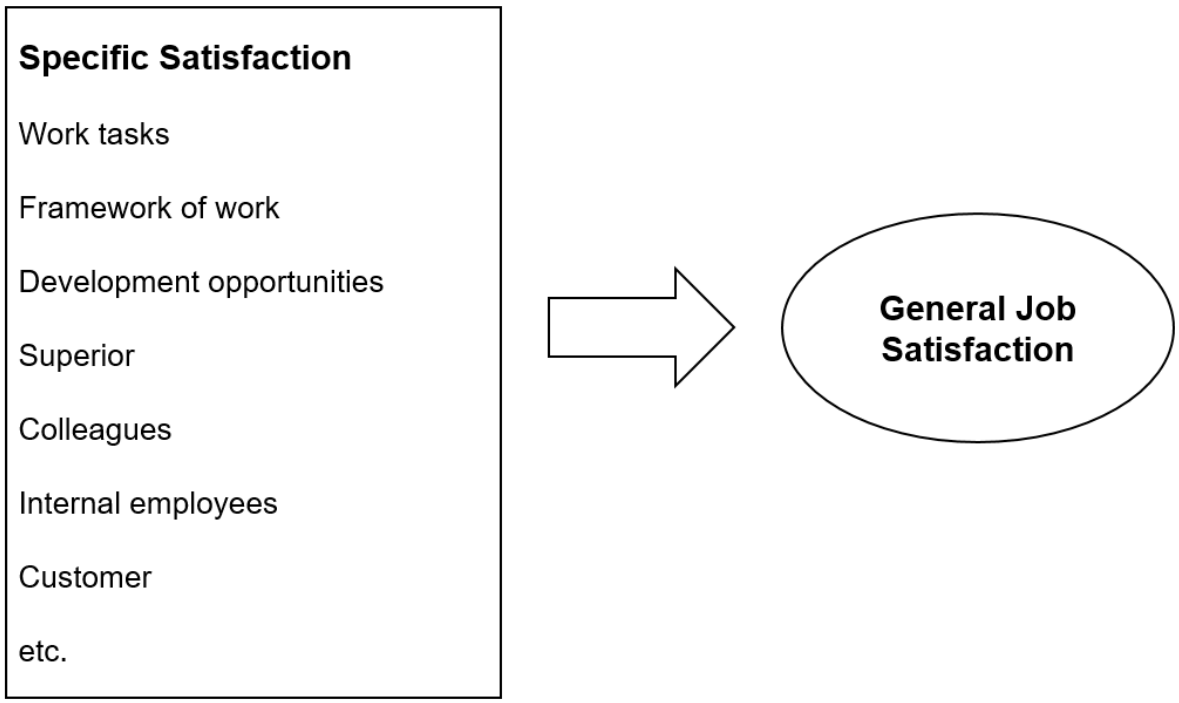

Figure 13: General and specific job satisfaction (Kanning (2017, p. 195))

According to Locke (1976) the job satisfaction is based on a target-actual comparison. On the one hand employees have certain expectations to her workplace – target values. The single individuals differ in content and expression of these expectations. The expectations can be based on our own needs, but also comparisons with colleagues and acquaintances, locally valid or socially widely represented conventions. On the other hand, the employees have their professional reality – actual values. From the comparison between what the employee expects and what he encounters in reality results the basis of satisfaction. The closer the reality to the expectations, the sooner satisfaction results.

Social identity

Social identity refers to the belonging of a person to social groups, whereby every human can have many different social identities. The employee of a company could amongst others define himself as "man", as "engineer", as "Football fan" or as "Audianer" (employee of the company Audi). Each of these social identities requires to have an idea, of all the similarities within the group members and the differences that distinguishes other groups. (Kanning (2017, p. 205))

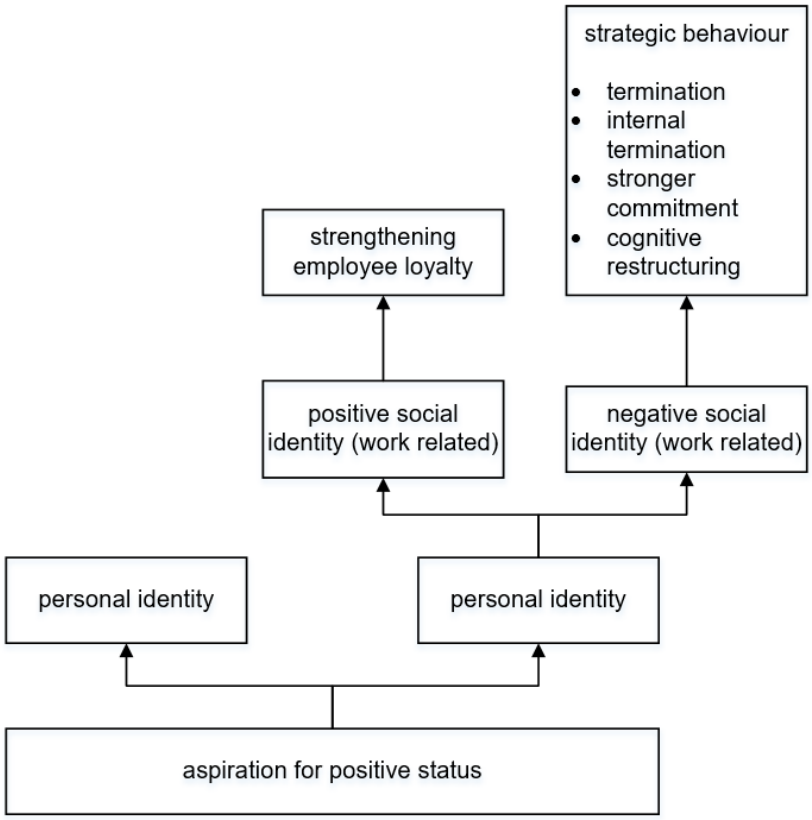

Figure 14: Model of strategic behavior (Kanning (2017, p. 205))

Commitment

The concept of commitment or organizational commitments refers to the subjectively experienced bondage of an employee with his employer. In this respect, there is a high overlap between commitment and social identity with regard to the employer. This is not inevitably always the case. A bond can also exist beyond social identity if belonging to an organization for example the employee gets material advantages which he will not miss in future. Such considerations led Allen and Meyer (1990) on a differentiation of different commitment forms which found a broad support in research.

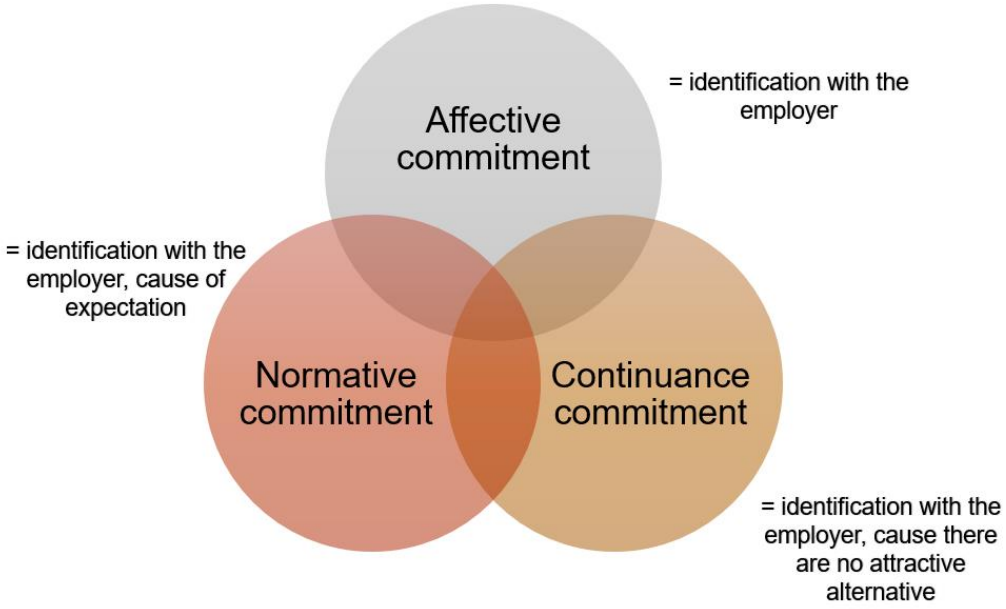

Figure 15: The three forms of commitments according to Allen and Meyer (1990)

According to Allen and Meyer (1990) the three different forms of commitment are:

- Affective commitment
- Normative commitment
- Continuance commitment

The affective commitment refers to the emotional connection of an employee with his employer. He feels joy or pride belonging and is willing to be loyal to his employer.

The normative commitment is based on the conviction to be liable to his employer. For example, the employer financed the education and for years paid the salary reliably, from which arises a certain obligation to stand behind his employer. If at the first opportunity someone is changing companies, for example because another company pays a higher salary or the current employer is in economic difficulties, he will be condemned by other people or will condemn himself as ungrateful. Therefore, exists a normative pressure for connectedness. The employee, however, puts figuratively speaking no "lifeblood" in the relationship. Because the normative commitment always reflects a bit the values and rules of a society, it does not surprise if this form of commitment, the culture has a particular influence.

The continuance commitment represents the soberest variant of the commitment. It is based on the cool weighing of advantages and disadvantages accompanied with a permanent affiliation with an employer. As long as for the employment, an employer

brings more benefits than changing to employer B, the employee experiences a bond. In times of high unemployment many employees feel special bond their employer, and not because identification or the commitment to the whole, but because there are no more attractive alternatives available. (Kanning (2017, p. 208))

3.5.3 Take Actions to Promote the Employee Loyalty

Table 8: Take actions to promote the employee loyalty (Kanning (2017, p. 234))

Work contents	Working conditions	Management
Increase and adjustment of work content regarding: professional qualification, abilities, skills, interests, work motivation	Job security	Setting precise and challenging goals
Increase the diversity of requirements	Performance based payment	Call for performance
Creation of holistic tasks	Professional performance evaluation	Give professional feedback
Increase the relevance	Realization of principles of justice	Let employees participate on decision
Increase the autonomy	Promotion of social competent behavior between employees	Promotion of social competent behavior between employees
Increased application of feedback	Strengthening social identification	Take the interests of employees into account in distribution of tasks
	Professional personnel development	Contingent reward of performance
	Reduce unnecessary stress and strengthen stress resistance	Promote an emotional bond for a joint work

The promotion of employee loyalty is one important task for HR managers and executives. Table 8 shows different possibilities to promote of employee loyalty regarding the topics of work content, working conditions and management.

If employers want to run in the indicated direction, it's not a question of options, but rather a question of readiness and suffering. In the extent to which a company loses good employee to the competition, is the extent to increases the need to be active accordingly. (Kanning (2017, p. 237))

3.6 Generation management – Generation XY

The generation management in times of Work – 4.0 requires the analysis of new phenomena. Decreasing birth rates and simultaneously increasing life expectancy are changing the population structure and also the company structures and cultures. There were never so many different generations worked together in companies at the same time. (Herget and Strobl (2018, p. 67))

The concrete characteristics of the revolution could be as follows:

In times of smartphones and the virtually nationwide possibility of internet access gives you the opportunity to work anywhere, even outside the company. If it is not a specific work at a specific time, then the working time can be adjusted to meet their employee own needs. One advantage is that such a flexible coordination to create a “family friendly” work. To make this kind of work possible a change from the still cultivated presence culture to a results-oriented culture is required. The basis of this is a lived culture of trust. The way forward this objective can be described as rather difficult. The majority of companies are not ready for digitization. The real problem of this is their companies culture. Because when it comes to the fitness for the future, the digital technology accounts for only 20%, but the rest is based on the requirements coming from the transformation process itself. Digitization is not just a technical process, but rather a social and cultural process. Fears arising from this pose a major obstacle for the upcoming changes. These fears are related to the high complexity, unmanageable diversity and unpredictable future. Especially older workers have difficulties in the areas, they are being considered less efficient, allegedly not in the mood for something new and their own qualifications seem outdated. Since in the future the average age

of the employed persons continues to increase, the confrontation with such attributions becomes a key role. (Herget and Strobl (2018, p. 74))

This is just one facet of the demographic change that has to be considered.

The following description of the generations helps to determine the differences but also the similarities between the different generations. According to these generation specific characteristics, also motivations must be adapted accordingly. (Mörstedt (2017))

- **Baby boomer (Year 1950 – 1965)**

Table 9: Baby boomer characteristics (Mörstedt (2017))

Values	Health Idealism Creativity
Characteristics	Team oriented Career orientation – quickly move into managing positions Work has the highest priority
Working life	Structured working stile Regular exchange in team Maintaining of relations and networks
Communication device	Phone
Motivation	Personal progression Appreciation for their experience Feeling to be needed

- **Generation X (Year 1966 – 1980)**

Table 10: Generation X characteristics (Mörstedt (2017))

Values	Independence Individualism Search for meaning
Characteristics	Pragmatic

	Independently Pursuit of a high quality of life Time is more valuable than money
Working life	Delivering Results Technically savvy Share power and responsibility
Communication device	Email, mobile phone
Motivation	High degrees of freedom in work design Development opportunities Work-life balance

- **Generation Y (Year 1981 – 1995)**

Table 11: Generation Y characteristics (Mörstedt (2017))

Values	Networking / Teamwork Optimism
Characteristics	Life in the here and now Growing up with new technologies "24 hours online"
Working life	The work must be fun, willing to learn, willing to work - but demand for private life very pronounced Flexible and adaptable, independent and independent way of working Leadership positions are no longer so important to them, rather specialist careers and project-related work Master in multi-tasking
Communication device	Web 2.0
Motivation	High degrees of freedom in work design Development opportunities Work-life balance

- **Generation Z (Year 1996 – 2010)**

The next generation entering the labor market belong to the so-called Generation Z. They grew up completely with digital technologies: Internet and smartphones are

naturally part of their lives - at work as well as in private life. Unlike Generation Y, Generation Z differentiates more between work and private life. They have a great desire for free development, but are also aware of their uncertain future. They will not reach the prosperity of their parent generation, but they have the possibility to develop in all directions. At the moment only, a few of this new generation are already present on the working market. There are no clear features visible yet.

Interaction of generation

Florian Kunze (2013) from the University St. Gallen calls two phenomena related to the demographic change. The biggest challenges related to the age diversity are: the climate of cooperation and readiness for cooperation. In the climate of cooperation, the theory of social identity and the similarity-attraction theory plays an essential role. They explain a basic appearance in social groups, according to employees of the same age and with similar interests have stronger feeling of either attraction as employees of different ages and with perhaps completely contrary inclinations. Willingness to cooperation, it is also influenced by the expected future career opportunities. Older employees due to the demographic change and the resulting longer contact with the company block certain positions for the younger ones. This reduces the willingness for an open cooperation massively. On the other side, more and more older employees have to be able to deal with younger supervisor. At the moment, there are four generations in working life, whose division is shown in the following Figure 16.

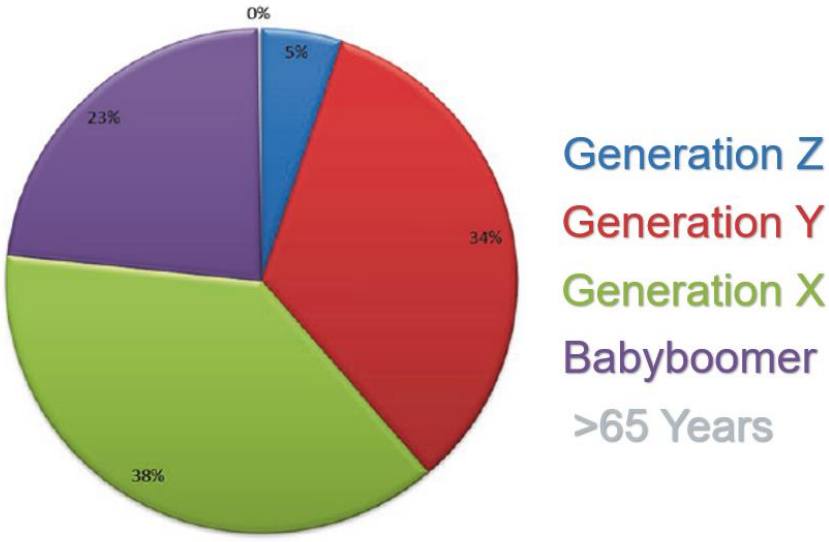

Figure 16: Generation distribution (self - presentation based on the data of the main association of the Austrian Social Security Institution) (Kunze (2013))

Empirical studies of (Kolland and Wanka (2015)) have shown, that only in the values of job security, mean and purpose there is agreement of all three generations within the value scale. In addition, some individual values are shared be two of the generations. This is how the members of generations X and Y are characterized flexible and demanding. The range of matches between baby boomers and generation X is bigger. Both groups see themselves as experienced, reliable, performance-oriented, independent and organized. The cooperation within the own generation is best rated which is not spuriously, as shown in the above-named theories. The biggest potential of conflict exists between baby boomer and generation Y. Each group feels disadvantaged compared to the other one and blame the other ones for the conflicts. 80% of baby boomers would like to have support measures for older workers and 93% of Generation Y for the younger employees. It is once again clear that the subject of cooperation of the importance of generations cannot be overstated.

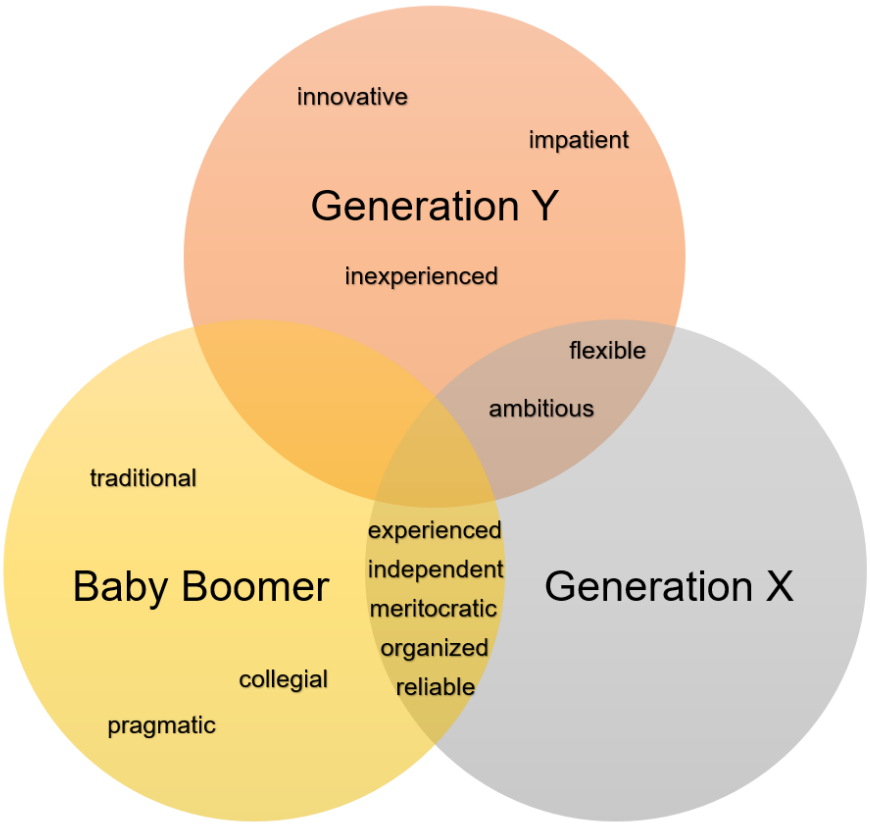

Figure 17: Generation related values (Kolland and Wanka (2015))

Working 4.0

As already mentioned in the previous section, the demographic change will be a big challenge for the companies future, but also a change in the world of work driven by the tremendous technical progress that gives companies a big opportunity. But the technique is only part of a troika. Work 4.0 means considering the technique and the effects on the companies and the within people working.

Alongside the extended technical possibilities there is a progressive digitalization of products, processes and services and thus effects the work organization and their employees. To transform the increased efficiency in future business opportunities in addition a corresponding capacity for innovation is needed. This environment in which speed, flexibility, efficiency, but also quality is playing an essential role, is also called VUCA – World:

- V – Volatility
- U – Uncertainty
- C – Complexity
- A – Ambiguity

Accordingly, the interaction between technology, organization and people must be seen as a whole. From the resulting effects, similar to in demographic change, tasks can be determined.

When production processes are fundamental changed, also the qualification profiles change, or when the innovation cycles will be shortened, the existing knowledge will be outdated much faster. Thus, in both cases increases the need and scope of education and training. This results in the necessity to clarify how the associated burden sharing between companies and employees should be done. (Herget and Strobl (2018, p. 83))

4 Organization and Organizational Structure

Organizations are socio-technical systems characterized by a specific goal orientation, a formal structure and an open system. Goal oriented cooperation is impossible without organizational rules. The following chapter provides insights in the terms of organization and organizational structure. In addition, some concepts of centralized and decentralized coordination will be explained.

4.1 Organization

There exists no clear definition in economic and social sciences of “organization”. Various theoretical approaches follow different definitions. A possible definition of organizations as a social entity is: Organizations have a permanently goal and have a formal structure, which helps to adjust the activities of the members to the pursued goal. Arnold Picot, professor and director of the institute for information, organization and management at the LMU Munich, considers the organization as the epitome of all task sharing and coordination of targeted regulations for achieving the objectives of the enterprise. (Pinnow (2011, p. 24))

In sum, under the organizational combines the problem of tasks division (distribution of an overall task to various task carriers) as well as the coordination (coordination of work-sharing tasks) to master an overall task. An organizational structure stands for the totality of all rules, which controls the distribution of tasks for the fulfillment of processes as well as the behavior of the task bearer.(Scharfenberg (1993, p. 217))

The central task of an organization

A business must be able to respond quickly to new requirements and it must target its resources specifically to the corporate use, true to the very old maxim: Try to realize the maximum benefit with a minimum of effort. The significant factors are flexibility, efficiency and effectiveness. (Pinnow (2011, p. 25))

4.2 Organizational Structure

In the literature on organizational structures is differentiated between management systems and structural models. The former includes the single-line system, the staff

line system and the multiple-line system. Important Structural models are the functional organization and the division organization at the one-dimensional level and on the multidimensional level the matrix organization and the tensor organization. All classic organizational structures have in common their hierarchical structure. The advantage of this regulatory principle is the structure of clear instructions and their reporting procedure. The competences are clearly regulated and the possibilities to control are good. In large companies, this organizational structure leads usually too many hierarchical levels. The problem with this structure is often the lack of communication the individual departments have with each other, because the different areas of responsibility are strictly separated. This complicates the decision-making in cross-departmental problems, because communication has to run in the ideal case along the line. (Pinnow (2011, p. 32))

The for this thesis relevant structure models are described in the following chapter. Because of the lesser importance of the other organizational structures in this work at Audi Hungaria, the will not be explained in detail in this part of the theory.

4.2.1 Line Organizational Structure

The line organization is based on one directly vertical relationship between the various levels in the company. To accomplishing the primary goal of the organization there are only line departments involved and the organization authority follows the chain of command.

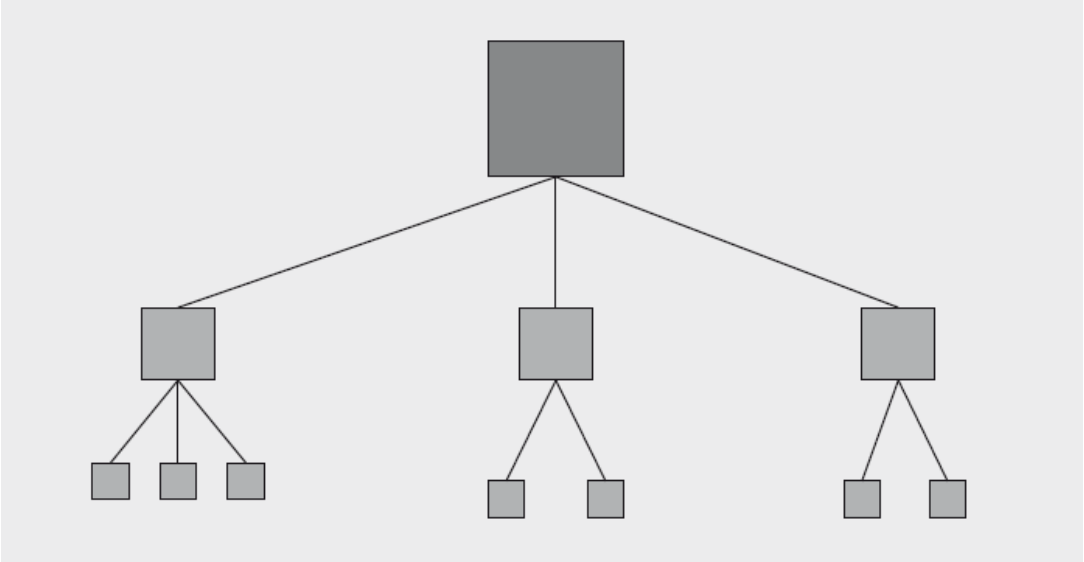

Figure 18: Model of a line organizational structure (Pinnow (2011, p. 36))

Advantages:

- A line structure tends to simplify and clarify responsibility, authority and accountability relationships. The levels of responsibility and authority are likely to be precise and understandable.
- A line structure supports fast decision making and flexibility.
- In small companies with line organizations the relationship between management and employee is close.

Disadvantages:

- As bigger the company is the more ineffective the line organization becomes.
- Improved speed and flexibility may not offset the lack of specialized knowledge.
- Managers should become experts in too many fields.

4.2.2 Multi-Line System

In the multi-line system, a unit can be supervised by different organizational units. The main idea behind this system, is the supervision by experts, which leads to a high specialization. The problem with this system is the possible overlapping of authority. If an employee has different supervisors for different areas, so through different interests of the respective executives the implementation of tasks can arise conflicts. The coordination effort, to avoid this is usually relatively high.

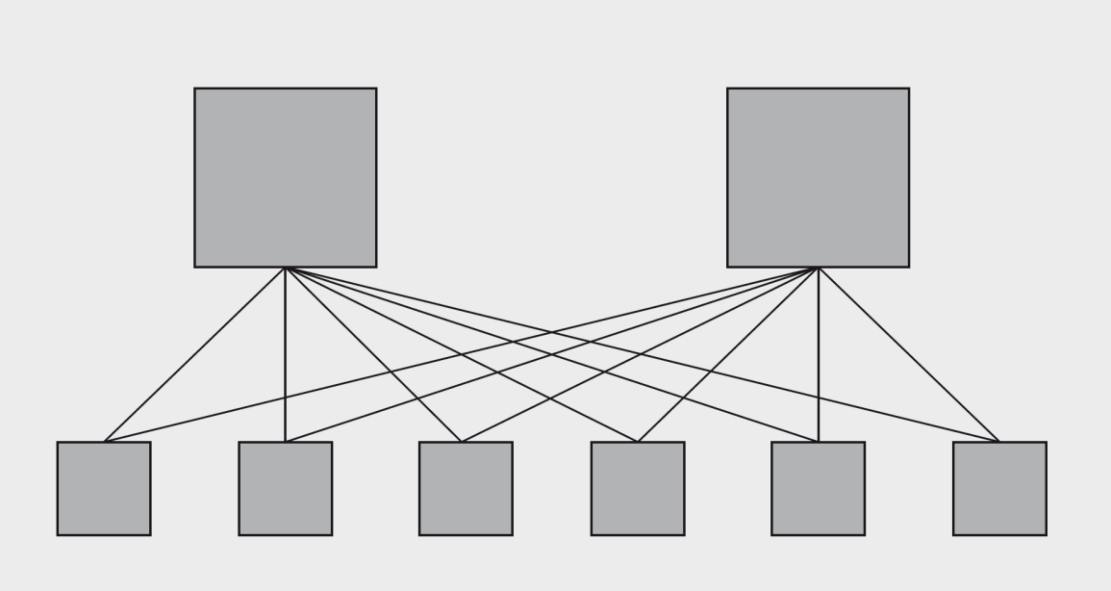

Figure 19: Model of a multi-line organizational structure (Pinnow (2011, p. 34))

4.2.3 Matrix Organization

Multi-dimensional structural models usually combine at least two control systems that overlap each other. In the matrix organization as a two-dimensional structural model, each executive position has two control instances responsible for them. This form of organization today is common in most large companies and can have up to ten levels of hierarchy. The decision-making and directive powers are in the matrix organization divided into more managers positions. This can lead to problems in the definition of competences between the management positions. The previously reached higher flexibility in the matrix can be neutralized due to the high coordination effort in decision-making at the top management level and conflicts between leaders can even lead to complete inability to act. (Pinnow (2011, p. 40))

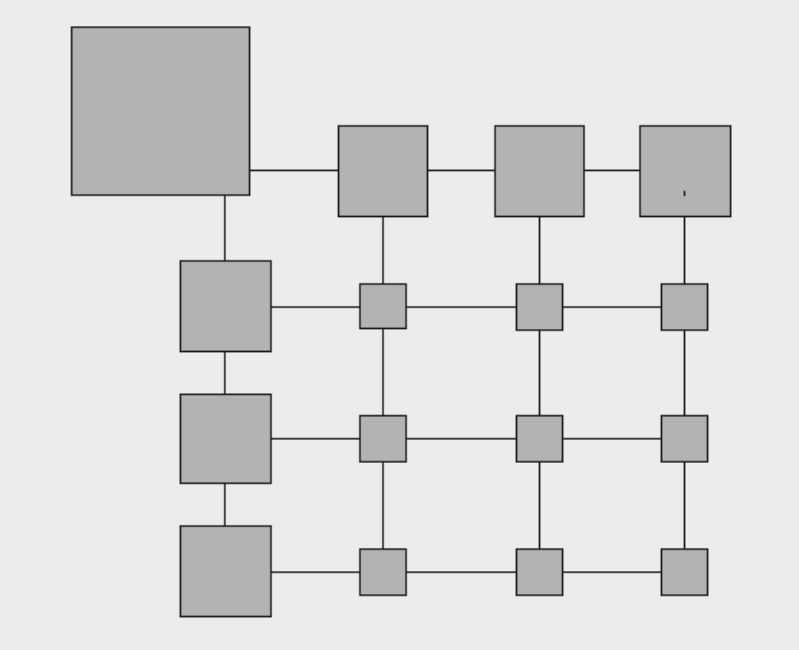

Figure 20: Model of a matrix organization structure (Pinnow (2011, p. 42))

The management problems can decrease when participation and leadership increase. As a prerequisite is the “matching” personality. (Palt (2013))

The following Table 12 illustrates that companies only benefit from the matrix organization if project management will be equipped with decision-making and authority.

Table 12: Advantages and disadvantages of matrix organization (Palt (2013))

Advantages	Disadvantages
Considering holistic, innovative solutions to problems from different points of view is possible	Problematic delineation of competences due to the multiple placement of the execution sites; thereby can arise competence conflicts and power struggles
Relief of corporate governance through specialized management functions within the different dimensions	Perhaps difficult and time-consuming coordination and decision-making processes
Short paths of communication	Danger of many compromises
Flexible adaptation of the organization to the market and competitive needs	High information processing capacity required
Hierarchy is not in the foreground	Bureaucratization tendencies through elaborate communication and competence regulations
Various possibilities of personnel development through entrepreneurial perspectives of the matrix manager	Strong need for qualified executives

4.2.4 Diverse Types of Matrix Organizations

Hierzer (2017) is characterizing the three different categories of a matrix organization, depending on the level of power and authority of the project manager:

- **Strong Matrix Organization Structure**

In a strong matrix organization, the project manager has the most powerful position. The project manager has a full-time job, to manage the administrative staff under him and to control the project budget. A strong matrix structure has similar characteristics as a project organization. The functional managers are very limited in their role.

- **Balanced Matrix Organization Structure**

In a balanced matrix organization, there is an equilibrium of the power and authority between the functional and the project management dimensions. The project manager has still a full-time job and has to control the administrative staff under him. In this organization structure, both dimensions have to control the budget of project.

- **Weak Matrix Organization Structure**

In weak matrix organizations, the project manager plays only a lower role. He has is limited in power and authority, only a part time job and has to do no administrative control. The project manager is more like a coordinator and the project budget will be controlled from the functional dimension. The weak matrix organization has similar characteristics of a functional organization structure.

4.3 Coordination – Decentralization vs. Centralization

According Scharfenberg (1993, p. 219) (de-) centralization means moving away from a center or movement towards a center. This movement towards one center of several units (or vice versa) can affect different facts:

- Competences, this means, rights of action regarding the fulfillment of certain tasks, in particular decision-making, participation and information rights (organizational (de-) centralization)
- Locations, where tasks are performed (spatial distribution of jobs, departments, entire services and companies; therefore spatial (de-) centralization), and
- Market contacts, therefore spatial expansion or concentration of the market business activity.

Very strong centralization therefore means: concentration of autonomy and responsibility at a headquarters; the others only have residual skills in the sense of regular execution. Complete decentralization then means utmost autonomy and self-responsibility of many task bearers, who coordinate themselves with each other on an equal footing.

There are issues of (de-) centralization that cannot be answered with a simple "either-or", but always with a fair mix of central and decentralized elements. (De-)

centralization is never a one-way street. A sole centralization would be break under their own excessive demand, as we have seen in Eastern Europe. And for the functioning of decentralized solutions, appropriate central frameworks, infrastructures and services must be created and maintained. (Scharfenberg (1993, p. 217))

Within the company should only be done such tasks by themselves, which are company-specific and have a strategically important character. Standard services, which can also be obtained in the external market or if necessary, can be done with a cooperation with another company, should not be internally. That means to focus on the core competences. Decentralization in the form of the swap to the external market, "outsourcing", for such non-core services a benefit, although often it is a difficult solution to enforce in individual cases.

According to Scharfenberg (1993, p. 232) the difficult question is to clarify in which way the necessarily internally should be created. This is possible if one applies the following guidelines:

The specificity of a support function can be divided into:

- Subject-specificity (the assignment of tasks requires precise knowledge of the specific working methods of the respective [market-oriented] specialist department on-site).
- Infrastructure specificity (the task distribution requires exact knowledge of the special overall connections and [also technical] overall systems of the enterprise).

The following Figure 21 explains this using the example of information system tasks:

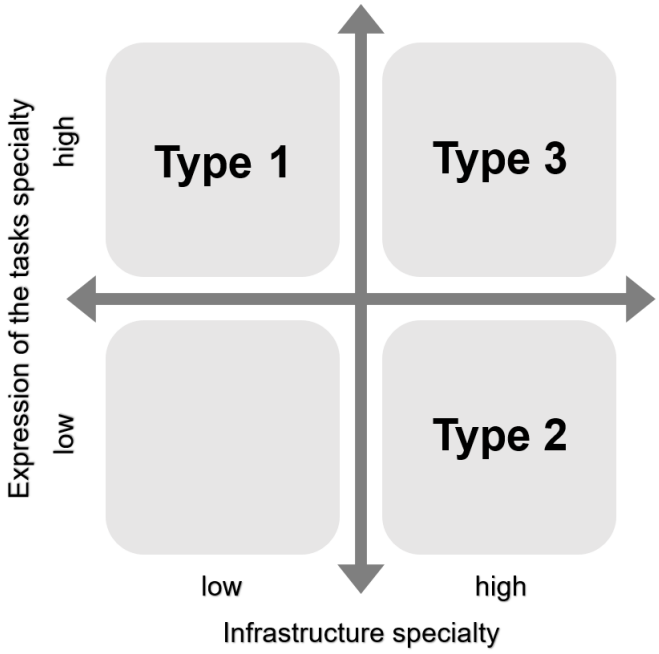

Figure 21: Decision matrix for (de-) centralizing internal functions (Scharfenberg (1993, p. 233))

There are three types of tasks (the fourth field is therefore unoccupied, because low total specificity leads to outsourcing to the external market). Assuming now that in the specialist departments the technical application know-how is available and in a central department the specific infrastructure know-how, so than the question of decentralization or centralization is no longer difficult.

Support tasks of type 1 are dominated by respective technical requirements. They are assigned to the respective specialist departments. These may need to supplement their skill-matrix slightly (for example, broadening the basic education or decentralized specialists). Also, they must be subject to certain general standards and methods of head office.

The actual function will be decentralized according to the specific technical support requirements perceived in their own responsibility, economically as well as flexible fulfilled and well maintained.

Type 2 tasks are dominated by the overarching political, technical and methodological features of the enterprise. Therefor they are attributable to a central department. In coordination with the superior business policy, it develops and maintains the company-wide principles, systems and infrastructures. The central department must do this with

the help of suitable planning and coordination mechanisms to take the future development the quantitative and qualitative requirements of the specialist departments to the infrastructures into account.

Type 3 tasks must in cooperative form between headquarters and specialist departments be settled, because they are both infrastructure-related but also have technical specifications to a high degree (hybrid solutions). Depending on the individual case, mixed project teams, mixed committees or ping pong procedures can be sensible organizational solutions. It may also make sense to allocate an infrastructure task to the department that uses it the most and to co-operate the others from there. (Scharfenberg (1993, p. 234))

5 Introduction Maintenance-Management and Organization

To get a better understanding of the importance of maintenance in this chapter the value of maintenance will be thoroughly explained. The different maintenance philosophies such as TPM and their potentials are explained briefly afterwards. This maintenance chapter will be completed by some challenges of today's and future critical maintenance resources.

5.1 Value of Maintenance

Influence of maintenance on strategic success factors

Strategic success factors are all those factors designated by their targeted use to achieve competitive advantages over the competitors, to secure sustainably the company's success. These listed features are basically also desirable properties with regard to the design of a maintenance management. With an adequate maintenance concept, it is possible to influence the strategic success relevant factors. According to Schröder (2010, p. 35) the maintenance has influence on the following dimensions:

- Cost
- Quality
- Time
- Flexibility
- Work and plant safety
- Environmental protection

5.1.1 Significance, Influencing Factors and Potentials of Maintenance

Maintenance in plant-intensive companies causes one of the biggest cost drivers under the indirect service areas. According to Schröder (2010) the operating maintenance costs vary from industry to industry from 5 up to 15% of the replacement value of the plant. Researches from BMBF (Bundesministerium für Bildung und Forschung), Figure 22, show that the costs for the direct maintenance services (personnel, consumables, spare parts, information systems, new technologies, etc.) are around 1,500 billion

euros across Europe. The Indirect cost component, which is depending on machine downtime, quality losses, warehousing costs, replacement investments, etc., is even higher by a factor of 5 and is about 7,500 billion euros.

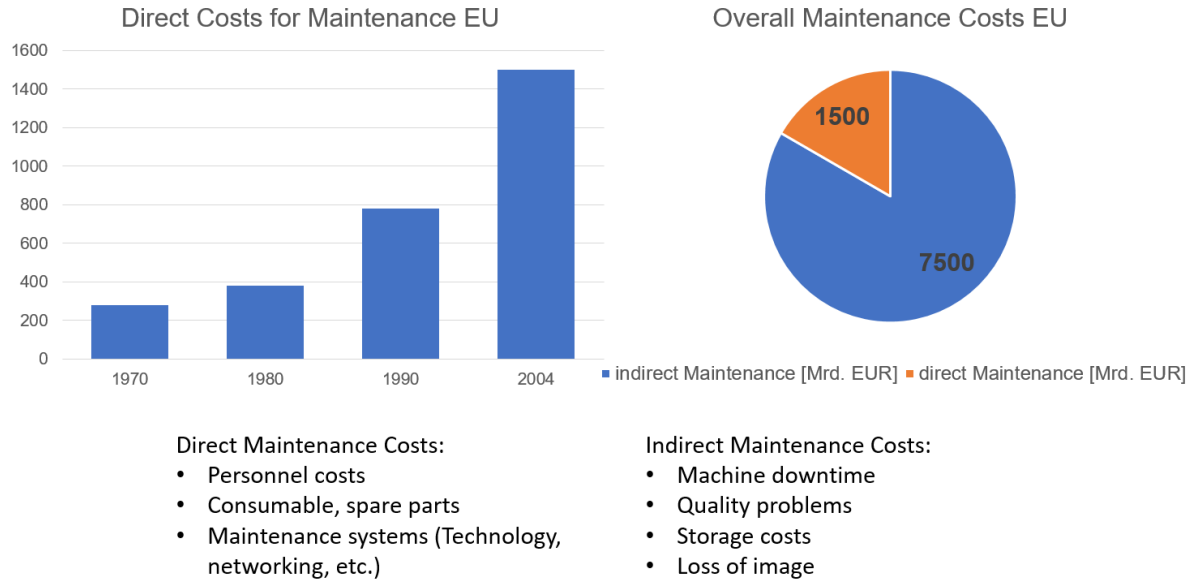

Figure 22: The economic importance of maintenance (Schröder (2010, p. 2))

Schröder (2010) estimates that in industrialized countries about 10% of the gross domestic product per year are spend for maintenance measures. The high indirect cost part, inter alia, is also caused by an inadequate maintenance management in operational practice.

5.1.2 Savings Potential of Maintenance

The success of a manufacturing company depends to a significant extent on the needs-based use of machinery and equipment.

The rising fixed assets, plant and equipment, the high demands on availability and reliability as well the increase in consequential damage costs, obligates to place the maintenance into focus for the overall business success. Target of maintenance management is therefore, a long-term maximization of performance indicators while striving to minimize costs. (Schröder (2010, p. 3))

Table 13 gives an overview of the biggest saving potentials in maintenance.

Table 13: Potential savings in maintenance (Schröder (2010, p. 3))

Effects of optimized maintenance	Potential range	
Staff reduction for maintenance measures	5-15%	
Reduction of storage costs	5-50%	
Time reduction for planned maintenance	0-40%	Direct costs
Reduction of the fault rate	10-30%	
Relief of the master and foreman	10-50%	
Increase in worker productivity	10-40%	
Avoidance of production outages, rework, etc.	15-25%	Indirect costs

5.2 Maintenance Strategies

The maintenance strategy defines the objectives for maintenance. These include the safety, availability, reliability and value retention of equipment and their operations. To achieve these objectives maintenance, inspections, repairs and improvements are carried out. The dosage of these measures in terms of scope and frequency is the core of strategic maintenance planning. At the component level, a distinction is made between the preventive time-based or condition-based maintenance types as well as the failure-based maintenance type. By the proper mix of these types it creates a value-based maintenance. (Leidinger (2017, p. 43))

According Pawellek (2016, p. 5) over the past decades, a number of different management concepts for maintenance have been established, which are listed below according:

- Total Productive Maintenance (TPM)
- Lean Maintenance
- Total Lifecycle Cost Strategy (TLC)
- Reliability Centered Maintenance (RCM)
- Knowledge based Maintenance
- Maintenance in Industry 4.0

5.2.1 Increasing Requirements for Maintenance

The requirements for maintenance have been increased considerably in recent decades, shown in Figure 23. Until 1950, maintenance played only a minor role. Machine breakdowns and the associated repair became accepted as a necessary evil and not associated with costs and profitability losses. Within breakdown-maintenance strategy, where maintenance actions are only carried out if their results downtime due to of malfunctions and defects. As it became known that breakdown-maintenance was no longer practicable, in 1951 started the introduction of preventive maintenance (Preventive Maintenance). In 1957, the Japan Institute of Plant Maintenance (JIPM) improved maintenance (corrective maintenance). In order to the increasing maintenance effort in 1960, preventive maintenance (Maintenance Prevention) has been introduced. This should guarantee an easier maintainability of plants. From these three maintenance elements arises (Preventive Maintenance, Corrective Maintenance, Maintenance Prevention) the concept of productive maintenance (Productive Maintenance).

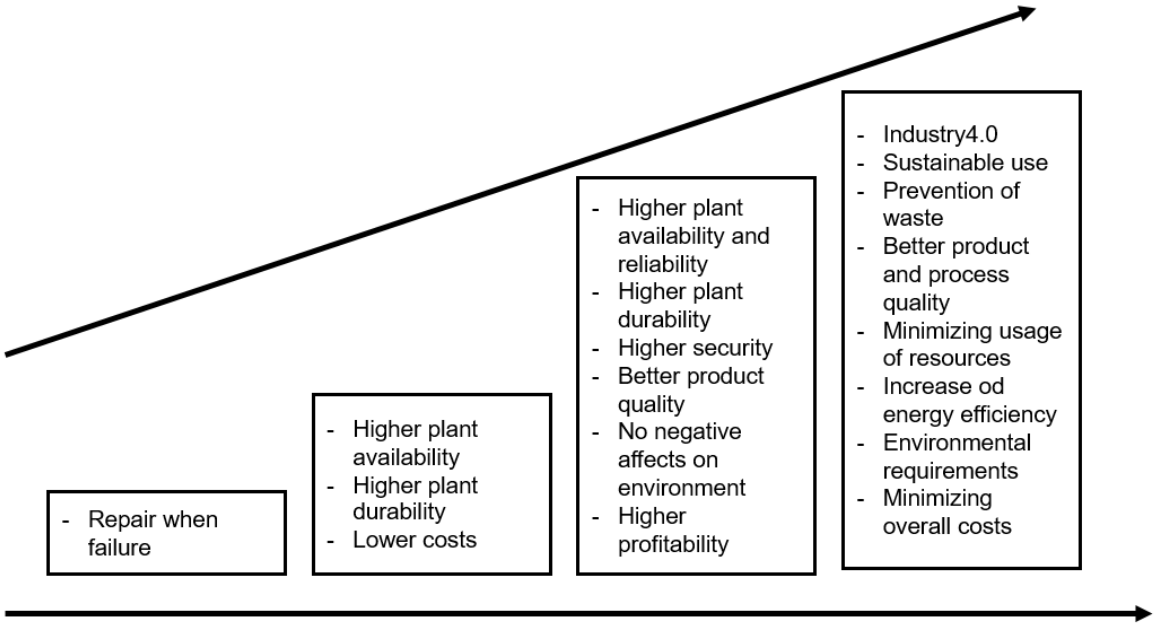

Figure 23: Increasing requirements for maintenance (Pawellek (2016, p. 4))

With the transfer of routine maintenance to the machine operators emerged in 1969 the "Total Productive Maintenance (TPM)". In the 80s TPM is also recognized in England and America. In Germany took it until the 90s, when individual companies implemented a productivity-oriented maintenance. Since 2000 new requirements for

maintenance have been popped up due to the sustainability goals in companies. Especially in the field of asset management there are considerable potentials in the life cycle of a plant. Which includes e.g. energy costs during the use of the system but also the selection of maintenance-friendly machines. In recent years, the complexity of the markets and the internal complexity as well as the demands on deliverability, availability, functionality and product prices continued to increase enormously. The new requirements will be handled with decentralized autonomous intelligence in interacting structures. In 2012 the solution is seen as the initiated future project, called "Industry 4.0". Integrated maintenance and spare parts logistics in Industry 4.0 is decentralized and autonomous units are formed, which will be a self-optimizing organization which depending on impending disturbances, will self-optimizing the production units and working together with both internal customers as well with external service providers in a timely manner. (Pawellek (2016, p. 4))

5.3 Maintenance Organization

The task of maintenance management is the design of the maintenance processes considering the success factors discussed in section 7.1. The characteristics of the production equipment, the knowledge of the maintenance personnel and the distribution of responsibilities between maintenance personnel and production staff play a crucial role.

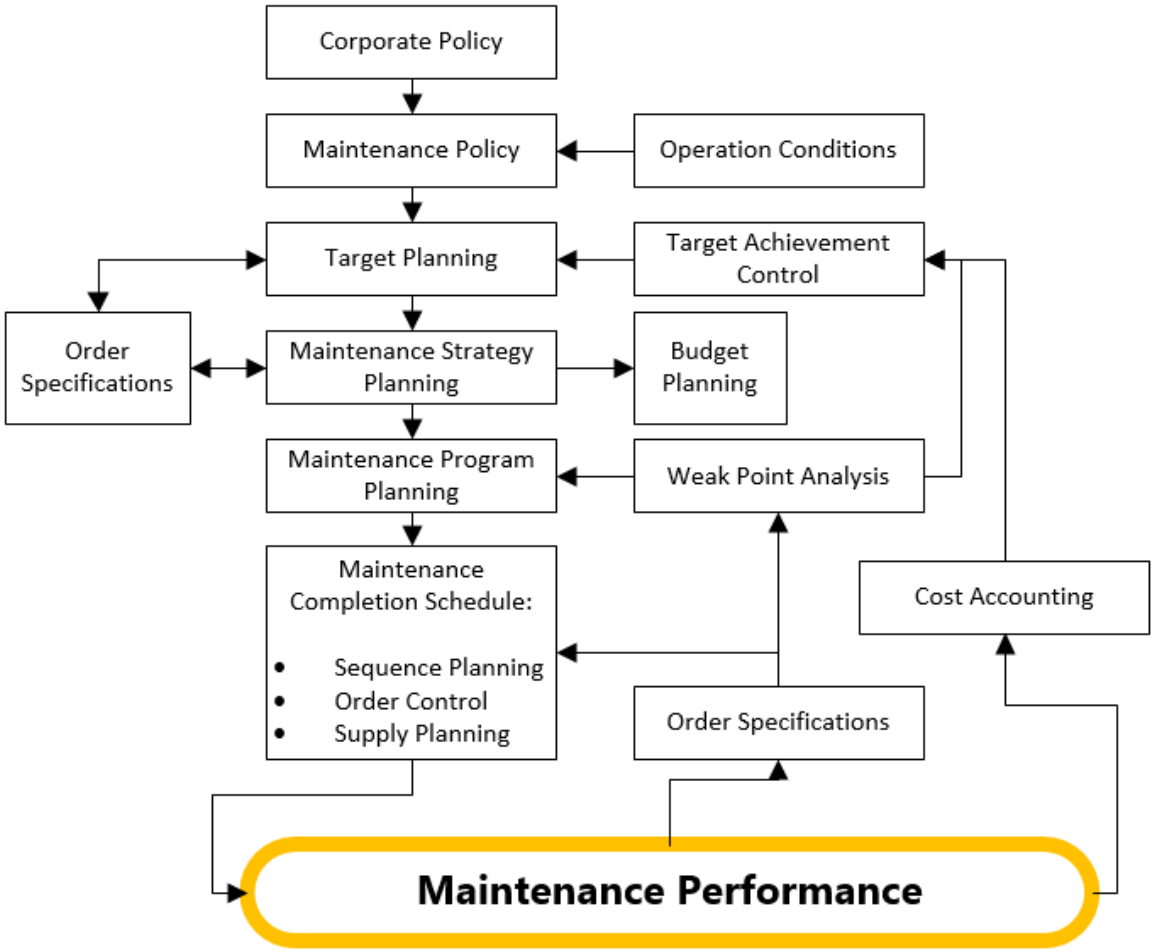

Figure 24: Control loop of maintenance management (Matyas (2016))

The management tasks of maintenance are shown in Figure 24 in the form of a control loop. Due to the characteristics of the variety of different maintenance tasks and the predominantly non-repetitive activities the maintenance management has similarities to managing projects. The determination of organizational arrangements, within the decision-making processes of maintenance should take place, represents a multi-level decision-making process. In general, it makes sense if the top management instance defines the organizational structure, which establishes a framework for the decisions and employee activities in the maintenance area. The detailed control of this operations is done in the context of the process organization, whereby the given restrictions and regulations by the outline of the structure must be respected. (Matyas (2016)

5.3.1 Matrix Organization in Maintenance

In the matrix organization, a functionally structured organization is overlapped by a horizontal, object-oriented organization. The performing maintenance job belongs to both the horizontal (performance-related) central maintenance area as well to the vertical (object related) product groups area. The matrix organization therefore is characterized by object centralization and multiple subordination. As explained in the previous chapter of the organizational structures, the matrix organization in maintenance is characterized be some advantages and disadvantages, shown in following table 12.

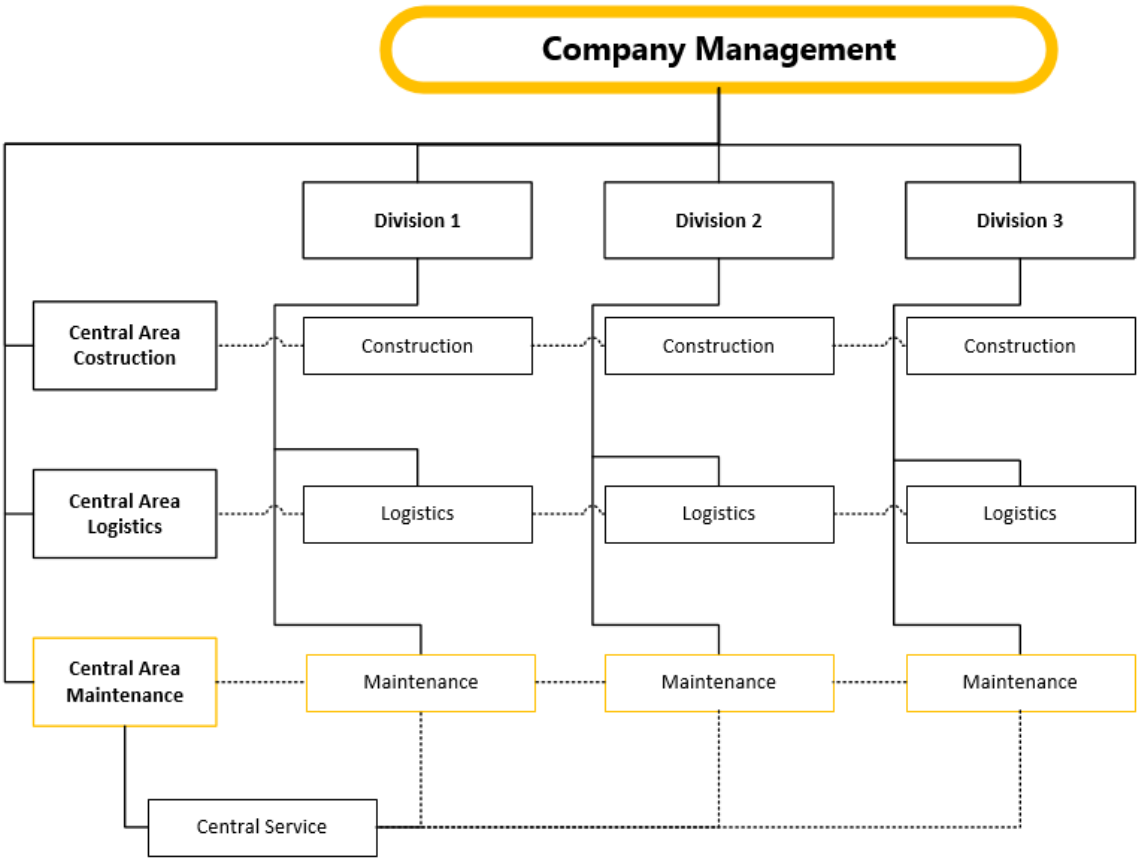

Figure 25: Matrix organization in maintenance (Matyas (2016))

Table 14: Advantages and disadvantages of a matrix organization in maintenance (Matyas (2016))

Advantages	Disadvantages
Simple and short communication channels	Increased need of information and communication
High problem-solving potential through competence overruns of the supervisor	Substantial number of management personnel required
High quality decision by specialization	Problematic delimitation of competencies complicates coordination and decision
Qualitative relief of the top management	
Employee motivation through direct contact with the top management	

5.3.2 Decentralized Maintenance vs Centralized Maintenance

In daily operation, the question arises again and again whether it would not be more sensible to integrate maintenance into the value creation process. The “ideal maintenance organization "does not exist. Rather, it must be examined on a case-by-case basis, which functions can be integrated in a meaningful way, or which residual activities remain in a lean, central service center or competence center maintenance. The service center acts as a service provider with cost responsibility. The necessary division of tasks between the remaining central maintenance and decentralized areas is described in following Table 15 according Matyas (2016, p. 76):

Table 15: Division of tasks between central and decentralized maintenance (Matyas (2016, p. 76))

Central maintenance (Service Center)	Decentralized maintenance
Maintenance strategy and maintenance program planning	Detailed planning and control
Maintenance and repair programs	Maintenance and repair (including production and quality assurance)
Weak point analysis in general	Weak point analysis plant-related
Standardization	Repair work (in the production team)

Information management, maintenance controlling	Operational and plant responsibility
Central employment pool	

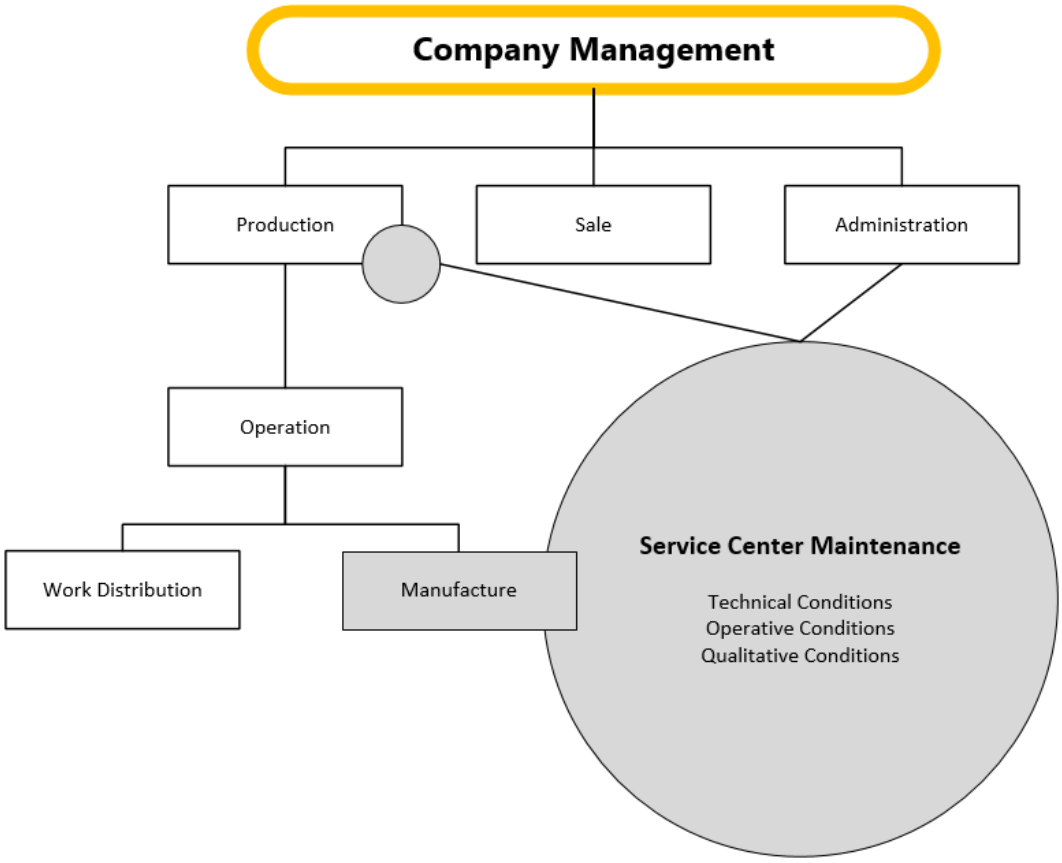

Figure 26: Possible form of organization in a production-oriented maintenance (Matyas (2016, p. 77))

The integration of maintenance activities in the manufacturing areas is a key element of the "Productive autonomous maintenance", which is an integral part of the TPM philosophy. The consideration of the service center maintenance as an internal service provider allows also outsourcing this area to an external service provider. (Matyas (2016, p. 76))

5.3.3 Outsourcing and Insourcing of Maintenance

Basic condition for the decision between own and external maintenance or a combination thereof is an analysis of the activity contents of the maintenance area.

Only then can it be determined to what extent it makes sense to have maintenance services performed by external providers. (Pawellek (2016, p. 272))

Comparison of technically and economically significant advantages of own- and external- maintenance according Pawellek (2016):

Advantages of self-maintenance

- Reduction of plant downtimes through immediate use of own specialists
- Improvement of the quality of maintenance due to specific experience of the company own staff
- Higher motivation of the own personnel in the determination of causes of failure due stronger identification with the company
- Increased performance flexibility through adaptability of the own workshops
- Protection of trade secrets and technical know-how by using their own personnel
- Knowledge and controlled application of specific environmental and occupational safety requirements (for example accident prevention regulations)
- Optimization of the coordination of different divisions by direct access possibilities on their own performance plans

Advantages of external maintenance

- Use of special knowledge and special tools of the third-party provider, due to lack of utilization should not be reserved
- Relief of own management
- Equal utilization of the own staff by the employment of the external provider
- Covering maintenance peak requirements without maintaining own overcapacity
- Warranty and rectification claim in case of poor quality workmanship
- Reduce costly education and training for own maintenance personnel
- Participation in lower wage costs of the aliens through different tariff affiliation
- Creation of higher cost flexibility through reduction or other use of fixed costs intensive own maintenance

Make-or-buy-matrix as the basis for decision-making on the strategic and economic determination of one's own depth of added value.

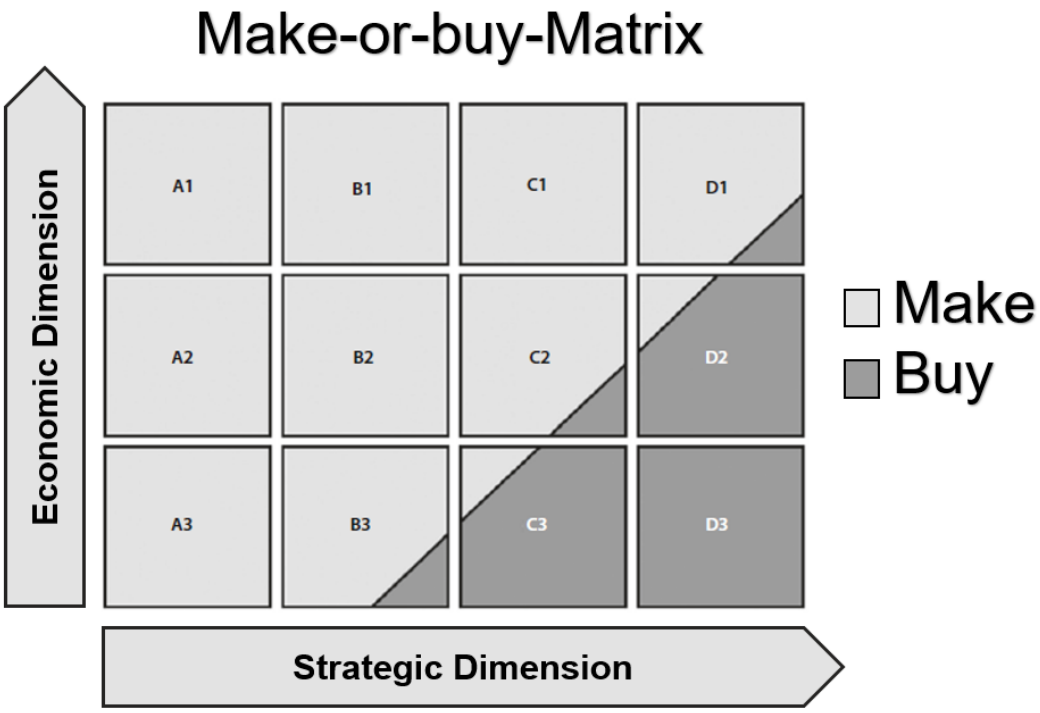

Figure 27: Make-or-buy-matrix for maintenance (Leidinger (2017, p. 87))

According Leidinger (2017, p. 87) the individual fields of the make-or-buy matrix have the following meaning:

Table 16: Meaning of the make-or-buy matrix (Leidinger (2017, p. 88))

A1	To avoid downtime, the maintenance as an own competence is immediately required. In addition, it is cheaper than the external creation. It is therefore necessary to have your own capacity for a complete execution of activities or, if necessary also to increase them.
A2	To avoid downtime, the maintenance as an own competence is immediately required. In addition, the manufacturing costs are at the level as externally procurable services. It is therefore necessary to have your own capacity for a complete execution of activities or, if necessary also to increase them.
A3	To avoid downtime, the maintenance as an own competence is immediately required. But with the addition, the own manufacturing costs are higher than external available services. It is therefore necessary to have your own capacity for a complete execution of activities or, if necessary also to increase them.

B1	To avoid downtime, the maintenance as an own competence is immediately required. In addition, it is cheaper than the external creation. But the individual maintenance group are not controlled. The required knowhow is therefore to build up and to have the own capacity for a complete execution of the activities or to increase them if necessary.
B2	To avoid downtime, the maintenance as an own competence is immediately required. In addition, the manufacturing costs are at the level as externally procurable services. But the individual maintenance group are not controlled. The required knowhow is therefore to build up and to have the own capacity for a complete execution of the activities or to increase them if necessary.
B3	To avoid downtime, the maintenance as an own competence is immediately required. But with the addition, the own manufacturing costs are higher than external available services. Nevertheless, the disadvantages of a dependency from external service providers are to rate higher than the economic hourly rate penalties. But the individual maintenance group are not controlled. The required knowhow is therefore to build up and to have the own capacity for a partially (selective) execution of the activities or to increase them if necessary. The selection should take an accurate "what if?" – analysis into account which, on the one hand, quantifies dependence on the external mark and on the other hand, the volume of utilization with the subject maintenance group.
C1	For the maintenance group belonging to this group, there is no execution of their own competence required. But with the addition, the external hourly rates after rating also the managing effort are higher than those of the own execution. If the own workload is high enough, it makes sense, to perform these maintenance groups. If necessary also an increase can be useful.
C2	For the maintenance group belonging to this group, there is no execution of their own competence required. In addition, the manufacturing costs are at the level as externally procurable services. Is the own utilization high enough, it makes sense to continue these maintenance groups as “filling work”. An increase is not provided.
C3	For the maintenance group belonging to this group, there is no execution of their own competence required. But with the addition, the own manufacturing

	costs are higher than external available services. These activities should not be done any more in the medium term and in a transitional period only covering some “filling work”.
D1	For the maintenance group belonging to this group, there is no execution of their own competence required. But with the addition, the external hourly rates after rating also the managing effort are higher than those of the own execution. The know-how for execution does not exist in the own enterprise. Is the own utilization high enough, it makes sense to selectively learn these maintenance groups.
D2	For the maintenance group belonging to this group, there is no execution of their own competence required. The manufacturing costs are at the level as externally procurable services. The know-how for execution is not available in your own company. It has no advantages to learn the execution of this maintenance groups.
D3	For the maintenance group belonging to this group, there is no execution of their own competence required. The external hourly rates after rating also the managing effort are lower than those of the own execution. The know-how for execution is not available in your own company. These activities should always be outsourced to external providers.

5.4 Challenges within the Maintenance

Accordioning to Schröder (2010, p. 11) many of the named potentials can be attributed to inadequate use of coordination tools in maintenance management. These includes strategic, structure based, cultural and data based issues shown in the table below:

Table 17: Different level of challenges in maintenance (Schröder (2010, p. 11))

Strategy	• wrong or missing maintenance policy, • insufficient planning, • no or no long-term goals, • poor controlling, shortcomings in the transparency of costs and performance and their causal allocation

Structure	• a dominance of hierarchical functional structures, • a lack of self-coordination, • insufficient standardization and • weak horizontal / lateral relationships
Culture	• the lack of guidelines or mission statements, • inadequate development and qualification concepts • the lack of incentive systems
Data	• the lack of comprehensive and consistent information systems • inadequate documentation and communication

To summarize, the importance of maintenance overall is underestimated. Only in exceptional cases there exist clear targets and a consistent target system derived from the production strategy, supported by a closed controlling cycle.

Generally speaking, in operational practice there are no concepts for the long-term development of maintenance management and even in economic well-managed companies through success-oriented management there are a series of weak points for an increase in success or a cost reduction. The main problem results, there is no holistic oriented framework for maintenance which shows and permits to evaluate the maintenance management. The rating must go beyond pure cost-dominated efficiency orientation and furthermore orientate towards a longer-term value system. (Schröder (2010, p. 11))

5.5 Resources and Capital in Maintenance

The maintenance assets or the existing resources represent the input for the service processes. Generally, the input describes all those input factors that are available to a system to create a certain output. The special feature of intangible inputs is that these cannot be consumed in the course of their use. Rather, they should be developed meaningful direction to increase efficiency and effectiveness. According to Schröder (2010, p. 191) examples therefor are:

- Employees, who learn as a part of their job

- Structures and processes, which are constantly adapt respective situation in the production system through permanent running through and improved by targeted questioning
- Relationships and interfaces that results or be strengthened through collaboration in the processes

Importance of the Human Capital

Human capital is defined as: "As the total intellectual and physical capital of employees of an organizational unit." This capital form includes all skills, abilities and experience of employees and executives. In addition, the term also integrates the dynamics of an intelligent organization in a changing competitive environment in the sense of a continuous further development of skills and abilities. Therefor the organization can only indirectly dispose of its human capital because it is owned by its Individual. For maintenance, this form of capital describes the attitudes, competencies, intellectual activities and experiences of their employees. There are all those persons carrier of human capital, who are directly or indirectly involved with the service creation processes of maintenance. This can be employees of the actual maintenance department, but also of production, quality, logistics, purchasing or external personnel involved in the maintenance processes. Decisive for the human capital is beside a technical competence also a pronounced methodological and social component of competence. Furthermore, factors such as attitudes and intellectual agility are part of the human capital. These form of intellectual flexibility plays a crucial role in the willingness to change. The implementation of new management concepts such as TPM requires a high degree of willingness to change, disentangling from the classic perspective and to be able to anchor new paradigms. Motivation and behavior of leadership are other factors that can influence positive the attitude of employees. The following aspects should be part as human capital in evaluation models (Schröder (2010, p. 192)):

- Motivation
- Training and Training
- Leadership
- Willingness to change

6 USE CASE AUDI HUNGARIA Zrt.

This case study begins with a brief introduction of the Audi Hungaria Zrt. followed by a short background overview of the automobile industry of German car manufactures in Hungary. More precise the actual maintenance organization of the engine production in Györ is thoroughly explained. Based on a simulation developed from the Technical University of Graz, the use case begins with the analysis from the actual situation in the maintenance organization at AH to verify the feasibility of a change management process to a new more efficient centralized controlled maintenance strategy. The last step of this study will be the discussion of the different outputs.

6.1 History Audi Hungaria

The foundations of today's AUDI HUNGARIA Zrt. was laid in Hungary in 1993, because of the strategic position. Since 1994, the plant at Györ at that time called AUDI HUNGARIA MOTOR Kft. has been producing engines for the Audi and Volkswagen Group. Today, the company is the world's largest engine factory and more than 30 million engines have been manufactured. In addition to the central task of engine production, other business areas have been added over the last 22 years: car production, tool shop and technical development. Today Audi employs more than 12,000 workers on an area of 5,200,000 m^2. As mentioned before, this thesis focuses primarily on the core competence of engine production. (Audi Hungaria (2015))

Background of Hungary:

The Hungarian culture was historically marked under the Turks, the Habsburgs and the Russians. Already during the world wars, it was so that you didn't get any nonpublic information without good relations. With this information you could gain benefits, conquer a better social position or simply a better life. These relationships still play a key role in Hungary today. Relationships are considered capital and are much more important than financial wealth and academic titles. Linked by a strong relationship orientation of the Hungarians business and private are often very closely connected. Due to the ever-changing circumstances in the history and the fear of punishment there was a great lack of responsibility in the Hungarian people. The unwillingness to take risks in decisions has a long-term effect. Due to a lack of communication and secrecy

of important, often essential information, the Hungarians tried to protect themselves. A reference to the supervisor's responsibility for decisions or mistakes is still present in present time. (Frankó (2011))

6.1.1 German Companies in Hungary Political Culture in East-Europe

Eastern Europe has increasingly moved into the field of interest of Western companies in recent years. The shift from centrally-managed economic systems to market-based systems promises to open this hitherto closed market of immense proportions for Western companies. Given the high degree of saturation of Western markets, many companies see this as a chance to open new sales markets in the long term. The expansion of Western companies towards Eastern Europe has therefore taken on some of the signs that are reminiscent of the American gold rush of the past century. The initial euphoria, however, quickly causes profound disillusionment and disappointment in many companies due to the massive problems. Reason for this was probably in many cases an inadequate preparation for the cultural and economic system-specific peculiarities of the Eastern European states and the consequent business policy problems. In many cases Western companies were also overburdened by the discontinuous political and economic development. The assessment of the volatility of the task environment from the point of view of the enterprise obviously did not correspond to the actual spectrum of rapidity and contradictory nature of the changes. (Engelhard (1993))

6.1.2 Hungary Today

In contrast to many other industries, the car manufacturers are very happy with Hungary. Because Audi and Daimler bring tens of thousands of new jobs into the country, they do not have to pay any special taxes. In other industries, however, the lamentation is great. Energy companies, commercial corporations, the giants of telecommunications, have had to dig deeper for almost two years now and pay special taxes to the ministry of finance.

Other companies are keeping their fingers off new investments in Hungary but the VW Premium subsidiary invests around one billion euros in the venerable university city, one of the largest investments in recent Hungarian history. This different approach to

treating different industry segments, for the Orban government has a simple reason. After assumption of office, the premier made a promise that his government would create one million new jobs within the next ten years. Without the automotive industry, such an ambitious goal cannot be achieved. Together with the suppliers, Daimler, Audi and Opel they are bringing tens of thousands of new jobs to Hungary. In addition, Audi and Daimler had their basic investment decisions made at a time when the Orban government in Budapest was not yet in office. (Menzel (2012))

Importance of the automobile manufacturing in Hungary

Table 18 underlines the importance but also the addiction for the Hungarian Government to the automobile sector. Today more than 30% of Hungarian gross domestic product comes from the big OEMs and their suppliers. More than 700 suppliers and 15 of the Top-20-Tier-1 suppliers have their own production on-site.

Table 18: Data and facts from Hungarian automobile industry (Wodraschke (2016))

Hungary	
Inhabitants	9.8 million
Forecasted economic growth	2016: 2.3%
	2015: 2.9%
Automotive industry share of manufacturing	30% (2015)
Car industry's share of total exports	21.6%
Number of persons employed in the automotive sector	Approx. 149000
Produced Engines (2015) / Automobile Production (Pieces in 2015)	2.6 Million Engines (Audi / Opel) / 492,000 cars

6.1.3 Challenges for the Car Manufactures in East-Europe

Audi and Daimler had to deal with a lot of resentment regarding the payment of their employees. In Hungary, both car manufacturers granted hefty wage increases in December 2016 after the workers had carried out several two-hour warning strikes. Even in Hungary, there is almost full employment around the car factories, here too, the search for skilled workers is tedious and thus the negotiating power of the labor union is much higher.

Eastern and Central European countries are struggling to lift the skills shortage in the automotive sector. For political reasons, they don't facilitate the influx from experts. In addition, the willingness to move because of a job within the country is very low in Eastern Europe. Therefore, the pressure on the large foreign automakers should continue to rise.

Outlook for the future

Because another option to improve people's education in the country takes a lot of time there is one last resort for automakers: If the cost to workers increases significantly, they will invest more in automating workflows to increase productivity. The times of the low-wage paradise of Eastern Europe are coming to an end. (Eckl-Dorna (2017))

6.2 Structural Design Audi Hungaria

Due to the size of the company the detailed description of structure of the organization is restricted on the engine production part of AH. The engine production alone is with more than 6000 employees the core business unit of AH. Five different engine types are produced currently for different car manufacturer of the VW group, and up to 8.800 engine per day can be produced at full capacity.

6.2.1 Structural Organization of the Engine Production

The engine production of Audi in Györ is a historically grown organization. The hierarchical levels of the organization are shown in Figure 28.

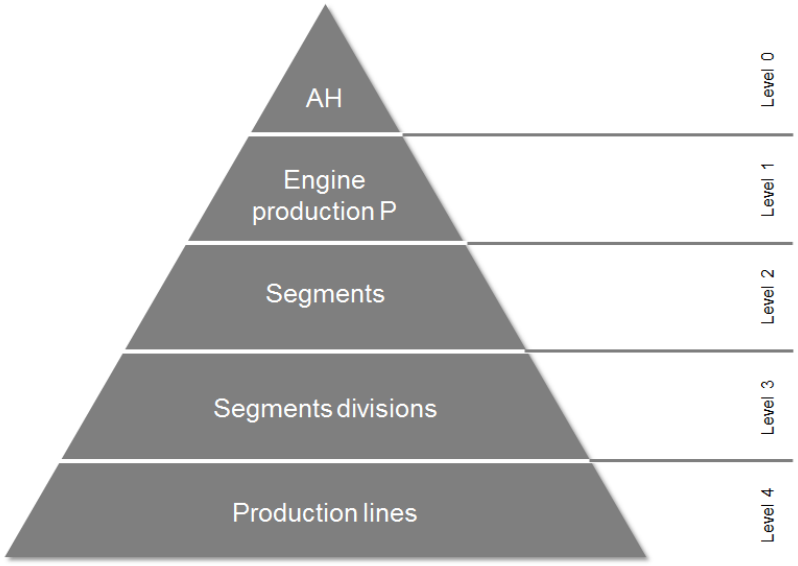

Figure 28: Hierarchical level of engine production of AH (Bachlechner (2017))

Level 2 is divisionally structured, that means the organization is divided into different Segments, which are characterized by the type of engine they produce. The differentiation is based on the type of fuel and the number of cylinders the engines have. There is also one not producing segment in the engine production, the Technical Service, called also “Werkservice”. It is a segment highly important for this thesis, because it’s an important part of maintenance. Alongside the already named engine production segments, the Production System, Engine ramp-up and Logistical planning segments shown in Figure 29, (which are not further relevant) round the Level 2 off.

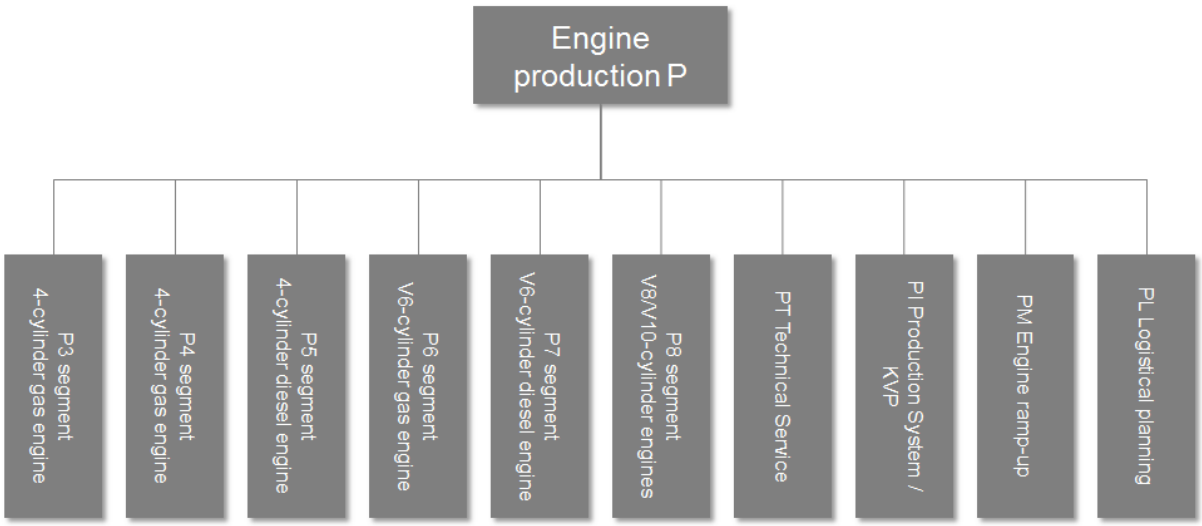

Figure 29: Level 2 – divisional structured engine production (Bachlechner (2017))

The engine production segments characterized with the denomination PX are further functionally separated into three fields: The mechanical production where all engine parts are machined, for example crankshafts or cylinder heads, the engine assembly, where all the parts from the engine production are assembled to the finished engine and the “Betriebsmanagement” where in particular all organizational tasks are handled. This is shown in Figure 30.

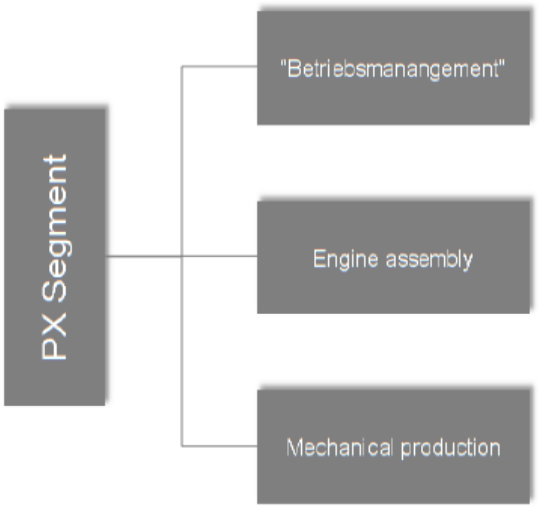

Figure 30: Level 3 – Functional structured organization of segments (Bachlechner (2017))

The Level 4 is described only for the Mechanical production and the Technical Service, which form the fundamental parts for the maintenance. The organigram shown in Figure 31, represents organizational unit structure from P3 – P8 (Engine production segments) and the PT (Technical Service segment). All for this thesis non-relevant units, as PI, PM, PL are not shown in detail.

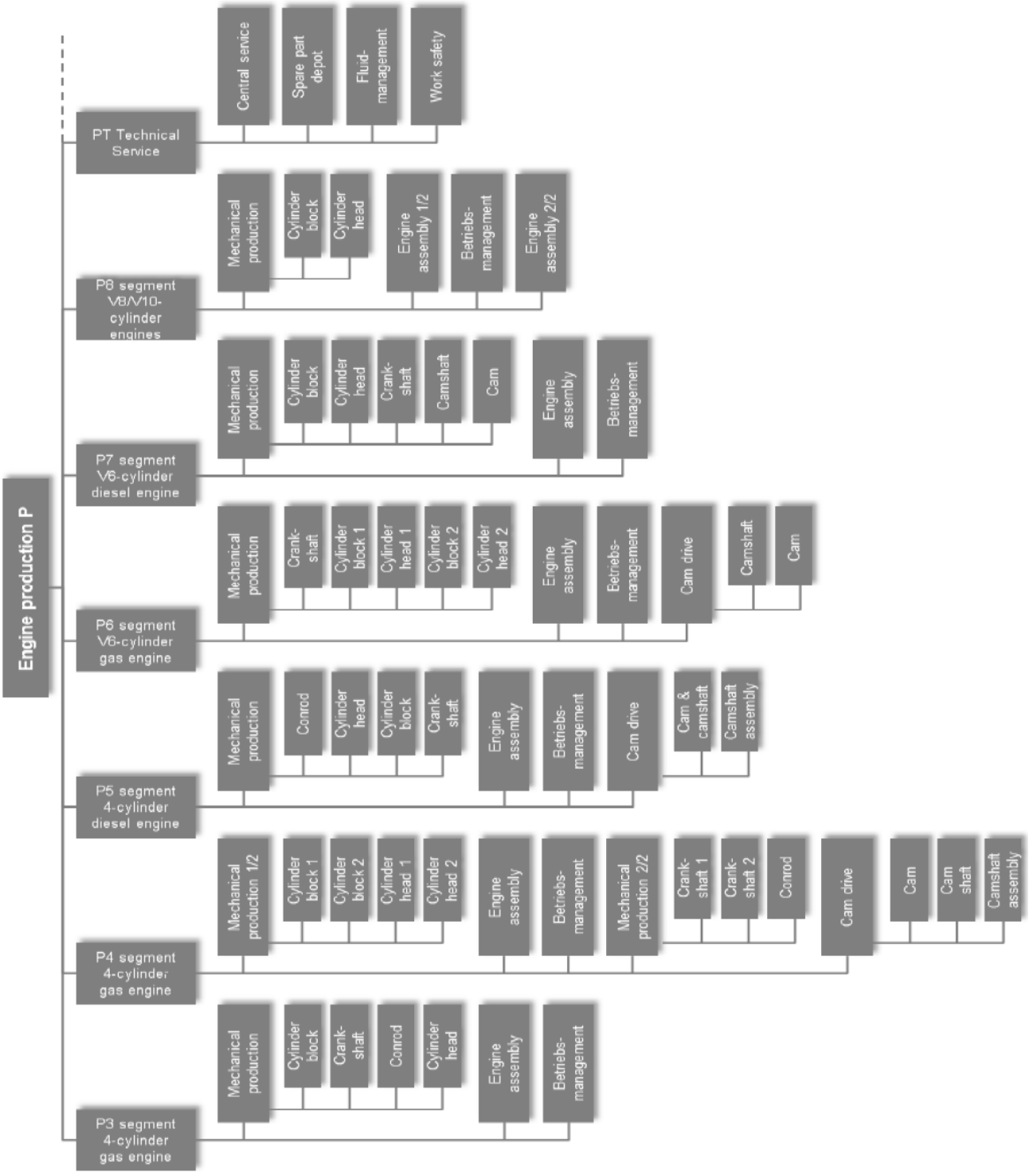

Figure 31: Organigram of the engine production of Audi Hungaria (Bachlechner (2017))

As we can see in Figure 31, the engine production at Audi is a complex system. Therefore, decision making requires a high qualified management structure. A crucial issue is also the information flow. It has to work in the way that all valuable information is available when needed to support the management for taking the right decision.

6.2.2 Actual State of Maintenance Organization

The maintenance at Audi consists of a big part of decentralized management and a smaller central supportive part. All decentralized maintenance units are placed directly at all production lines. The Technical Service is a central unit that supports all production lines if they need help.

The organizational structure of a production line:

The currently more than 30 production lines seem to be organized differently. The number of employees for each shift and also the shift models vary from line to line. Nevertheless, there is a main structure which is valid for all production lines. This general structure is shown in Figure 32.

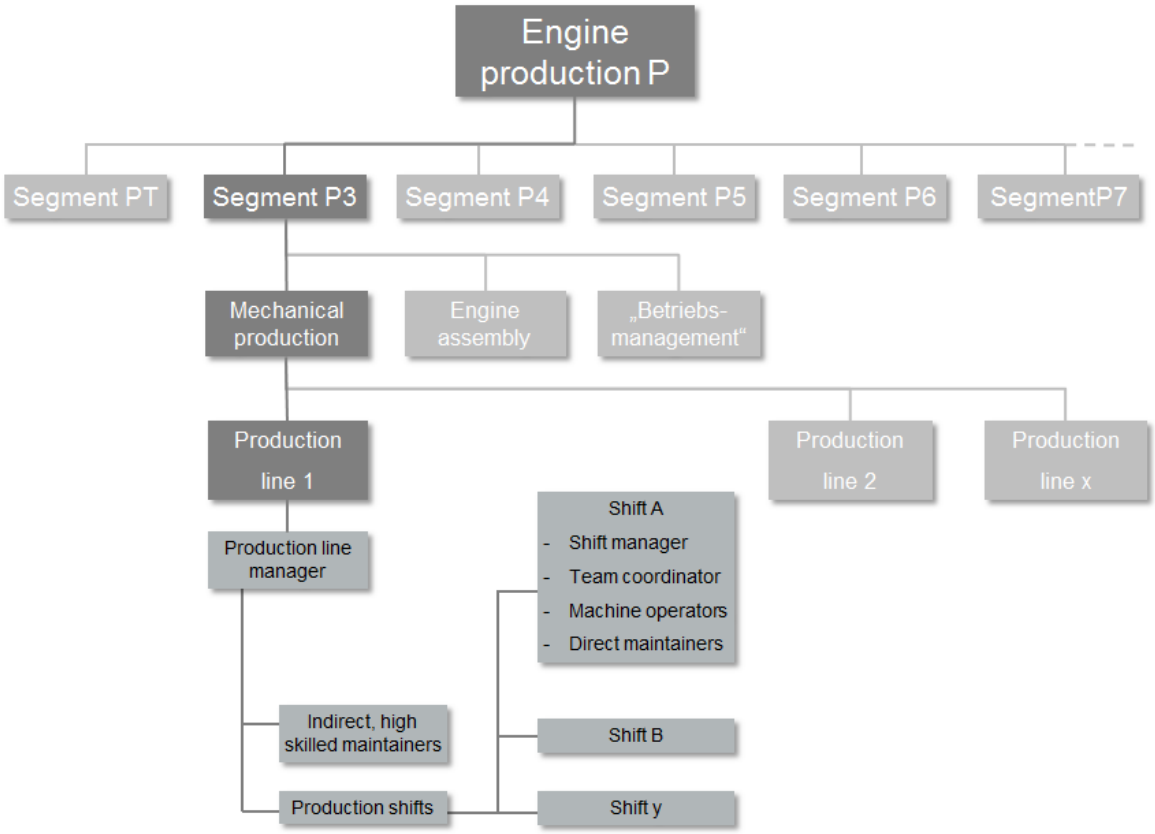

Figure 32: The organigram of a production line at the position level (Bachlechner (2017))

In Figure 32 it can be seen how a typical mechanical production line is structured. Every line has a Production line manager which supervises his own team formed by indirect high skilled maintainers and the production shift staff which differs from shift to

shift and differ on every line. Shifts model depending on the order situation and the utilization vary from eight- or twelve hour shifts up to 7 days a week.

The organizational structure of the Technical Service - "Werkservice":

The so called "Werkservice" is a part of the Technical Service PT. It is a central located organization, which aim is to support maintenance of all the production lines with problems that cannot be solved cause of lack of know-how or technical devices. Often the "Werkservice" is also called because there is a lack of staff capacity on the line to fix some problems.

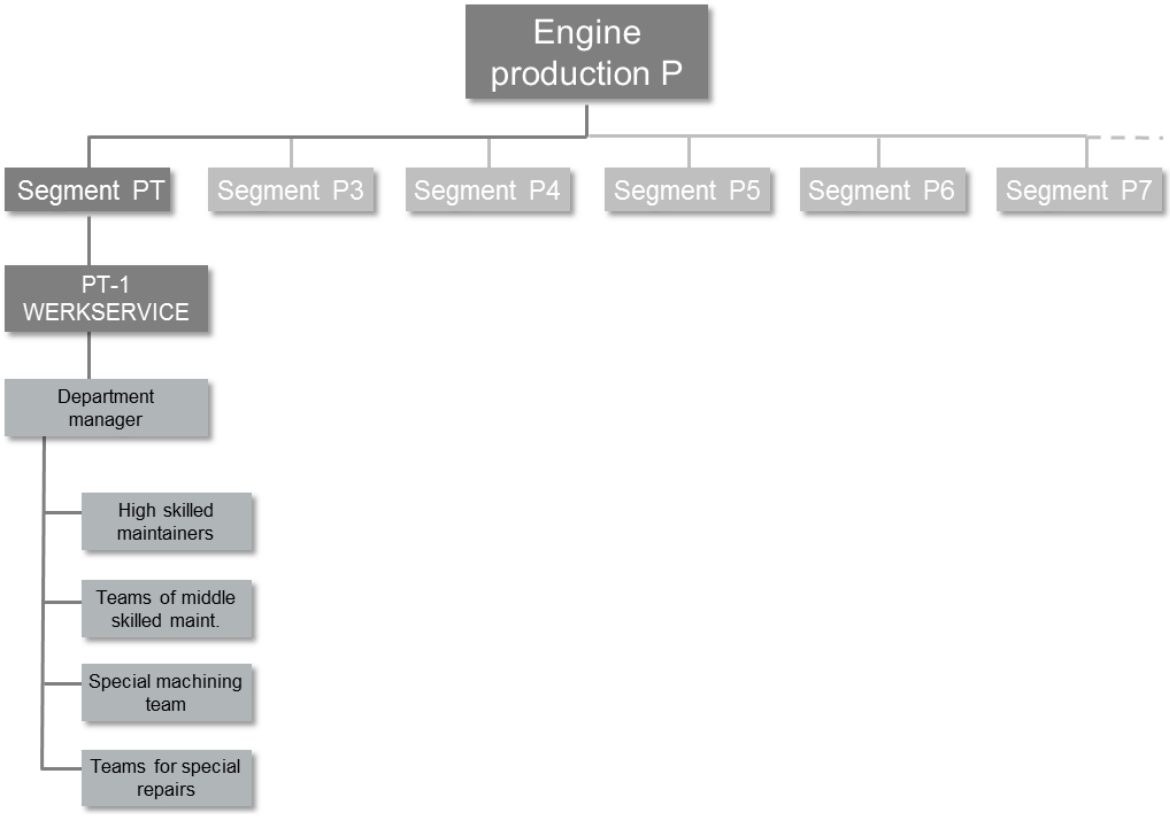

Figure 33: The organigram of the "Werkservice" at the position level (Bachlechner (2017)

6.2.3 The Maintainers at Audi Hungaria

The maintainers can be characterized in different ways. The way Audi mostly differs the maintainers is shown in Figure 34. The four dimensions are:

- Relation to Audi (internal/external)
- Acting – boundaries (centralized/decentralized)

- Specialization
- Skill level and acting boundaries within the production line

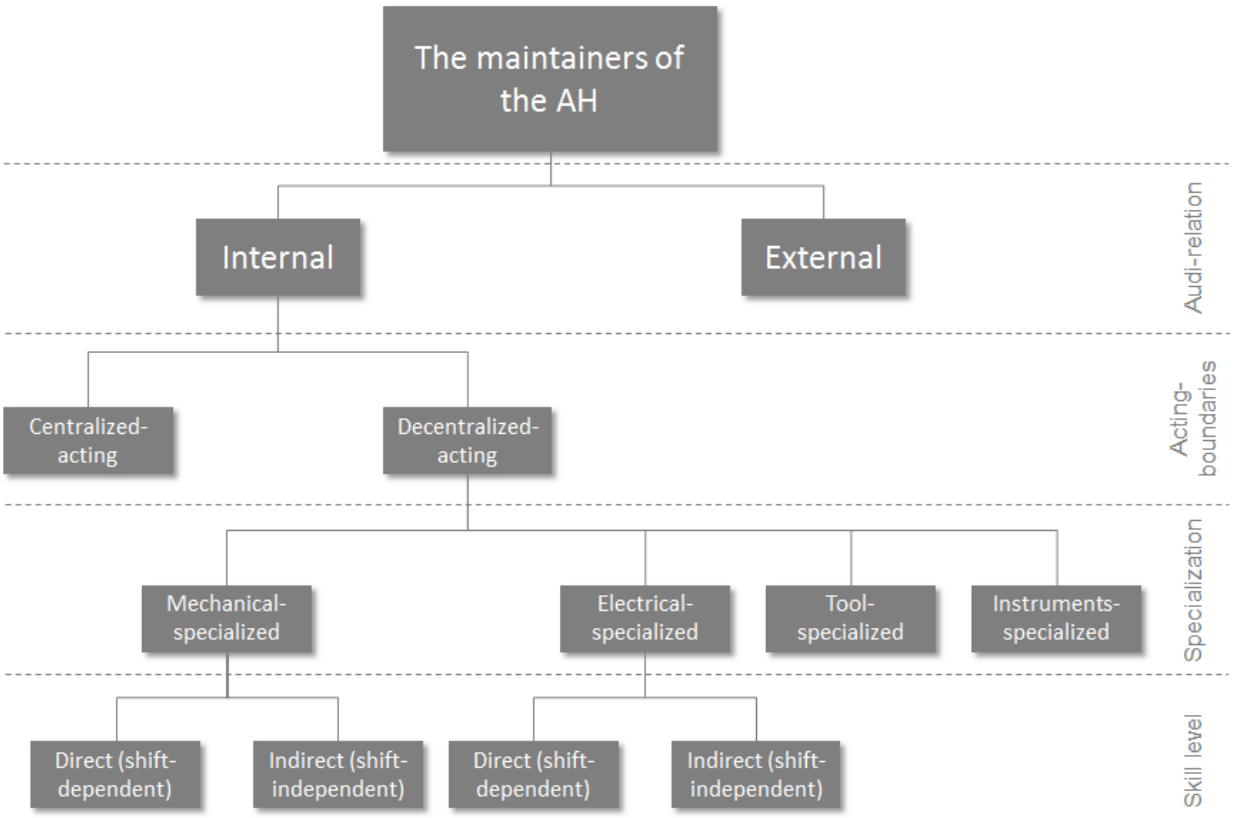

Figure 34: The function tree of maintainers in the engine production (Bachlechner (2017))

Internal maintainers:

The internal maintainers are all that maintainers employed directly by Audi Hungaria.

External maintainers:

External maintainers are experts from the machine manufactures or can be also external maintenance service suppliers.

Centralized – acting maintainers:

The centralized acting maintainers as mentioned in the previous chapter, belong to the "Werkservice". These maintainers are high skilled for special work tasks, normally such

tasks that cannot be handled from the decentralized acting maintainers, for example changing spindles.

Decentralized – acting maintainers:

All the decentralized belong to the production lines. Each production line has his one decentralized team working only on their machines. These maintainers have a special knowhow for the machines used on their production lines.

Mechanical – specialized maintainer:

These maintainers have a special education on the mechanical part of maintenance. Normally there is at least one mechanical maintenance engineer on each line, in bigger production lines there can be more mechanical – specialized maintainer. The indirect maintainers are also called “mechanical maintenance engineers”.

Electrical – specialized maintainer:

These maintainers have a special education on the electrical side of maintenance as well also on the IT part. This combination of electrical and information specialists is becoming more and more important in the industrial revolution of digitalization. Normally there is at least one mechanical maintenance engineer on each line, in bigger production lines there can be more electrical – specialized maintainer. The indirect maintainers are also called “electrical maintenance engineers”.

Tool – specialized maintainers:

These maintainers, called also “tool engineers”, deal with all the issues regarding the tools in the production line. There is always only one tool engineer located on a production line.

Instruments – specialized maintainer:

These maintainers, called also “instrument engineers” deal with all issues of quality checking in the production line. This includes adjusting and calibration of the measuring instruments. There is only one instrument engineer assigned to a production line.

Direct (shift-depended) and indirect (shift-independent) maintainers:

This subdivision exists only in the two categories of mechanical and electrical specialized maintenance area. All indirect maintainers are also called maintenance engineer and they are located in an office direct in the production line. The direct maintainers differ in skill level and responsibility. They are working as a production employee directly in the production line. They are shift depended, and often these two tasks of mechanical and electrical specialization are combined in one person.

Other production employees:

The production employees are also a part of the overall maintenance team, the fulfill some predetermined maintenance tasks.

6.3 Theoretical Base for the Change from Decentral to Central Controlled Maintenance

The concept behind the idea to change the actual situation in the maintenance strategy and organization in the engine production of Audi Hungaria is based on a simulation of different maintenance strategies done by the Technical University of Graz in 2016.

Additional information: Project TU Graz Simulation

2015 the CEO of engine production at Audi Hungaria started the Project TPM4.0. The project combines the two ideas of Total Productive Maintenance (TPM) and the Industry4.0. The combination of internet of things, predictive maintenance along with the digitalization makes this project highly important to be more flexible and efficient in the highly competitive the fast-changing automotive world.

An important partner of this project is the Institute of Mechanical Engineering and Business Informatics of the Technical University of Graz.

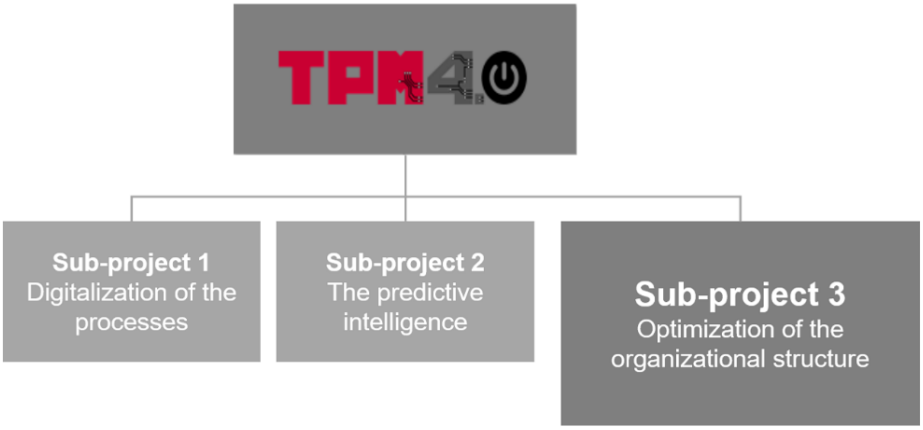

Figure 35: The subdivision of project TPM4.0

This thesis is built on the output of the sub-project 3. The sub-project 3 was dealing with how the current situation in the maintenance could be optimized regarding the following issues and restrains:

- Rising the productivity
- Better working conditions
- No staff reduction
- No staff hiring or outsourcing

The Technical University of Graz did a simulation to compare different maintenance organizations for the engine production at AH. The main inputs can be categorized as follows:

- Organizational structure related inputs
  - Maintainer placement, skill levels, waling path and speed
  - Control structure
- Operational structure related inputs
  - Processes and probabilities
  - Escalation times
- Production line related inputs
  - Shift plan, machine failure, cycle times, production plan and redundancies

With this input a lot of different scenarios has been simulated. The inputs varied from central controlled and decentral placed maintainers to central controlled and placed maintainers. Also, different walking speeds for maintainers has been simulated.

To get a better overview of the simulation the results of the different scenarios are shown below in the Figure 36.

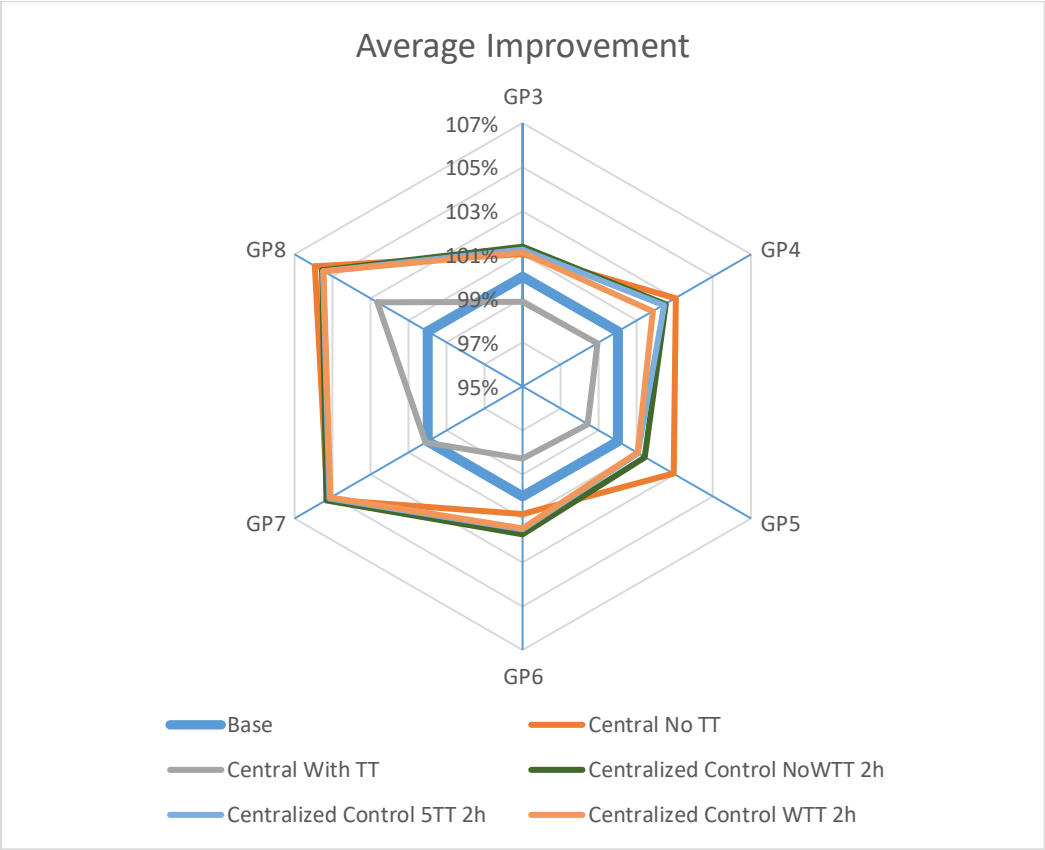

Figure 36: Results central controlled maintenance with different travel times

With centralized control similar results can be achieved as with complete centralization without travel times. Even with realistic travel times the average improvement of performance is high.

The Scientific outputs from the simulation of the Technical University of Graz:

- Centralization brings performance increase
- Better distribution and more balanced utilization of employees
- Real travel times make centrally placed employees impractical
- Centralized control and decentralized placement enables increased production with realistic travel requirements

6.4 Motivation to Change

The motivations to change regarding the different parties and especially on the various hierarchical levels. In the following subsections, the motivation to change the existing maintenance organization of the levels affected by the TPM4.0 project is described. In Figure 37 the parties involved are shown.

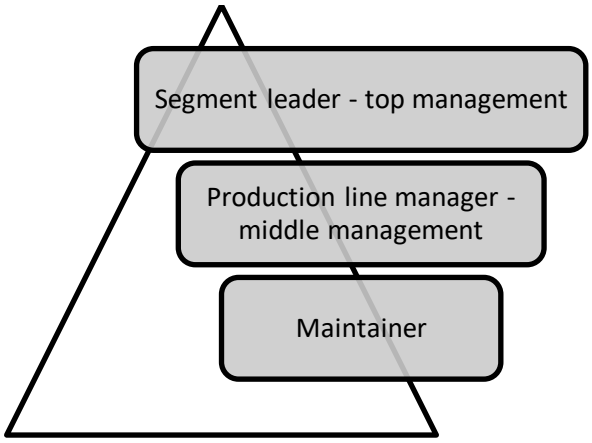

Figure 37: The different levels affected by the change

Segment level – top management:

In the segment level, there are two parties who are affected more or less by the change from the actual decentralized maintenance system to a central controlled maintenance.

On the one hand, there is the mechanical engine production, segments P3-P8. To improve the maintenance effectiveness, prevent unnecessary downtimes by best use of the available resources are primary goals for the head of a production segment. Besides to the apparent cause to increase the overall equipment effectiveness and to decrease the costs of maintenance, there is another not to be underestimated key driver. For those how are working within the TPM4.0 project the motivation is quite high, because it is a “prestige-project” and the order for this project comes from the very top of the company.

On the other side, the “Werkservice”, the centralized-acting segment which supports all engine production segments if they need their service. Therefor it is an internal service provider and no directly producing unit of the company. The biggest challenge the “Werkservice” is facing is the outdated dimension. The company has grown very fast in the recent years and production lines and the production area has been increased many times over, but without adjusting the size of this important internal

service provider simultaneously. Actually, the PT Segment is scarce of personal and have a limited budget to be able to handle all the requirements in an effective way. Therefore the “Werkservice” has a high motivation to change the actual situation in maintenance. The will take a significant role gathering and managing the knowhow and to control the information flow. That’s way they are the driving force with the highest motivation.

Production line managers – middle management

It is decisive to get this group of managers on board, to be willing to change. Every production line has a production line leader, head of the production line maintainers. At the moment, they are controlling the maintenance organization on their own production line, and decide when and how maintenance actions are done. This means the line specific knowledge and the decision making in maintenance is completely decentralized.

It is obvious, as is so often the case, in a changing process it seems the middle management has the most to lose. In a central controlled maintenance organization, the maintainers are not more only subordinate of the production line managers but also have to take orders from a central unit. This means the middle management has to share some of their employees, and therefore also some power.

In the case of Audi most of the middle managers show a big interest and know the importance of such a change, to be competitive also for the future. But there are some parties, as it seems, thinking they would lose too much and prefer their comfortable position.

Maintainer

There are again two parties of maintainers which are affected by such a change.

The indirect maintainers, the higher skilled “engineers”, represent the biggest group of affected employees. As mentioned in chapter 4.1 there are diverse types of employees. It seems that A-employees are highly motivated to change something, because they see the possibility to get new tasks and challenges. There one can see the shortcomings from the actual organization, and how important would an exchange of employees be to gather also know-how from other production lines.

A bigger group of employees, in the literature they are also referred to as B- or C-staff, they care more about their own situation. Many of the maintainers have a comfortable position, and especially on production lines with stable conditions, a change to a central task assignment means in effect new work for those. Resistance and incomprehensibility are programmed.

To sum it up, a lot of employees have organized their working situation, in a way they are able to have some other side job to manage their living expenses. They younger generations of employees have also other priorities, for example the work live balance. If managed in the right way this could be a good chance to bring all the young staff on the motivated side to change.

The direct maintainers represent the other group of the affected maintenance staff. For them a centralized maintenance organization would change slightly their work tasks. They would support other production lines if they are short-staffed and their maintenance tasks will be more standardized.

6.5 Culture of Audi Hungaria

As mentioned already in chapter 4.1 to understand the corporate culture is a main criterion to successfully change an existing structure.

The TPM4.0 project team consist of more than a half of team members from Germany and Austria, which either are characterized by the German speaking culture. In particular to meet the challenges which occur during the shock phase but also in the aggression and depression phase as described in chapter 3.3, it is a crucial, to understand the culture to handle the resistance and master those challenges.

Comparison to the German Culture

For this work, relevant is to understand why there are or could be some challenges to change an existing structure or organization. Change-Management in Germany is not working in the same way as in Hungary. The people and therefore their habits, needs and expectations are influenced by the culture. As already mentioned in chapter 4 the cultural aspect of a company is one of the fundamental issues to understand to be able to successfully change something.

As we can see in Figure 38 the how Richard Lewis describes the behavior of different cultures. Especially he believes, that the categorizations of national norms do not change significantly over time. The different cultures follow clear trends, sequences and traditions. Reactions can therefore be forecasted, and in most cases also be managed. Even in unstable countries, because they are currently political end economically fast changing, (for example Russia, China, Poland and Hungary) deep rooted attitudes and beliefs will not change. Values are stable even when pressured by reformists, government or multinational companies.

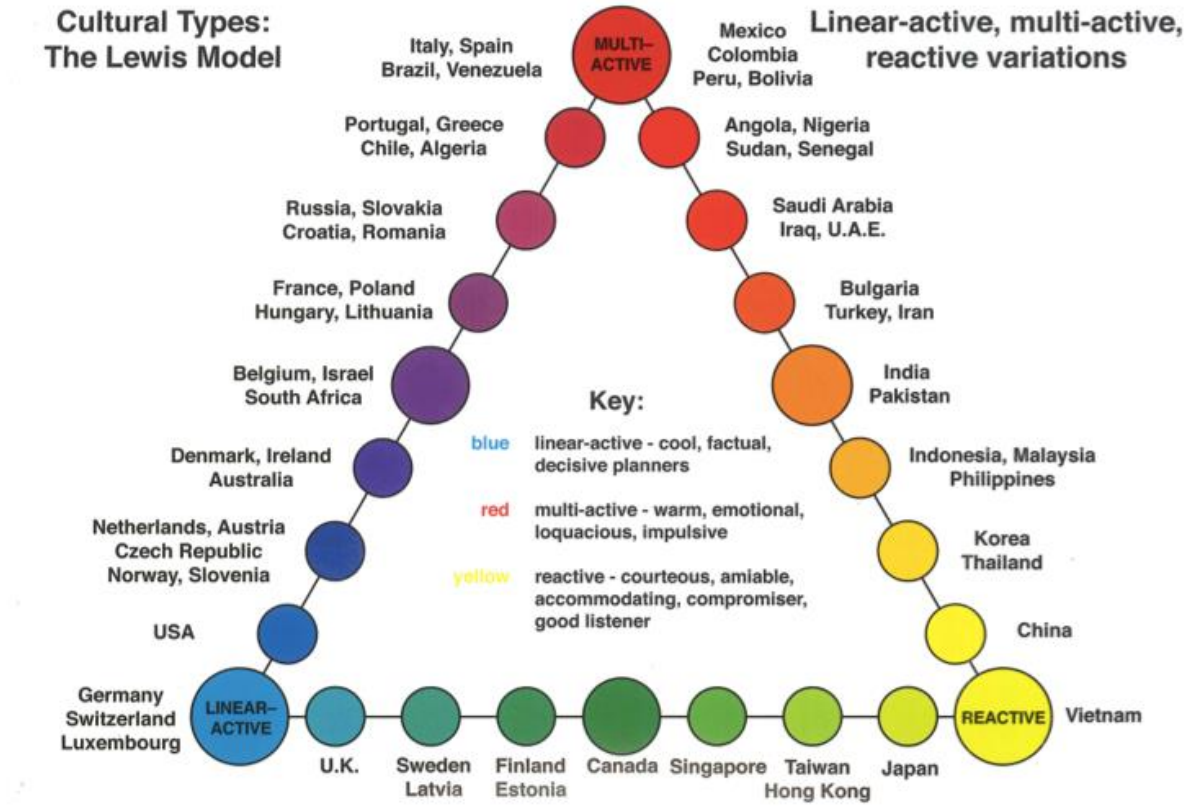

Figure 38: Lewis model of culture (Lewis (2008))

If we compare the two cultures of a German company AUDI which is settled in Hungary we can see that those two cultures have a major difference in how people are reacting.

Germany is a clear Linear-Active culture in comparison to the Hungary which is more on the Multi-Active part. Some description about the differences according Lewis (2008) shown in Table 19 below:

Table 19: Cultural Types according Lewis (2008)

Linear-Active	Multi-Active	Reactive
Talks half of time	Talks most of the time	Listen most of the time
Does one thing at time	Does several things at once	Reacts to partner's actions
Plans ahead step by step	Plans grand outline only	Looks at general principles
Polite but direct	Emotional	Polite, indirect
Partly conceals feelings	Displays feeling	Conceals feelings
Confrontation with logic	Confrontation emotionally	Never confronts
Dislikes losing face	Has good excuses	Must not lose face
Rarely interrupts	Often interrupts	Doesn't interrupt
Job-oriented	People-oriented	Vary people-oriented
Sticks to facts	Feelings before facts	Statements are promises
Truth before diplomacy	Flexible truth	Diplomacy over truth
Sometime Impatient	Impatient	Patient
Limited body language	Unlimited body language	Subtle body language
Respects officialdom	Seeks out key person	Uses connections
Separates the social and professional	Mixes the social and professional	Connects the social and professional

Regarding the feasibility analysis from changing the organizational structure in maintenance, we have to deal with a certain type of people. We are talking about engineers and employees in the production of a technical company. This group of persons can be characterized by tending to affinity for a multi-active culture, even if their culture could show some other characteristics.

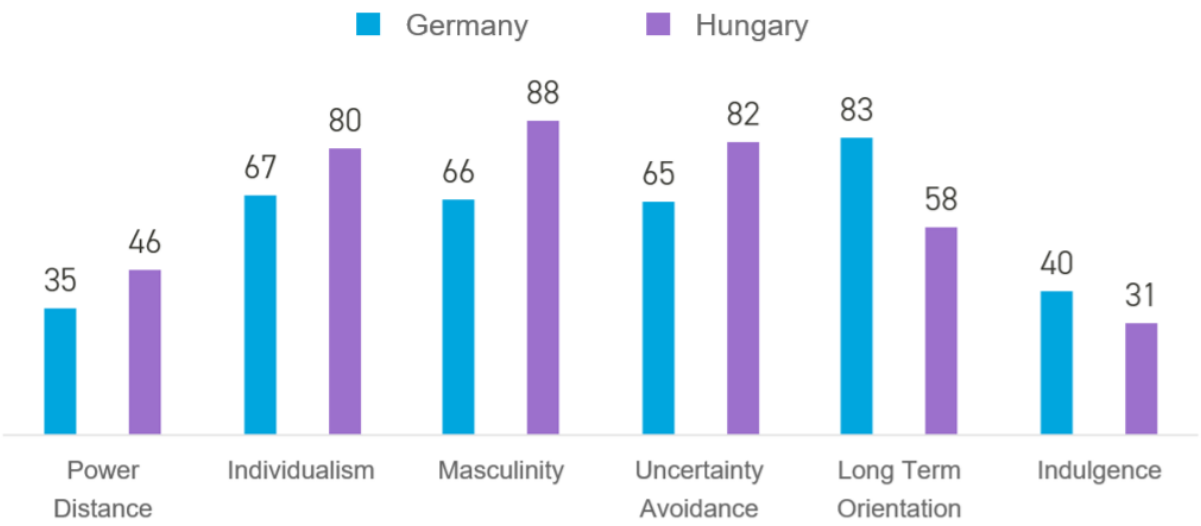

Figure 39: Country comparison of Hungary and Germany according the dimensions of Geert Hofstede (2018)

Description Hungary's of the six dimension in comparison to Germany according Hofstede (2018):

Power Distance

Hungary scores with 46 a higher power distance in comparison to Germany. Which means they are tending to be independent, but the accept their hierarchy for convenience. The leader considers the experience of the team member, but it is the co-determinations rights are fare not so extensive as in Germany, and they don´t must be considered by the management. The attitude towards managers are informal and they address each other with the first name.

Individualism

With 80, they are one of the highest scoring countries and that means, Hungary is a very Individualist society. A casual social framework, where it is expected, that individuals are caring only for themselves and their closest families. The relationship between employee and employer are contract based on mutual advantage. Promotion is based only on merit, and they have a lower loyalty comparing to Germany, cause of their stronger individual orientation.

Masculinity

Hungary scores 88 in Masculinity, that means more than a third more than Germany. In masculine countries people follow the basic principle: "living in order to work". The

expectation from managers is to be decisive and assertive and conflicts are resolved by fighting them.

Uncertainty Avoidance

With a scoring in the dimension of uncertainty avoidance of 82 its again much higher than in the comparison to Germany. There is a high preference to avoid uncertainty. Therefor Hungary can be characterized with maintaining norms and rules, beliefs and behaviors, and they are not open to other behavior and ideas. These cultures have the need to be bounded to rules, and they are very resistant for innovation. Security of the individual is there highest motivation.

Long Term Orientation

Hungary is with 58 a pragmatic country, but the score is more than a third lower than the very pragmatic Germany. People believe that truth depends on the situation, context and time. They have a strong propensity to save, and perseverance in achieving results. They also show the ability to adapt their traditions easily to changing conditions.

Indulgence

Hungary has a low score of 31 in the dimension of Indulgence. It is slightly lower than Germany. Low scoring indulgent societies are more cynical and pessimistic than others. Restrained societies are not interested in leisure time and satisfaction of their desires, they believe in their own restriction by social norms and they feel spoil themselves is wrong.

6.6 Development of Concepts

One major advantage of a central controlled maintenance organization is the possibility to survey the whole engine production, and manage the maintenance units in the most efficient and effective way. As shown in Figure 36, the simulation output of the Technical University of Graz, with a central controlled system where the production line maintainers are located still decentralized a notable efficiency enhancement can be achieved. The precondition to make this system able to operate in the most effective

way is multifunctional usability of the maintainers on different production lines, depending on where needed.

Production line complexity

To get an overview about the production line in Figure 40 is shown the production line overview of Audi Hungaria. The red squares, G1, G10 and G20 demonstrate the large production halls where all the production lines of the different segments, marked be distinct colors, are located.

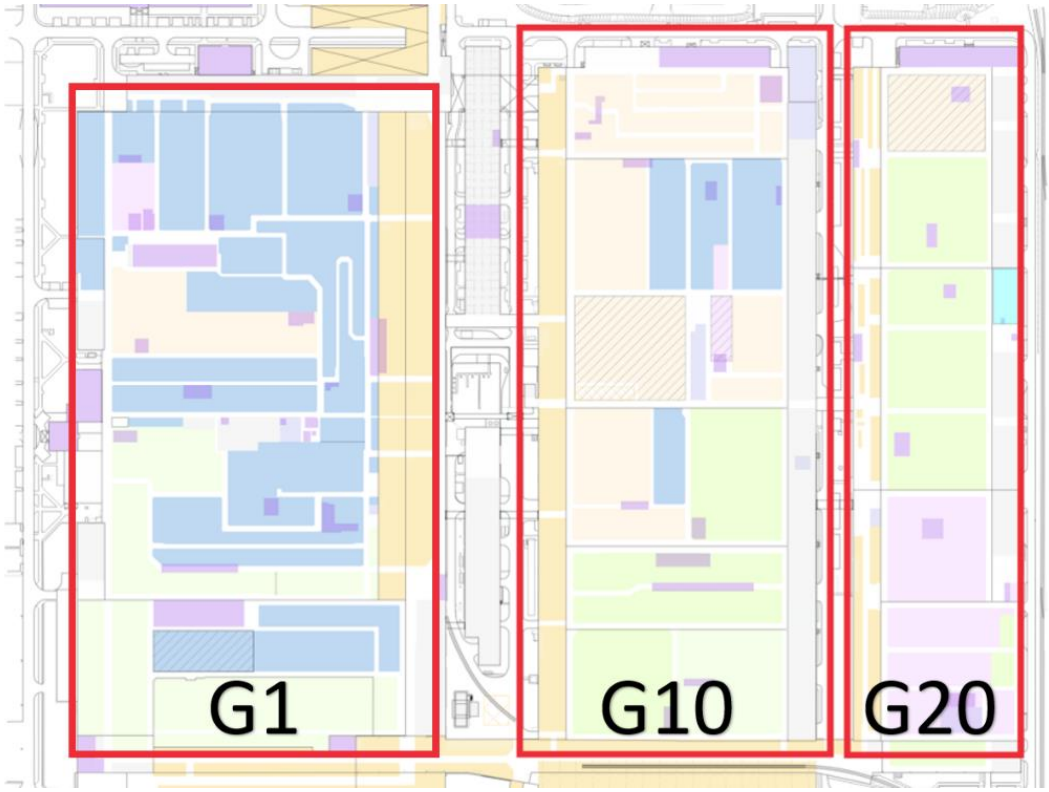

Figure 40: Engine production plant overview AH (adapted from Audi internal document)

Cause of the fast-growing company in the recent years, and the need to enlarge the production line are the initial production hall G1 was extended by the hall G10 and some years later with the additional hall G20. As it can be seen by the different color-marked segments there is no clear strategy of clustering the different production lines segmentally. There are about 30 mechanical production lines split in 6 segments and normally each segment is split in 5 fields depending on the engine part produced.

The 5 different engine parts produced are:

- Cylinder block
- Cylinder head

- Crankshaft
- Conrod
- Camshaft

The production and the machines of the above-named parts are too diverse that a universal maintainer could work on all production lines. The challenge therefore is to find an applicable method to cluster parts of the engine production lines in a way, the maintainers can be utilized versatile. Furthermore, the training effort of maintainers to realize a versatile utilization should be feasible.

6.6.1 Cluster Model

There are distinct types the clustering can be done. Some are more suitable, some less, the challenge is to find the ideal but also practicable way. Following is a list of potential cluster models:

Production line: The current situation how the maintenance is organized.

Segment: Bring all maintenance units on the same skill level to operate on the whole segment. This model has the decisively advantage of the current segmentally organization don't have to be changed.

Dry- and wet-machining: There are 2 main materials used in engine production. One is aluminum and the other is grey cast iron. The two materials differ in the mechanical processing and therefore also in the type of machine.

Rotatory- and cubic-processing: The 5 engine parts produced in Györ differ in the direction of motion of the machining process. The camshaft, conrod and crankshaft are rotatory machined and the cylinder head and the cylinder block cubic.

Facility type: When one looks at the entire production plant it comes apparent that depending on the type of production line, that the process of how the parts are machined are running through similar system types. These facility types are not completely equal but the kind how they are working and therefore also maintained are similar. These types for example can be: washing facilities, robotics, machining center or transfer lines etc.

Machine manufacturer: The idea behind clustering the different machine manufacturer is that the main principle how machines of the same manufacturer are build up are very similar. If a lath and a milling machine are compared, most of the individual components and also control systems are normally the same or at least very similar.

Machine: Cluster all different machine types. For example: lath, milling machine, honing machine, grinding machine, etc.

To find the right cluster is important to keep the walking ways for maintainers which are working on various production lines as short as possible. In addition the challenge is to combine the most similar production lines with regard to the machine manufacturer and production technology to keep the training effort within limits.

6.6.2 Skill-Matrix

The skill matrix forms the basis for the actual state analysis of the direct and indirect acting maintainers working on the production lines of AH. This helps to show the skills gaps and to find appropriate actions to close these. Take actions for a balanced skill distribution can vary from sponsorships of highly qualified colleagues, internal or external training to temporary task assignment, so called rotation of employees.

Goal of the competence matrix:

This method helps with competency planning. The relevant technical, methodological and personal competences are identified, gaps are determined and measures are derived for different areas, services or roles. The effectiveness of the action plan can be assessed. Corresponding metrics can be included in a Service Balanced Scorecard and used to control productivity.

Audi internally had already some different kind of competence matrixes, but there was nothing for a significant evaluation. All the skill tables of Audi were not specific enough end often they are target specifications based on the salary level. This does not allow a clear statement how a flexible use of maintainers can be managed.

To get a meaningful overview of the maintenance skill situation of all the maintainers a competence matrix based on facility type, and even more in detail, on the machine manufacturer has been created.

Structure of the competence matrix:

The competence matrix shown in Figure 41 is an example for a typical production line.

The rating system goes from 1 to 4 and is described as follows:

- 1 – in training
- 2 – performing simple tasks independently
- 3 – independently working
- 4 – independently working and teaching

The first step was to classify the facility types for the whole engine production. Furthermore, there was made a list of all the machine manufacturer for each production line and assigned to the appropriate facility type. Each maintainer, this means all indirect maintainers (Maintenance engineers) and all direct maintainers (working directly on the production line) were rated how their maintenance skill-level is with regard on the machine manufacturer. In addition to the maintenance skills also the German language skills and the experience related to the current production line was noted.

The German skills are important, because most machine manufacturer come from Germany and they send also German speaking specialists if they are required in Györ. The language skills are also rated from 1 to 4, whereby 1 means very low knowledge and 4 really good knowledge of the language.

FACILITY TYPE	MACHINE MANUFACTURER	IH-ING + IH-M	Elek. IH Ing.		Mech. IH Ing.		Mess. Ing.	Elek. / Mech. IHM
			ING 1	ING 2	ING 1	ING 2	ING 1	IH 1
Transfer line	Grob		4	2	4	2		3
Machining centre	Grob		4	2	4	2		4
Washing technology	Dürr		4	2	4	2		3
	Elwema		4	2	4	2		3
Test technology	Bayer		4	3	4	1	3	4
	Lehnert						4	
	Leitz						4	
	Hommel						4	
	Zeiss						3	
	Marposs						3	
Special machining	Gehring				4	1		3
	Kadia		4	3	4	2		4
Transport	Grob		4	3	4	2		4
Roboter	Fanuc				4	1		3
	Kuka				4	1		4
Assembly	Grob		4	2				
	Bosch		4	2	3	1		
Experience on the production line [years]			7	2	6	1	2	7
Language skills - German			4	1	2	1	2	4

Figure 41: Competence-matrix from a cylinder block production line

Because of the high complexity of the different NC-, PLC- and Drive-Control system installed in the production machines also the skill-level for these was important to collecting the data. Therefore, the competence matrix for the electrical-specialized staff was extended. An example for this is shown in Figure 42, a production line for cylinder block manufacturing.

MASCHINENHERSTELLER	IH-ING	ING 1							ING 2						
	NC-PLC-DRIVE CONTROLSYSTEM	Siemens 840D Power Line	IndraDrive Bosch Rexrot	Siemens 611U	GHC	Siemens S7	Bosch Schraubsystem	Roboter	Siemens 840D Power Line	IndraDrive Bosch Rexrot	Siemens 611U	GHC	Siemens S7	Bosch Schraubtechnik	Roboter
Grob		4	4						2	1					
Grob		4							2						
Dürr		4							2						
Elwema		4				4			2				3		
Bayer		4		4		4			3		2		3		
Gehring			4	4	4	4				1	3	2	3		
Kadia		4							3						
Grob		4							3						
Fanuc								3							1
Kuka								4							2
Grob		4							2						
Bosch							4								

Figure 42: Competence matrix for NC-, PLC- and drive-control systems

It should be mentioned that the category robot technology, named “Roboter”, is not a real NC-, PLC- or drive-control system but it’s a simple mixture of electrical adjustment a maintainer is able to do. There is no real robot programmer in the company and therefore a high rating as 4 is not so significant for this future important technology field.

6.7 Results and Interpretation

On the basis of all the competence matrixes some analysis about the actual state of the maintainers skill distribution in the company has been made. Due to the fact, that the whole company has more than 30 production lines distributed on three major production halls, the following results obtain data from two of production halls. With the hall G10 and G20 more than the half of the production lines are represented and at least two from each segment. Therefore, the output of these data can bring valuable results.

6.7.1 Skill – Actual State of Maintainers

In the following diagrams all the relevant maintenance staff of Audi Hungaria is shown. The classification of the maintenance units was already explained in chapter 7.2.2. for a significant benchmark the maintenance skill levels of the different production lines have been compared.

This benchmark was done for:

Indirect acting maintainer:

- Electrical maintenance engineers
- Mechanical maintenance engineers
- Testing equipment maintenance engineers

Direct acting maintainer:

- Electrical specialized maintainer
- Mechanical specialized maintainer

Figure 43 shows all electrical maintenance engineers from the hall G10 and G20 with the distinction of the different segments.

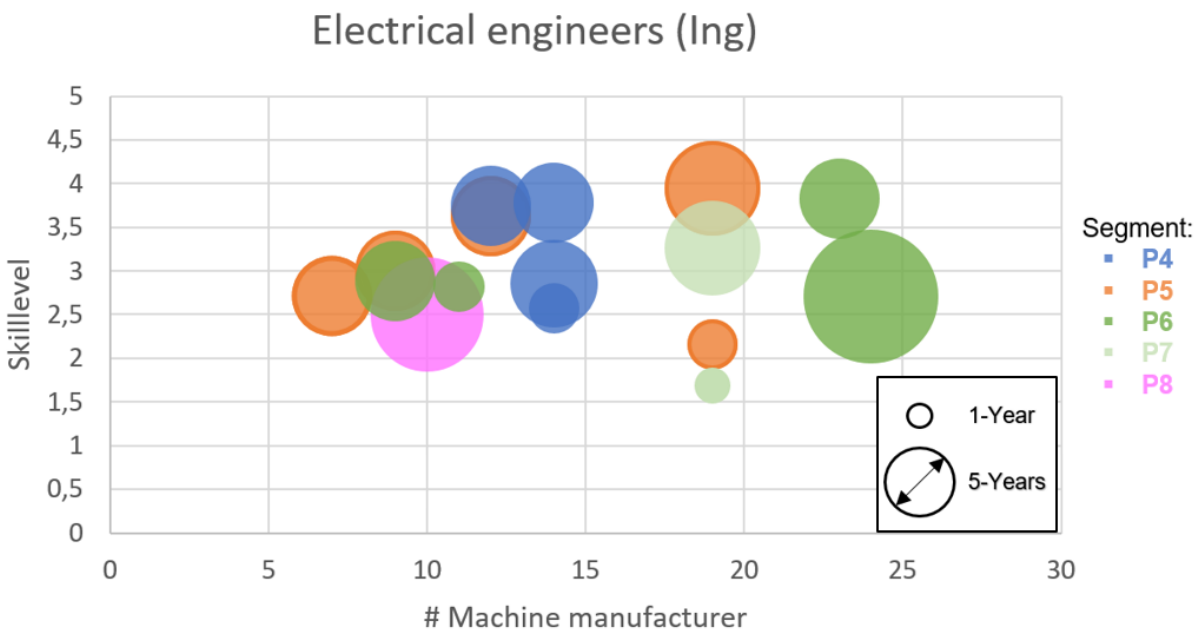

Figure 43: Electrical maintenance engineers (Elek- Ing) according to segments

The x-coordinate of Figure 43 describes the complexity of the production line. The complexity increases if there is a high number of different machine manufacturer to maintain. On the y-coordinate the average skill level from 1 to 4 is displayed for each maintainer. The color of the bubbles represents the various segments from P3 to P8, and the size of the bubble indicates the experience of the maintainer on his production line (shown on the right bottom of the diagram as an example for 1 and 5 years).

As can been seen the distribution of the skill level of the different engineers from 1,6 to 4.0 is very broad. There is also a quit high complexity difference between the production lines. The difference in bubble size highlights the unbalanced distribution, how long an employee is working on the same production line. The detailed consideration of this output will be discussed later in chapter 7.6.4, the discussion.

Figure 44 shows all mechanical maintenance engineers from the hall G10 and G20 with the distinction of the different segments.

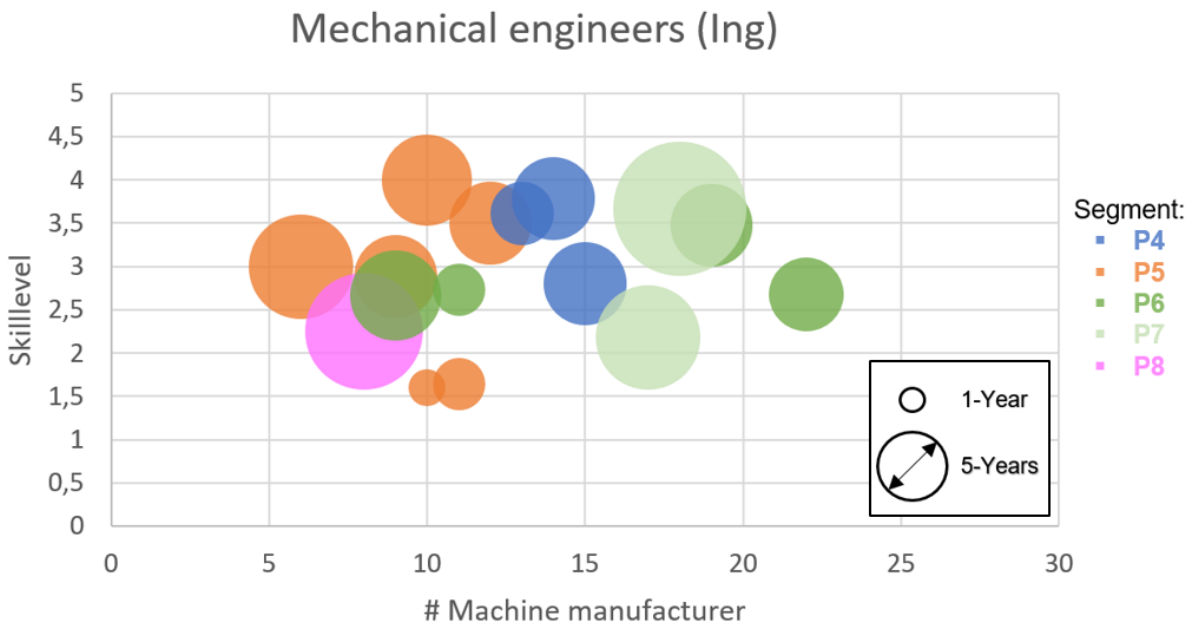

Figure 44: Mechanical maintenance engineers (Mech-Ing) according to segments

The x-coordinate and the y-coordinates are the same as in Figure 43. As can been seen the distribution of the skill level of the different engineers from 1,55 to 4.0 is very broad. There is also a quit high complexity difference between the production lines. The difference in bubble size highlights the unbalanced distribution, how long an employee is working on the same production line. The detailed consideration of this output will be discussed later in chapter 7.6.4, the discussion.

Figure 45 shows all test engineers from the hall G10 and G20 with the distinction of the different segments.

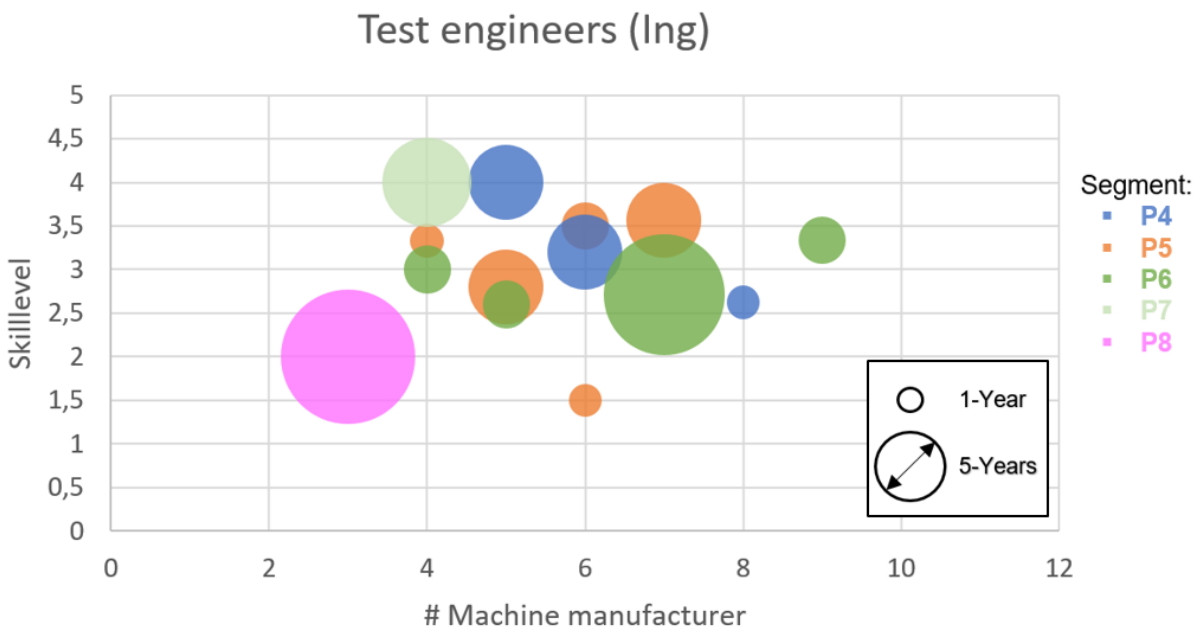

Figure 45: Test engineers (Mess-Ing) according to segments

The x-coordinate and the y-coordinates are the same as in Figure 43. As can been seen the distribution of the skill level of the different engineers from 1,5 to 4.0 is very broad. There is only a slight difference in complexity between the production lines. The difference in bubble size highlights the unbalanced distribution, how long an employee is working on the same production line. The detailed consideration of this output will be discussed later in chapter 7.6.4, the discussion.

Figure 46 shows all direct acting maintainer from the hall G10 and G20 with the distinction of the different segments.

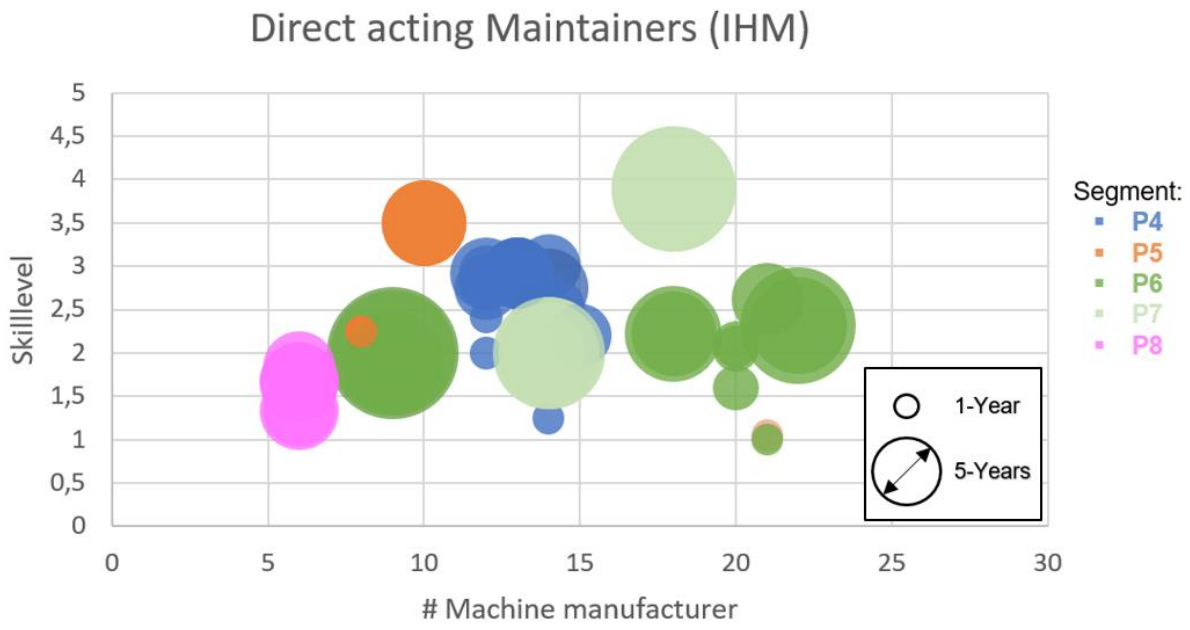

Figure 46: Direct acting maintainer (IHM) according to segments

The x-coordinate and the y-coordinates are the same as in Figure 43. As can been seen the distribution of the skill level of the different engineers from 1.0 to 4.0 is extremely broad, and the average of the skill level is low. There is also a high complexity difference between the production lines. The difference in bubble size highlights the unbalanced distribution, how long an employee is working on the same production line. The detailed consideration of this output will be discussed later in chapter 7.6.4, the discussion.

For a better comparison, in Figure 47 all indirect maintenance engineers are shown according their specialization. Therefore the colors distinguish the three for maintenance relevant engineer groups. Grey stands for Test-engineers, blue for Mechanical-engineers and orange for the Electrical-engineers.

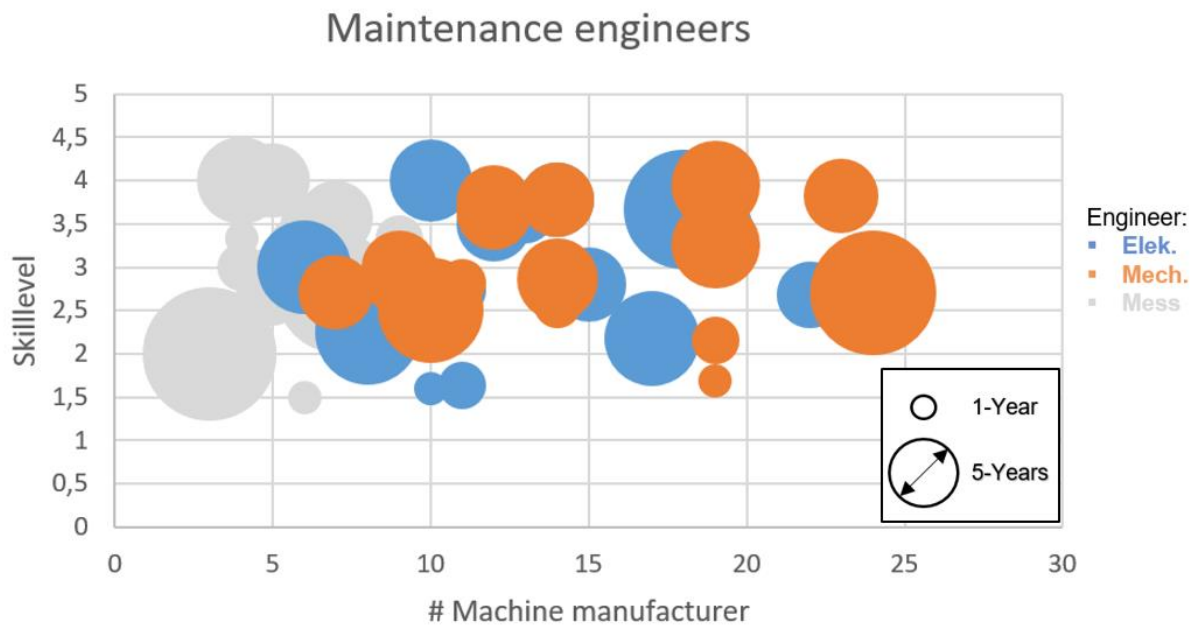

Figure 47: Indirect acting engineers according their specialization (Mech-, Elek- and Mess-Ing)

The unequal distribution of the skill level overall but also within the own specializations group is evident. Even more apparent is that there is also no relation between competence level and experience on the production line.

6.7.2 Organizational Model

How potential clustering could be done, was already mentioned in chapter 7.6.1. In the course of this thesis, different models of cluster have been analyzed. In the following figures is shown the output from clustering based on the machine manufacturer and rotatory- and cubic-processing. A major criterion was the walking time between the different production lines and to keep the know-how complexity due to different machine manufacturers within limits.

In Figure 48 the potential cluster are depicted by the dotted lines. In this version shows the potential solutions of the rotatory machining production lines.

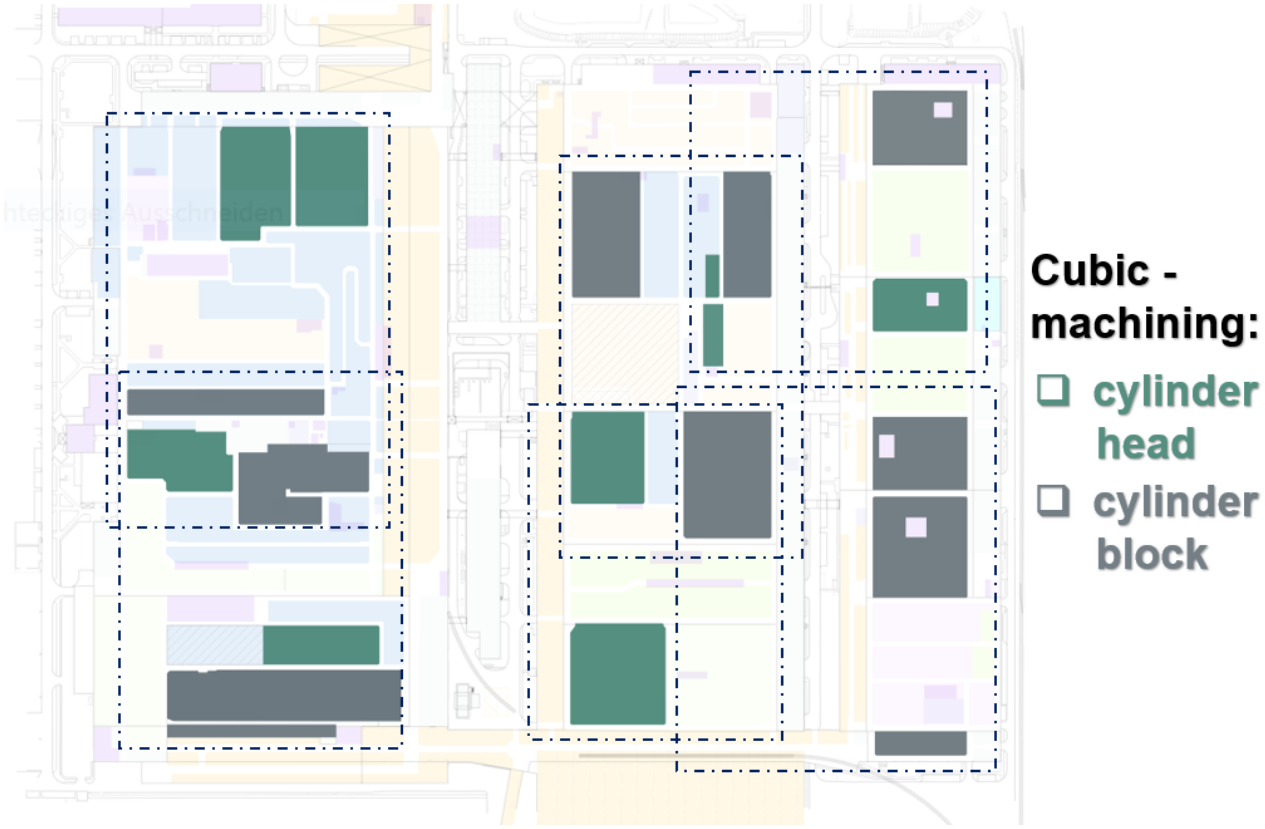

Figure 48: Cluster models for the cubic machining production lines

On the background of the Figure 48 is shown the bird's eyes view of the production plant of Györ. Highlighted are the cylinder head production lines and the cylinder block production lines, together they represent the section of cubic machining production lines. The detailed consideration of this output will be discussed later, in chapter 7.6.4 the discussion.

In Figure 49 the potential cluster are depicted by the dotted lines. In this version shows the potential solutions of the cubic machining production lines.

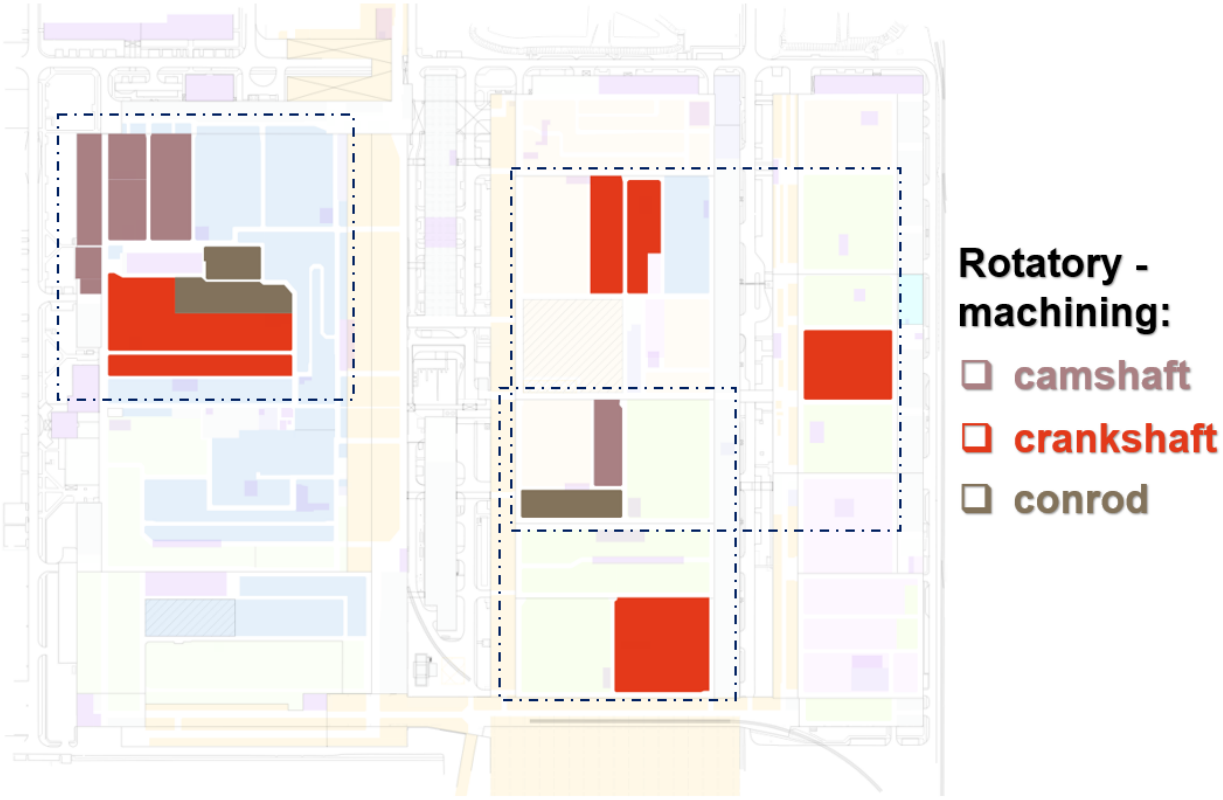

Figure 49: Cluster models for the rotatory machining production lines

Also in this Figure 49 the background represents the bird's eyes view of the production plant of Györ. Highlighted are the camshaft, crankshaft and the conrod production lines, together they represent the group of rotatory machining production lines. The detailed consideration of this output will be discussed later, in chapter 7.6.5 the discussion.

6.7.3 Team of Experts and Their Correlations

To create the competence matrix every single production line manager and furthermore some selected employees for each relevant maintenance group was interviewed. This was important to get a closer feedback how their reactions are about the idea to change the running maintenance system.

If we combine the output from all interviews from top of the hierarchy, the head of segments, to the bottom, the direct acting maintainers, some crucial issues are repetitive.

The following is a summary of the most often repeated issues, and described more in detail:

- Teams of experts
- External maintenance costs
- Monopoly of external service providers
- Motivation – Fluctuation

Team of experts:

This issue was mentioned nearly every time an interview with a production line manager or a maintenance engineer was done.

Currently in the organization of Audi Hungaria there are very few so called expert-teams which can be called for support if the production line need some help or advice. Bonding or screwing technology are examples for already existing expert groups. They are used frequently and operate very well. The disciplines where Audi internally has shortage of knowledge are listened as follows:

- Robotic
- NC-programming
- Calibration of measuring equipment
- Cooling systems

The above named special technology fields are currently not available, therefore in this areas Audi is strongly dependent on external service provider.

External maintenance costs:

The maintenance of Audi Hungaria depends to a certain extent from the costs of external service providers. This is the case because the knowledge of the internal maintenance units is missing in some areas. A reason of the missing knowhow is the structure of the maintenance. The budget distribution goes hand in hand with the decentralized organization structure of maintenance. A single production line is not

able to offer specialized trainings to his employees for technology fields which are not needed every day. Referred on a single line this would not be economically efficient. In the recent years more and more was outsourced and therefore the importance of external costs is not to be underestimated. A schematic representation of the cost allocation of an engine production line in Györ is shown in the following Figure 50.

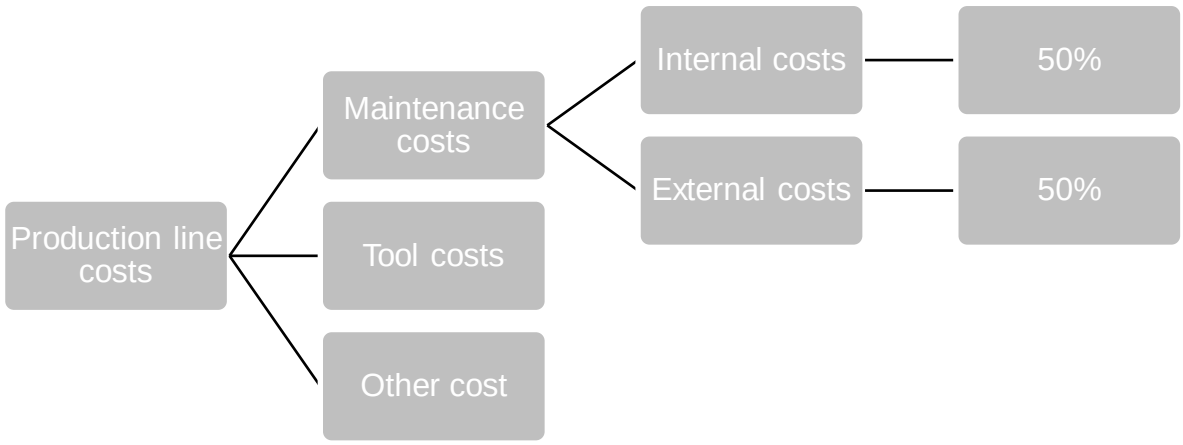

Figure 50: Maintenance-cost structure for a cylinder block production line

Monopoly of external service providers:

The external service providers, mostly German machine manufacturer, have a strong position for negation. This is a notable exception, normally OEMs have the power to dictate the price for their suppliers or service providers. Decisive is the poaching of the best and most experienced Audi-maintainers. Successive the best and most trained maintenance engineers left the company in the resent years, and most of them work still in the company as external personal, with a substantial higher wage compared to Audi internal personal.

Motivation – Fluctuation:

As mentioned before, the fluctuation of experienced employees is a big problem, and will be even bigger in the future. If employees leave the company after the whole training and education effort from Audi side, the internal maintenance knowhow will decrease from year to year.

As described in chapter 4.5, the employee loyalty for a big company is important. Those experienced employees who leave the company just for a better payment are not A-staff. But also, the A-employees have no chance to develop themselves and to get furthermore specialized trainings in a particular area within a decentralized maintenance structure.

Another future challenge comes with the generation change within the company. Today most of management positions are occupied by persons from the Generation-X, Top management positions often also by baby boomers. As mentioned in chapter 4.6, the generation management, there is a big potential for conflicts between those generations. The second big generation related challenge is that in the near future the biggest group of employees in the company are from Generation-Y. The generation specific motivation from the named generations are different. Audi Hungaria 2013 was obtained the fifth time the award for the most attractive employer of Hungary. The motivation and the expectations of the next important generations (Generation-Y and Generation-Z) are different and all companies have to be aware to adjust their incentives accordingly.

All four issues somehow are related to each other. The detailed consideration of this output will be discussed later, in chapter 6.7.5, the discussion.

6.7.4 Central Controlled Maintenance

Direct acting maintainers – IHM:

The investigation of the Audi intern competence matrix and the analysis from the work tasks of direct acting maintainers, and also the comparison to other Volkswagen Group engine production companies, has shown that a central controlled maintenance is achievable. The decisive criterion how good the line overlapping use of these maintainers work, depends on a major part on a standardized task list.

Indirect acting maintainers – maintenance engineers / ING:

It is important to manage also the indirect acting maintainers. The maintenance engineers own most of the production line specific knowhow. To be able to use these experience in the most efficient way is to manage them centralized and to allow them to work also on other production lines.

A major change in organizational structure is therefore needed. The following Figure 51 shows a simplified representation of the needed maintenance matrix organization.

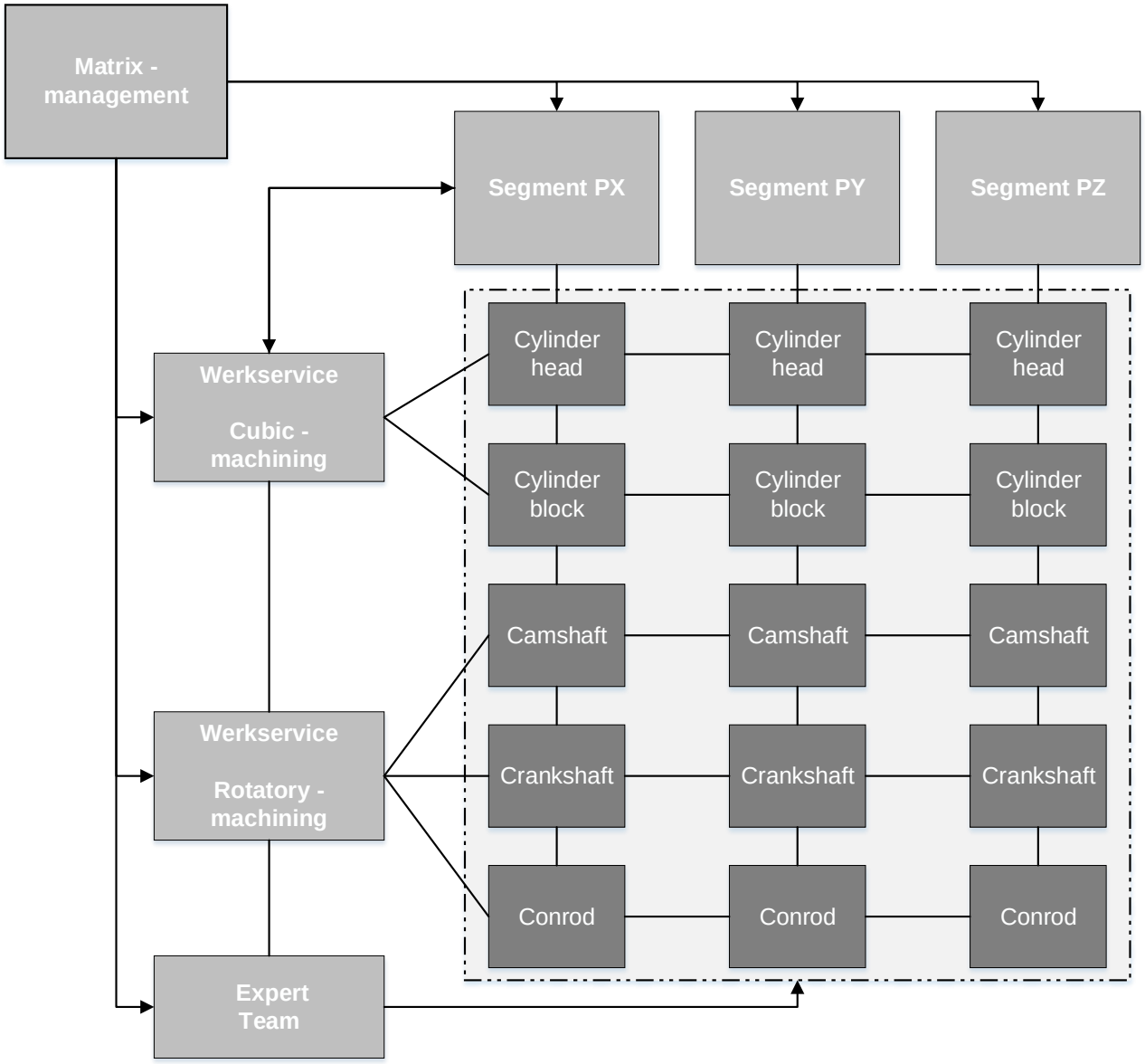

Figure 51: Maintenance organization matrix for the engine production in Audi Hungaria

6.7.5 Discussion

In this chapter, the results from the outcome of the skill competence matrix, the cluster model as well as the main issues resulting from these, will be discussed and interpreted. All the results should help the TPM4.0 project team to give some additional inputs for the further change management process.

Skill Distribution of Maintenance Units

As it can been seen in the previous bubble diagrams in Figure 43,Figure 44 andFigure 45 also the diagram in Figure 52 and Figure 54 underlines the unequal distribution of know-how compared to segments and between the different engineers. Also, the complexity of the production lines is very different. Furthermore, it shows that the average complexity due to different machine manufacturer is much lower for a test equipment engineer as for the mechanical or electrical engineers. The electrical engineers have an average skill level of 2,9 and an average experience of 5 years on the production line in comparison to 2,9 skill level and 5,5 years of experience on the line for mechanical engineers and the test engineers have the highest average skill level of 3,1 with an experience of 4 years. Noteworthy is that the skill level is not related to the experience of the work on the production line. For the case of high skill level and a low experience this may be the case, that the employee had already more experience on a former production line, which in this skill matrix was not evaluated. Remarkable are the cases where the skill level is not at all proportional to experience, when the experience exceeds the double-digit number of years and the skill level is far below 3.0. A reason for this could also be, that the education and trainings for the maintainers depends on the management of the decentralized production lines.

The centralization, the central coordinated maintenance, is a conceivable way to harmonize this distribution of skill levels per production line. Another important aspect is the rotation of the employees, not only within the own segment, but at least within those two groups of rotatory or cubic machining. A fundamental condition, which can be realized by such competence matrix, is to know exactly where the maintenance resources are placed. Therefore, a centralized information management is decisive, which is also a major advantage for this ongoing centralization project. In the same time this can only be realized when all this information management is done by a central organized maintenance which is acting company wide and is not subordinate to a production segment, for example the Werkservice.

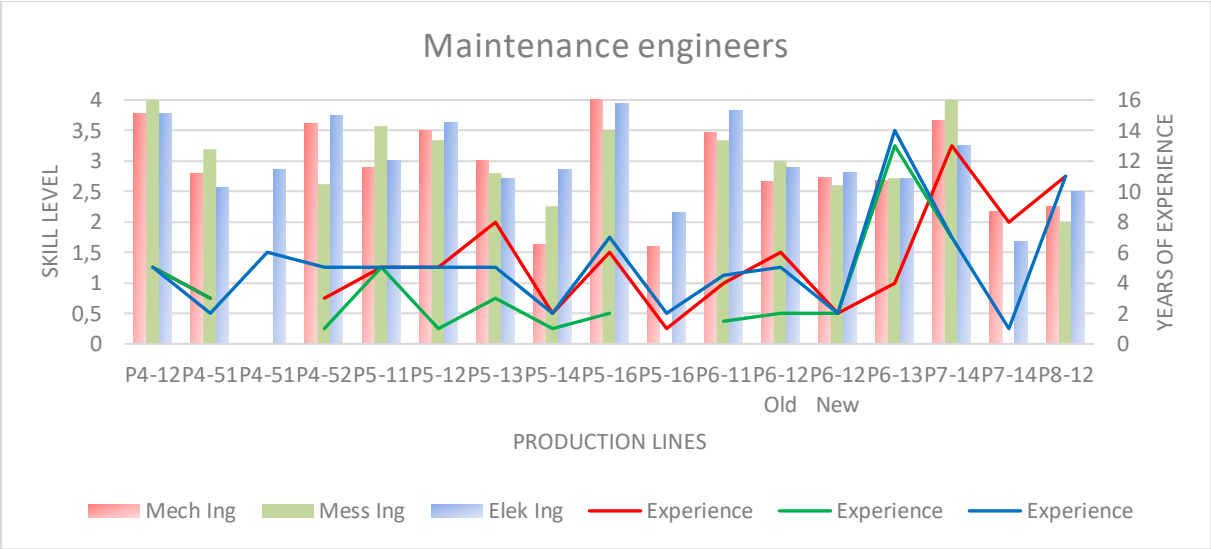

Figure 52: Maintenance engineers: skill level relation to experience

Figure 53 shows the maintenance skill level of the direct acting maintainers related to the experience on the production line. Also in this chart the unequal distribution of the skill level is evident. Even more evident is that there is also no relation between competence level and experience on the production line. The mean value of skill level of both, mechanical and electrical maintainers is 2,3 which is lower in comparison to the relative high mean values of more than 6 years of experience per line.

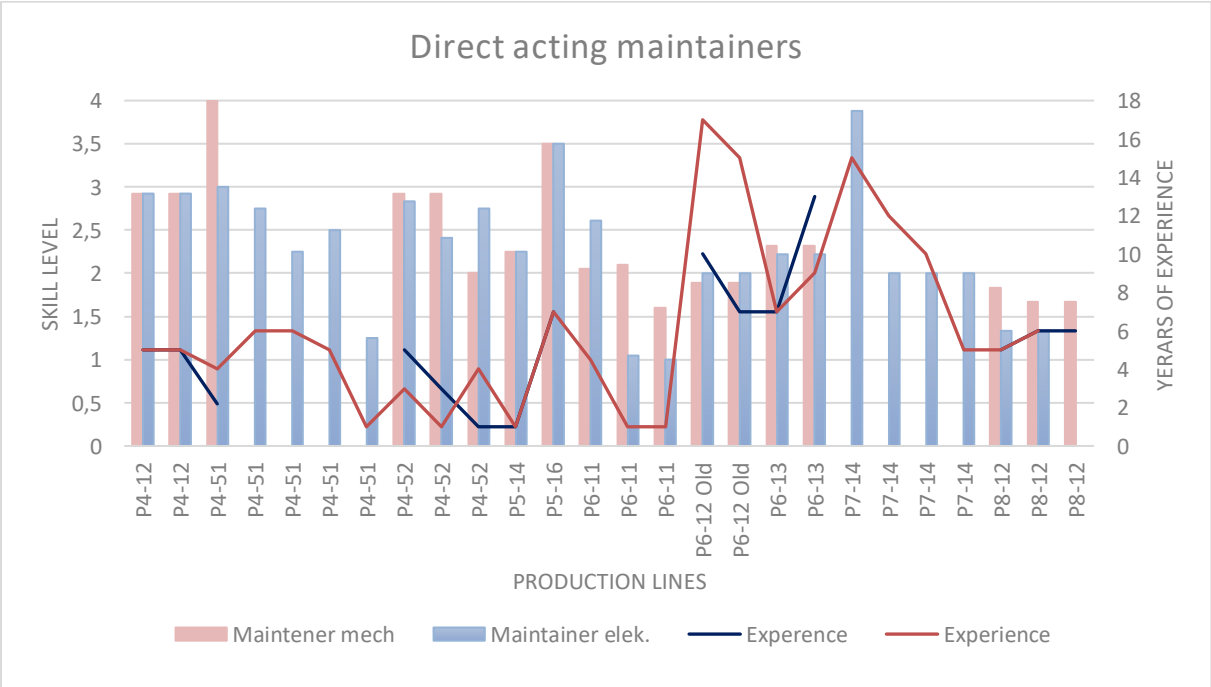

Figure 53: Direct acting maintainers: skill level relation to experience

Also for this group of maintainers a centralized solution can be an advantage. It can be seen that in some production lines the relation between experience and skill level is very good, this can be attributed to the good training and education program of the production line. Due to the fact of the low average skill level of direct acting maintainer, an overall use of these units in all production lines seems much easier to realize compared to indirect acting maintenance engineer. A mandatory prerequisite is a standardized task list for direct acting maintainer. These can be divided according to the cluster model of the above-named rotatory and cubic machining, and help to simplify the task lists and the retraining effort of maintainers.

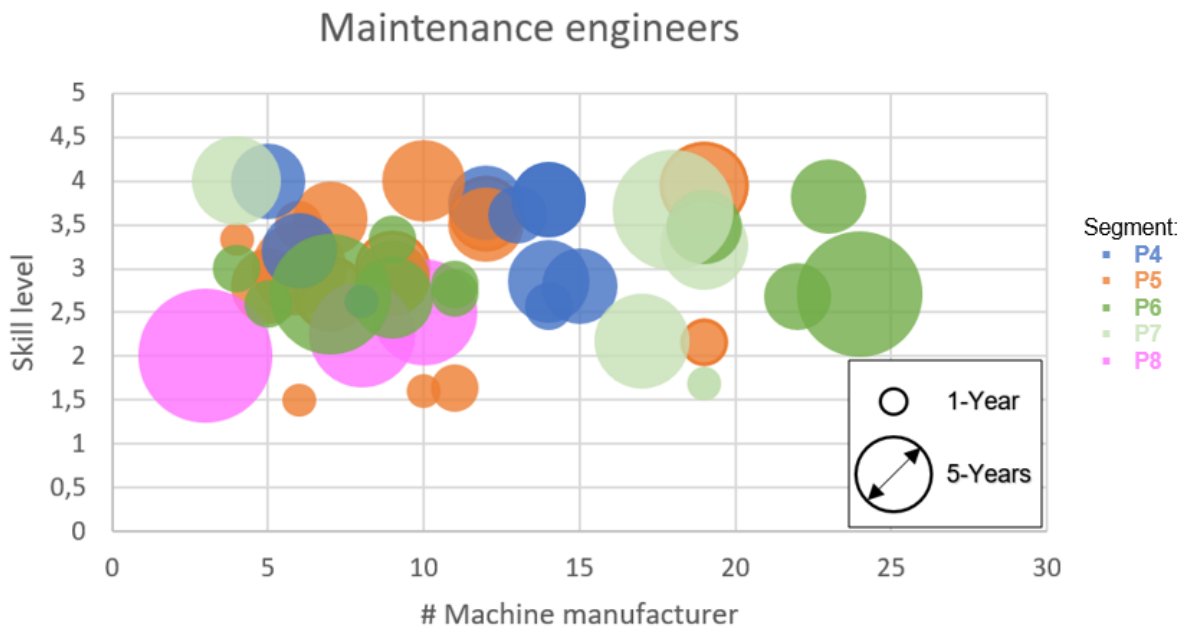

Figure 54: All indirect acting engineers according their segments

Organization – Cluster:

The named cluster model for production lines, rotatory machining and cubic machining, can simplify also the retraining. The investigation has shown that the machines manufacturer for rotatory machining are different compared to the that the cubic ones. Especially for the mechanical maintenance units, this type of clustering can facilitate the training effort for working on more production lines. The challenge for electrical maintenance units are not the different machines, but the different control systems. This can vary also for machines of the same manufacturer, especially for age related differences of control systems. A retrofit, bringing the old control systems on a new standard, would also help to keep the training effort as small as possible. An important point is that the cluster models are designed in a way, that the walking time for the

maintenance units are justifiable if they have to support another production line. Another decisive advantage of clustering in the above described way is the possibility to benchmark within the own company.

The enormous number of different machine manufacturer makes the whole organization and the versatile usage of maintenance challenging, but handle this defiance in the best possible way is important to be competitive also in the future. Clustering some performance areas helps to reduce the number of manufacturers, and therefore makes it easier to realize the centralization. In addition, a centralized organized training system is necessary to react on the current situation.

Team of Experts and Their Correlations

- External maintenance costs
- Monopoly of external service providers
- Motivation – Fluctuation

These three critical issues are all interconnected, and are not to underestimate challenges for a successful future of the company. Being an attractive employer to be able to attract and retain good employees is a primary goal of every company.

Know-how can not only be accumulated as an economic resource. The loss of know-how, which is dearly bought, can become a costly undertaking for companies in longer term. If for example, an employee leaves the company, know-how can suddenly come into the possession of a direct competitor.

Introducing a team of experts in an opportunity to insource or backsource the missing know-how. On the other side it is a way to meet the challenge of this monopoly situation of the external service providers. It can be a chance to be less depending on the external service providers. In addition, it creates a new job opportunity which results in making the employer more attractive.

A centralized organization system makes it possible to create a centralized expert team, and to manage this in the most effective way. In addition, it can help to reduce the costs of trainings by utilize them in a more effective way, because not every single production line has to think about witch training effort is economically justifiably when using the trained maintenance unit just on the own production line.

With the change of generation from X to Y another important issue arises. As long as the claims are met, the Y-employees will be loyal. If the employer no longer meets their requirements, they will go without hesitation. This is for sure a big difference to the older generations. To be able to build up a system where insourcing is an effective solution to challenge the dependency to the external service providers, the company has to react and adapt their incentive system.

7 Conclusion

This implementation analysis of central controlled maintenance is based on a simulation output of the University of Technology Graz. To get an overview of the actual state of maintenance the necessary data has been collected by completing the skill matrix.

Output summary of skill matrix:

- Unequal distribution of knowhow on the production lines
- No uniform relation between skill of maintenance units level and experience on the production line
- High number of different machine manufacturer used within the company, also for production lines with the same product type
- Lots of different NC-, PLC- and Control systems are used
- Difference of task complexity between the different maintenance engineer groups
- Low average of skill level for direct acting maintainers compared to their average experience on the production line

All this outcomes signal there is a big potential in how the maintenance organization can be optimized. Working on different production lines, depending on the actual necessity. To be able to send the decentralized positioned engineers and maintainers to various production lines a new classification of all the production lines have to be done. Keep the training effort as little as possible for bringing the employees to a balanced competence level, is the idea behind the cluster models.

Output summary for the organizational models:

- Clustering the engine production lines according rotatory and cubic machining
- Basis for standardization of the maintenance tasks for direct acting maintainers
- Basis for the education effort to bring the engineers on an even skill level
- Reduction of the complexity of tasks due to the high number of different machine manufacturer

- Keep the walking paths of the maintenance units as short as possible and simultaneously trying to cover as many production lines as possible to take advantage of the flexible usage of maintenance units
- For mechanical engineers the cluster models model is important because their knowledge is related strongly to the machine manufacturers
- Retrofit of control systems makes reduces the training effort for electrical specialized maintainers
- Possibility of continuous benchmark to other production lines of the same type if maintenance engineers work on different production lines
- Fundamental to balance the skill distribution is a continuous rotation of employees beyond their current segment structures

The evaluation of the maintenance competences within the company has shown a really big potential: The team of experts.

External maintenance costs can be decreased by an active strategic insourcing of competences. Currently there is a big dependence on the external service providers, because with this decentralized maintenance system there is no possibility to educate some specialists in the field of for example robotics or NC-programming. On a single production line these special investments for education are not exploited. To give the good skilled and motivated employees the possibility to develop themselves and to prevent a fluctuation of important manpower with lot of knowledge, an implementation of a company own team of maintenance experts is a solution. Especially because with the getting older of the machine park of the engine production, the maintenance topic become even more important in the future. There are a lot of critical issues related to this topic. Key topics of external maintenance costs, the monopoly situation of external service providers in Hungary and the problem of fluctuation of experienced employees. Not only the avoidance of unwanted fluctuation and the long-term loyalty of employees to the company, but above all the acquisition of qualified professionals this so-called war for talents is becoming the most important topic of the future on the agenda of companies. The effects of demographic change on the labor market makes it clear that good employees are one of the most important and scarcest resources of corporate success. Modern and innovative personnel management can help to positively influence this company's success. Adapting the incentives according X- and Y-generations is crucial, to be also in the future one of the most attractive employer in

Hungary. Good human resources work is therefore an independent and meaningful value creation factor.

The conclusion for the Audi use case, advises to change from the decentralized organized maintenance system to a central controlled maintenance system placed in the Werkservice. The maintenance units will be still placed decentralized but the maintainers can support also other production lines. An exceptional case are the teams of experts, which are central controlled and located in the Werkservice. This teams acting company wide and are not subordinate to the production lines.

It will be a challenging process going through this change management process. A big problem, explained in chapter 2.2 and 2.5 to overcome the power structure and to establish in every level of the maintenance organization to same sense of urgency. The different cultural backgrounds of the project team TPM4.0, German project leader and Hungarian heads of segments, is challenging and to avoid such problems argues through ethnocentric leadership styles are no longer contemporary. Managers abroad should use their leadership style focus on the culture of the country, not on their own culture. The background for this topic was explained in chapter 6.5 and it is based on Hofstede´s model. There can be a weakness in the evaluation of individuals, because they can be quite different from the stereotypical picture of the country.

8 Outlook

To make this concept of a centralized maintenance organization, the standardization of tasks for the direct acting maintenance units is inevitable. Furthermore, a more detailed analysis of competence distribution, on the basis of number and importance of machines manufactures can be useful for reinforce the outcome of this feasibility study. Another relevant process which can be investigated more precise is to optimize the operational structure of the maintenance. If it turns out that the Werkservice isn't the ideal location and partner for centralize the maintenance management, a centralized organization within the production segment could be another solution, implicating a rethinking further outsourcing strategy for some central maintenance task. For one thing is clear, there in a change management process in such a big company is and remains a herculean task.

List of Figures

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9 Publication Bibliography

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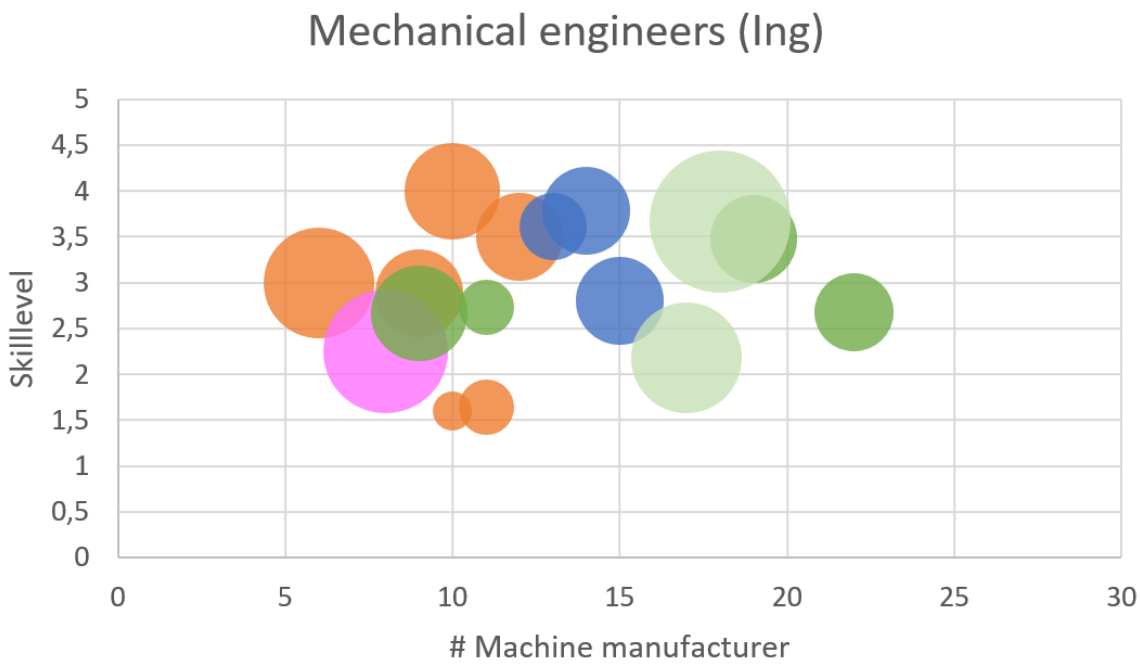
A. Appendix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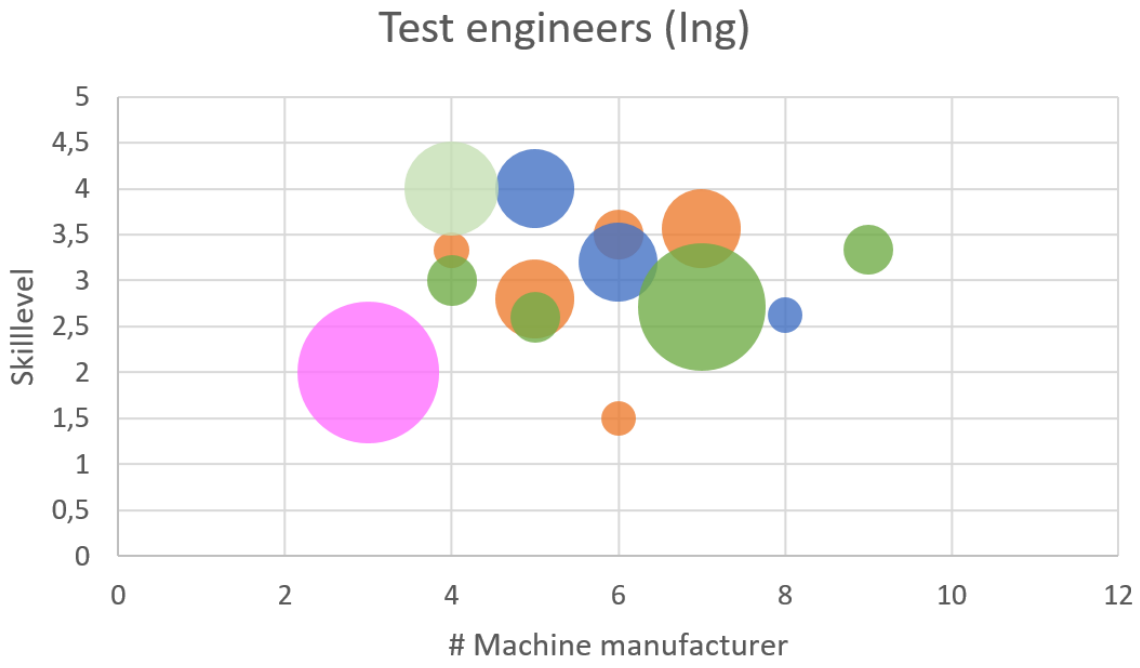
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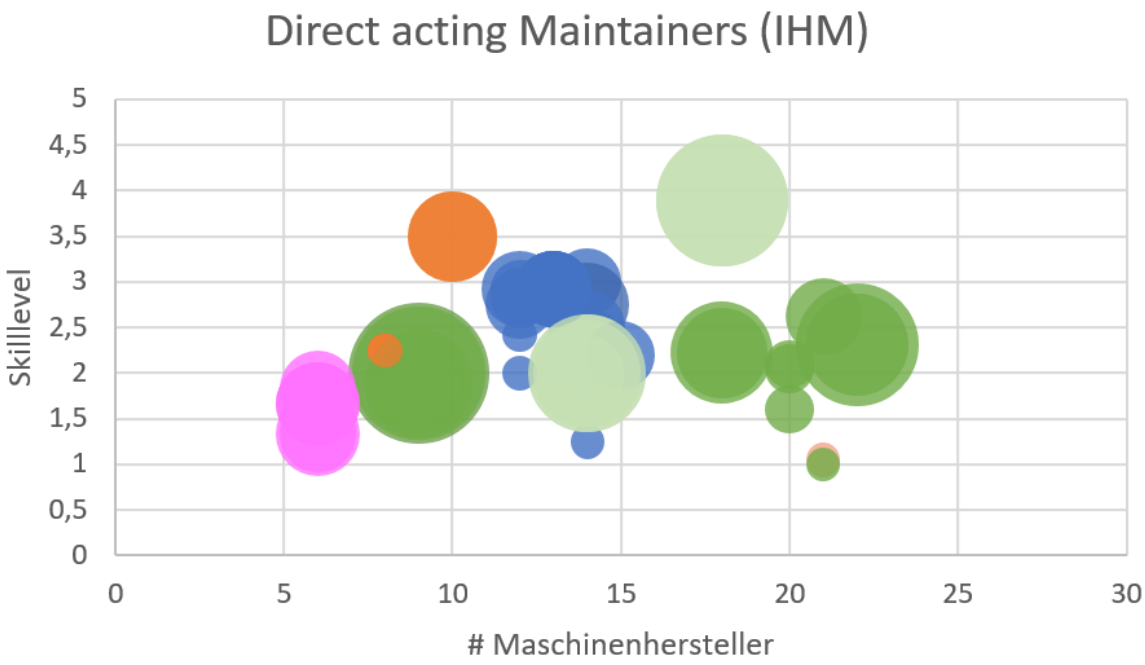
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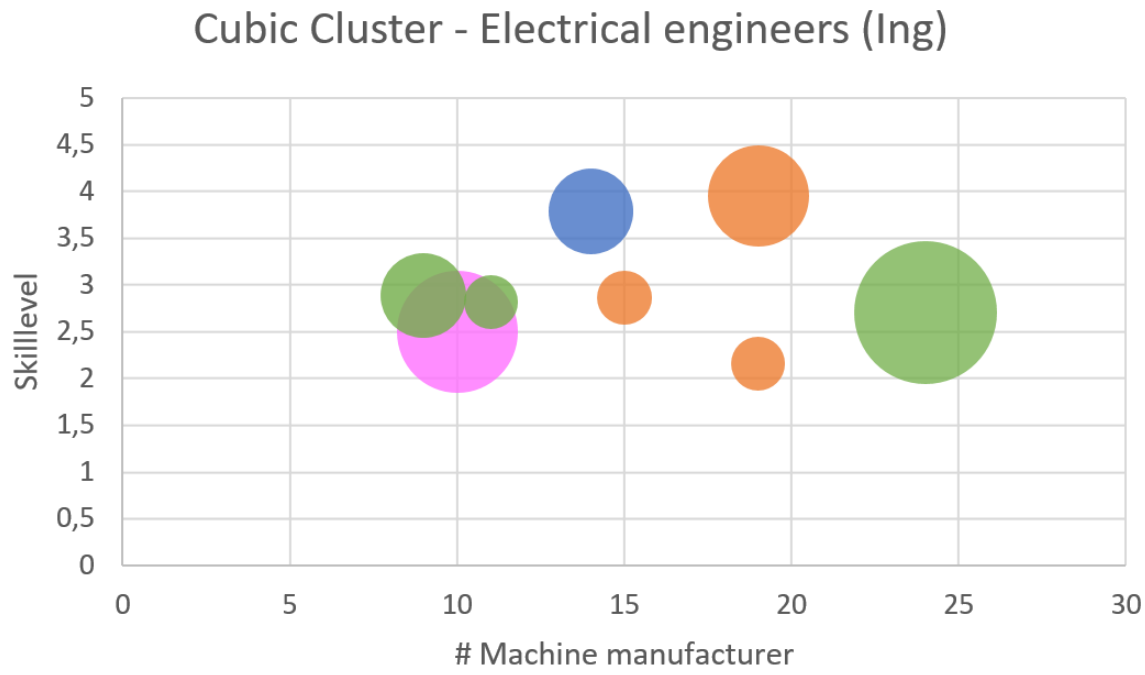
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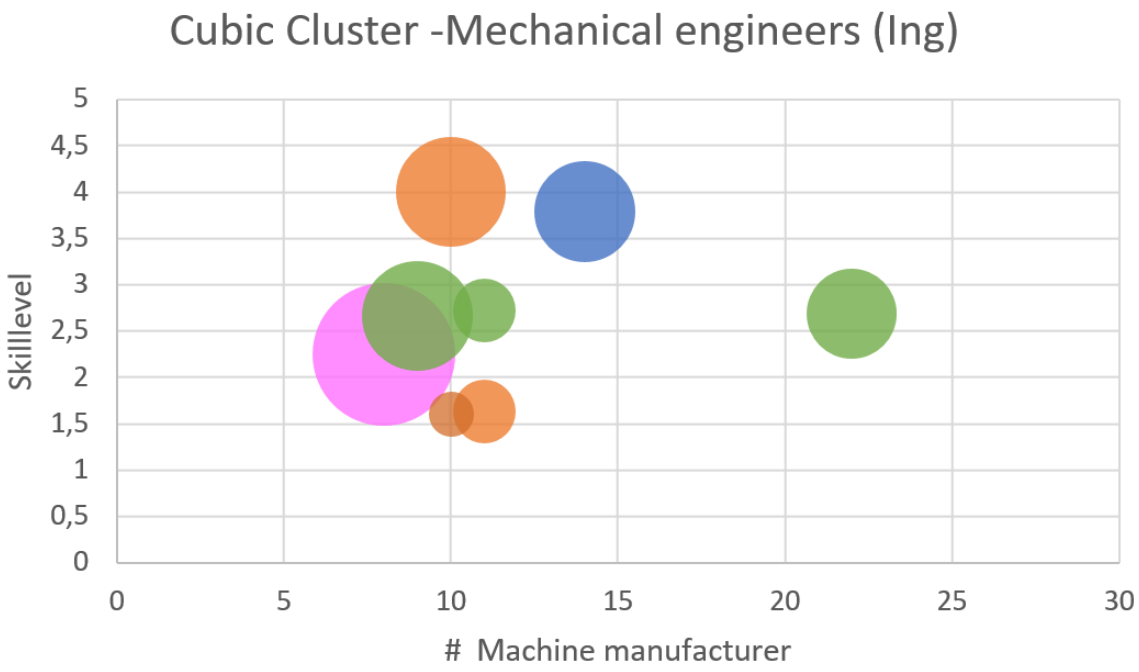
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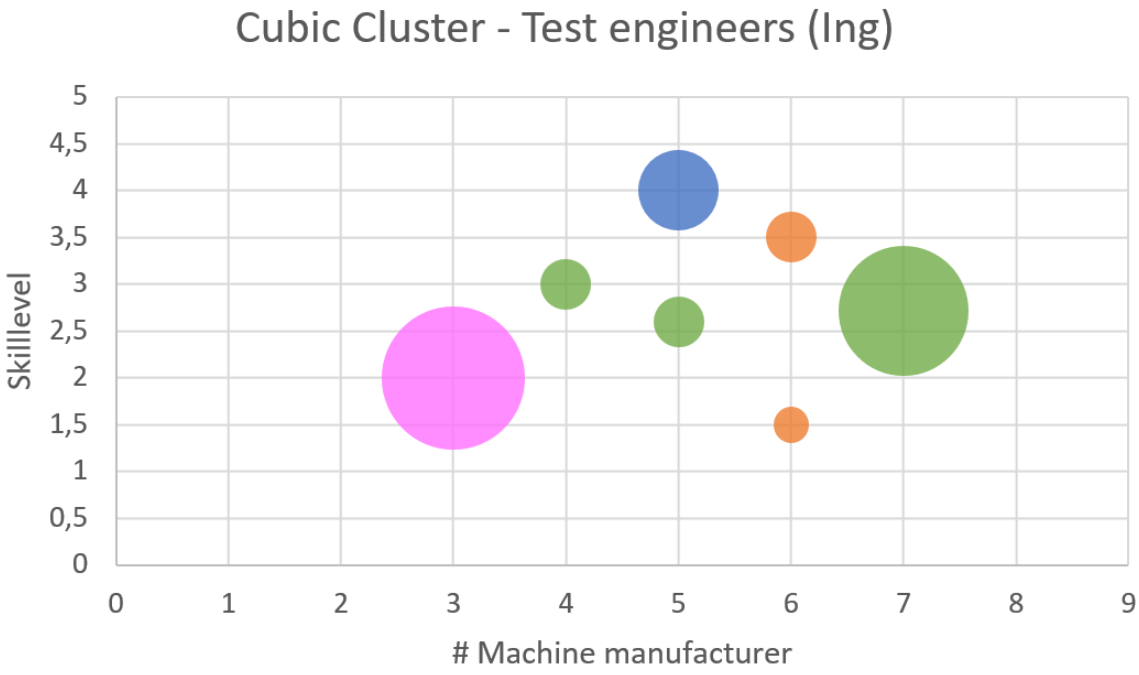
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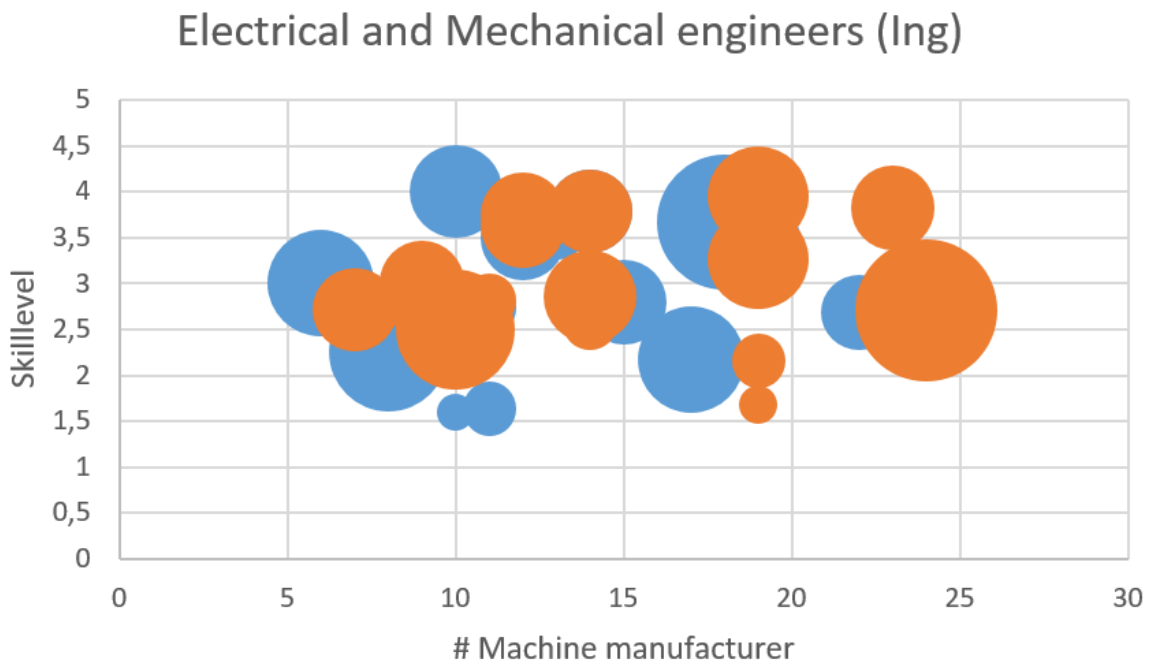
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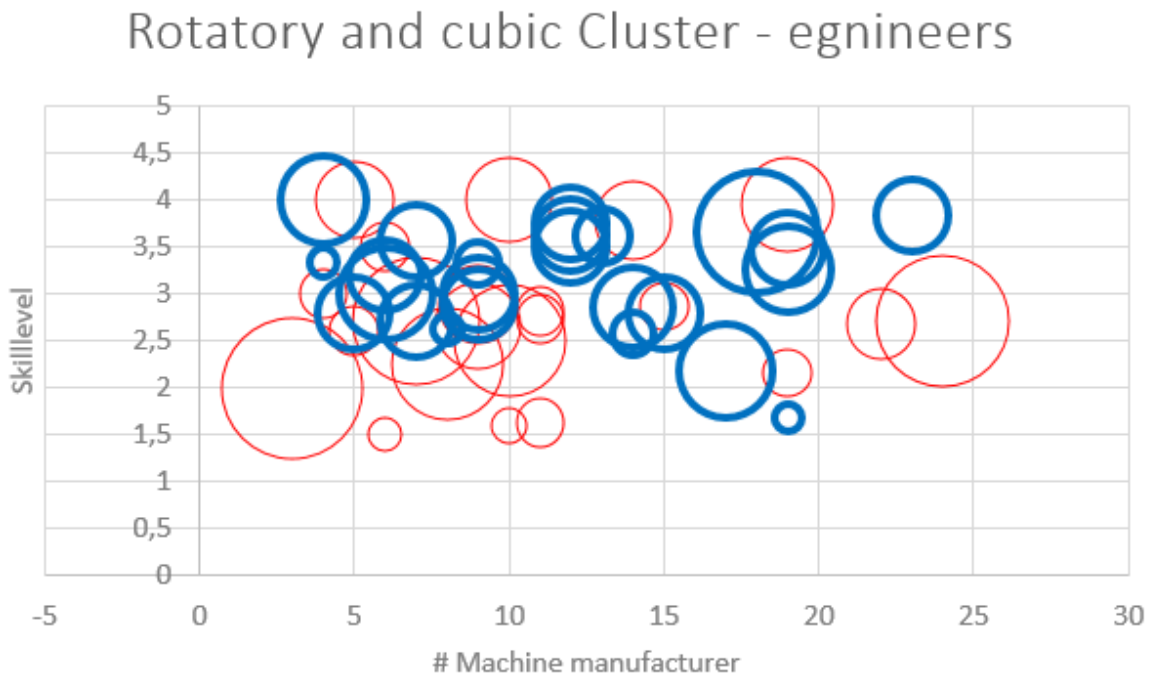
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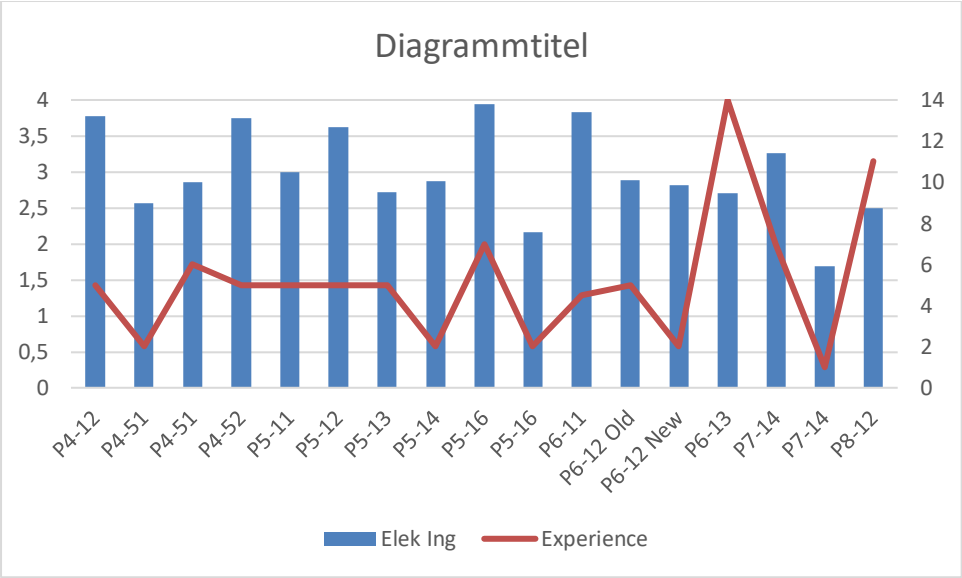
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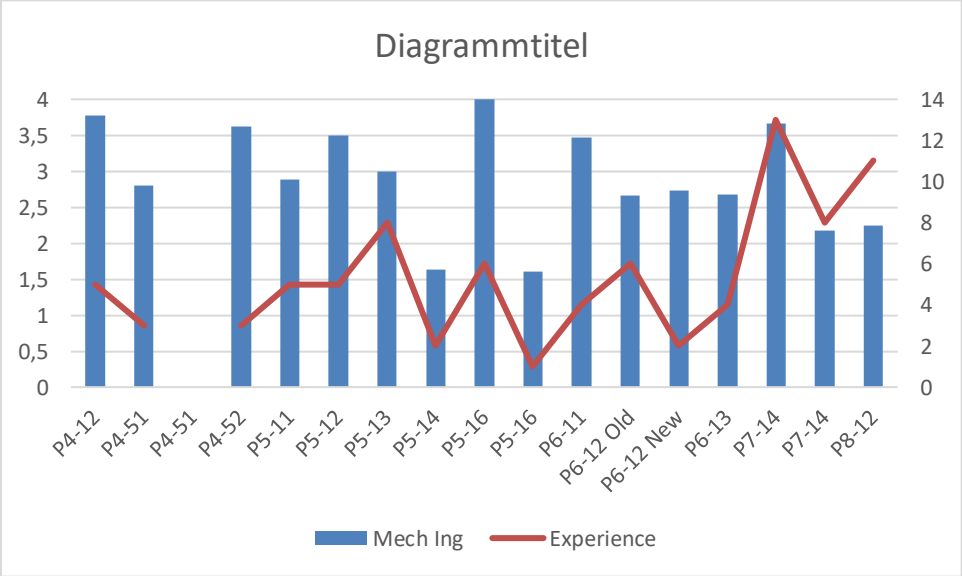
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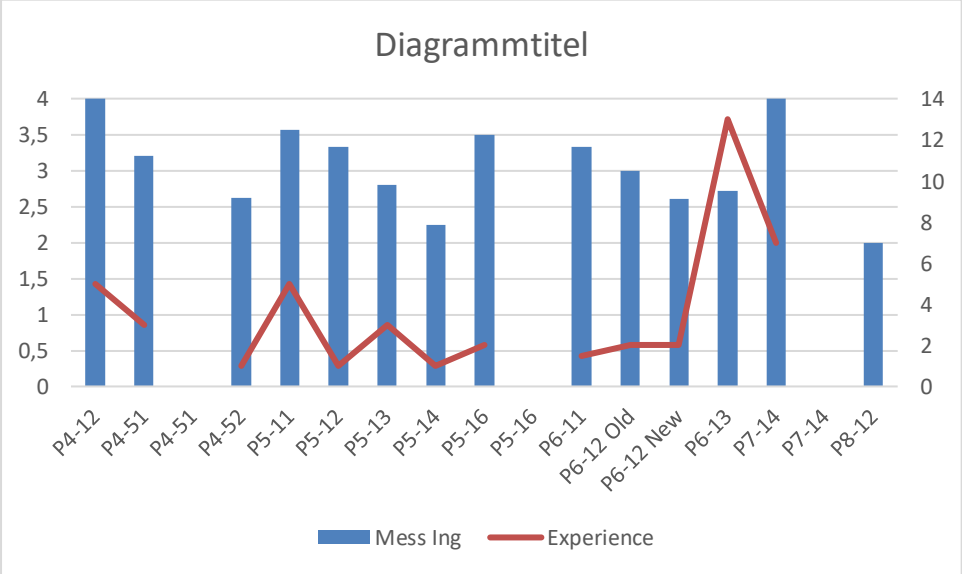
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