Smart Working: in the Context of Mobility Management

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Acknowledgement

First, I would like to thank my thesis advisor Professor Guido Gentile for guiding me throughout my research and steering me in the right direction whenever needed.

Thanks to Movesion Company that was involved in the research and the creation of the smart working package, in addition to their support with filling the survey and validating the results.

Special thanks to Professor Mariano Corso of the Smart working Observatory of Politecnico di Milano for sharing their reports on smart working that were an essential part of this thesis.

I would also like to acknowledge my dear friend Professor Lubna Tarabey of the Faculty of Sociology at Lebanese University as the second reader of this thesis. I am grateful for all the help and guidance she provided.

Finally, I must express my gratitude for my parents, sisters, and lifelong friends for providing me with support every step along the way and encouraging me throughout the process of researching and writing this thesis. None of this would have been possible without them.

Thank you.

Dayana Bou Shakra

Abstract

Smart working is a hot topic worldwide nowadays, heralding modern practices that are slowly taking over the old office culture and transforming the workplace. Italy, being one of the very few European countries that have laws to regulate smart working, has seen a consistent rise in the number of smart workers throughout the years. The purpose of the research is to investigate smart working in Italy and other European counties not only as a tool of managing the workplace, but also in the context of mobility management.

The topic of smart working is broadly discussed in the first chapter, also a snapshot of its presence in Europe is presented. By looking for a relationship between smart working and mobility management, smart working is considered as an employee reduction program. More information in this regard can be found in the second chapter.

In the third chapter, for a better understanding of the effectiveness of smart working, a cost model was formulated, with the main feature of quantifying the costs and benefits that can result from the transformation of a company.

Finally, in the fourth chapter, a survey was designed, which functions as a ranking model, with the ability to identify employees most suitable for this kind of work.

The result of this research is the smart working package that is being supported by Movesion. Among others, this package has two main functions, one being the ability to calculate the costs and the benefits resulting from smart working for any company, and the second model focuses on helping the company select the most adequate employees to perform smart working. The results of the cost model illustrate how smart working is beneficial to all parties and present average values of the benefits and costs incurred by adopting the model. The results of the survey showed that most employees of Movesion are suitable to be smart workers.

Keywords: Smart working, Mobility management, Italy, Company, Employee, Environment, Costs, Benefits, Cost model, Rank model.

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Introduction

The concept of smart working seems to be spreading out fast throughout the European labor markets, although with different names and diverse concepts.
It transforms the working practices by the elimination of space and time constraints.
The trend suggests that smart working will keep on growing due to its significant benefits for companies, employees and the environment. This transformational tool is considered as one of the biggest structural changes in the working place and it holds great potential.

The Chartered Institute of Personnel and Development (CIPD) defines smart working as "an approach to organizing work that aims to drive greater effectiveness in achieving job outcomes through a combination of flexibility, autonomy, and collaboration, in parallel with optimizing tools and working environments for employees".

When it comes to Italy, Smart working has the support of Presidenza del Consiglio dei Ministri: Scuola Nazionale dell'Amministrazione (SNA) and Presidenza del Consiglio dei Ministri Dipartimento per le Pari Opportunità. In fact, many events related to smart working are taking place, such as the Smart Working Day, which is a vertical event targeting Italian major cities. On December 13, 2018, the first Smart Working Day was held in Rome, with the aim to raise the awareness of administrators, managers, workers, entrepreneurs and citizens on the opportunities offered by smart working or "lavoro agile".

According to the smart working observatory of Politecnico Di Milano, there is an estimate of 480 thousand smart workers in Italy. Yet, there is an obvious difference between the public and private sectors, as studies show that more than half of grand private companies have structured initiatives of flexibility, compared to less than tenth of the public administrations.(Corso, Crespi, & Gangai, Smart Working in Italy, 2016)

In the context of mobility management, smart working is being used as an employee reduction program, because it has a direct effect on traffic, especially during rush hours. Switzerland is one of the countries that has managed to use this program to its advantage; when highways were reaching their capacity during peak periods, Switzerland granted 50% of its employees the ability to be smart workers.

The questions posed in this thesis are the following: What are the benefits and costs of applying smart working to the company, the employee, and the environment? And how can a company choose the employees to be granted the opportunity to smart work?

To answer these questions, two models were created; the cost model answers the first question, whereas, the rank model answers the second. The cost model aims to study the effect of one less trip to the office; it consists of a list of costs to the company, the employee and the environment, and another list for the benefits. After defining all the factors to be included in the model, all variables were quantified. The creation of formulas to calculate each cost and benefits allows this model to assign values according to the company in question. On the other hand, the rank model

can filter employees through a survey; it can help a company decide which employees are more suitable to be assigned to work outside the office, thus producing less trips.

The paper concludes that Smart working must be viewed not just as a managerial tool by companies, but also as a trip reduction program which benefits to all parties involved: company, employee and environment. In this time of environmental crisis, any measure that has the capability to reduce the pollution generated in our cities should be studied and applied. Urban traffic is one of the major causes of air toxicity in cities, more measures need to be taken to reduce its impacts, which can lead to health problems and can also damage monuments and works of art in city centers.

Chapter 1: Theory of Smart Working

1.1. Introducing Smart Working

Smart working is a transformational tool used by companies to overcome regular working conditions in a beneficial way. It allows for the work to be done with minimum constraints and maximum flexibility, where work changes from being a place to go to into an activity being performed, regardless of the place and time of it being performed. This method uses communication and information technology as a tool to create a more responsive work environment, to optimize the company's performance and to deliver better customer services, and it's valuable for both the employer and the employee. (enei, 2013)

Smart working goes beyond the concept of working remotely, as it can also include coworking, counseling and mobile working. It's a flexible way of working that focuses on results. The introduction of flexibility in a workplace liberates the workers from having rigid schedules and obligatory office hours, it allows them to interact with employers and clients via an internet connection. Smart working is growing worldwide, with important companies such as Amazon, IBM, and Dell adopting smart working conditions due to its benefits. (Rome Business School, n.d.)

When it comes to Italy, the Ministry of Labor and Social Policies defines smart (or agile) working as a way of performing the work activities without time or space constraints, but by the introduction of phases, cycles and objectives that can be established between the employer and the employee. The goal of this is to help the employees achieve work-life balance in a way that helps increase their productivity. Law n. 81/2017 includes the definition of smart working and guarantees that agile workers receive the same treatment of regular workers, it also discusses organizational flexibility, the voluntary nature of this work, and the use of instruments that allow remote work. (Ministero del Lavoro e delle Politiche sociale , n.d.)

This law provides a regulatory framework and measures for the protection of non-entrepreneurial self-employment, to encourage flexible articulation in the places of subordinate work. In addition to that, Art. 14 della Legge 7 agosto 2015, n.124 discusses promoting the reconciliation of life and work schedules in public administrations. (Dipartimento per le Pari Opportunita, n.d.)

Although Smart working is widespread not only in Italy, but also throughout the European countries, there seems to be no well-defined structure of this practice, not even a single name, however this phenomenon is defined by the Smart working Observatory as "*a new management philosophy founded on returning greater autonomy and flexibility to people in choosing how to work, in terms of workplace, working times and which tools to use, in return for assuming more responsibility for results*". (Corso, Crespi, & Gangai, New Ways of Working: Taking Stock of Smart Working in Europe, 2017)

Differentiating smart working from teleworking is essential, even though in both cases the work can be performed outside the context of an office, yet the two concepts should not be confused. To

elaborate, in smart working the employees carry out their tasks outside the office on an average of one to two days per week, they can choose their preferred location freely and the instruments or tools (such as personal laptop, tablet, smart phone…) to be used. On the contrary, teleworking involves long continuous periods outside the office, where the location and the instruments to be used are already provided by the employer. (Dipartimento per le Pari Opportunita, n.d.)

Smart working has transformed from an opportunity into a necessity, a tool that rediscovers and gathers all the hidden energy and dynamism of an organization and transforms them into momentum.

1.2. Benefits of Smart Working

Before discussing the benefits that smart working provides, it is important to look at the drivers that played a role in the development of this working method. By focusing on the elements that caused the change, it might be easier to understand the consequences.

The increased demand for work-life balance is one of the key drivers for smart working, nowadays employees are not only looking for challenging jobs but also, they demand the right to perform it with flexibility, in other words they want to perform their tasks whenever and wherever they want, in a manner that allows them to better manage their personal life and their jobs.

A second key driver is cost and efficiency. Given that the office space is usually expensive, using the old working methods leaves the offices under occupied, and that is a wasted cost; in addition to that a lot of time is lost by commuting to the office. A study shows that workers in UK spend around 7 hours a week commuting, that alone adds up to 47 days a year on the road, and this time could be used for better purposes. Also, the cost of business trips can be reduced by the use of smart work.

The third driver is the change in demographics and the workforce, the shape of the workforce continues to change for instance during the past few decades there has been a great increase in the percentage of women in the workforce, a change in the working patterns and an increase in the percentage of the ageing workforce.

Technology comes in fourth. Due to the rapid development in this field, colleagues and customers can connect and share knowledge from anywhere, at any given time of the day with ease, through technological devices such as an employer provided PC, company or personal laptop, smart phones, and tablets that are more available than ever.

Sustainability is the fifth driver, where Smart working can produce a decrease in the need to travel thus reducing congestion during the rush hours, and CO2 emissions from cars and offices.

The sixth and last driver is customer needs. Here globalization plays a great role, the way that smart working emphasizes on services, relationships and knowledge helps the companies achieve better results especially with the bigger demand for customized products and the bigger competition available.

Ever since Smart Working was implemented, its effects on the workplace, the worker, and the environment have been studies closely to find its true value, these studies verify that this revolutionary method is in fact effective and results in plenty of benefits.

It is interesting to realize that smart working incorporates flexible working practices, but unlike teleworking, that is found to be more beneficial to the employee at the cost of the employer, smart working benefits both parties tremendously.

Benefits for the business include increased productivity, efficiency and space saving which leads to a decrease in the property cost, reduction in the cost of fuel and parking that is provided for the commuting employees, extension in the business hours where the time traveled by the employees to the working place can be used as extra working hours, increase in the level of motivation, innovation, performance and engagement of staff which also reflects on the absenteeism and the turnover of staff by reducing the costs related to them, reduction in the disturbances due to weather, travel problems, and office security issues, attraction of high quality talents that may not be able to relocate or commute every day to the office, enhancements in the utilization of skills, the ability to match the workforce with fluctuating demand, the ability to meet customer's expectations and, last but not least, it is beneficial to new product development performance through increasing cross-functional communication resulting from increased virtual interaction. According to a study done by Milan Polytechnic's Smart working Observatory, it has been calculated that smart working is able to increase the productivity of companies by the amount of 27 billion Euros and reduce cost by 9 billion Euros.

Whereas employees gain a vast selection of benefits, those range from reduction in travel time and its costs, decline in frustration and stress linked to barriers or travel problems and a drop in distraction level. Contrarily, it increases personal productivity, focus, concentration, innovation levels, engagement at work, trust, wellbeing, health, happiness, job satisfaction plus it provides the ability of integrating healthy eating habits and exercise into the working day. In other words, it provides the possibility of achieving the highly-sought work-life balance.

When comparing a smart worker to other types of workers, surprisingly only 1% of smart workers seems to be dissatisfied with their work compared to 17% of other workers, over all smart workers are more satisfied with their jobs. Also, they possess more digital skills as the ability to solve complex problems by using digital tools, collaborate efficiently online, and use a wide range of new communication tools, plus they are more mobile and self-empowered than the rest of workers. (enei, 2013)
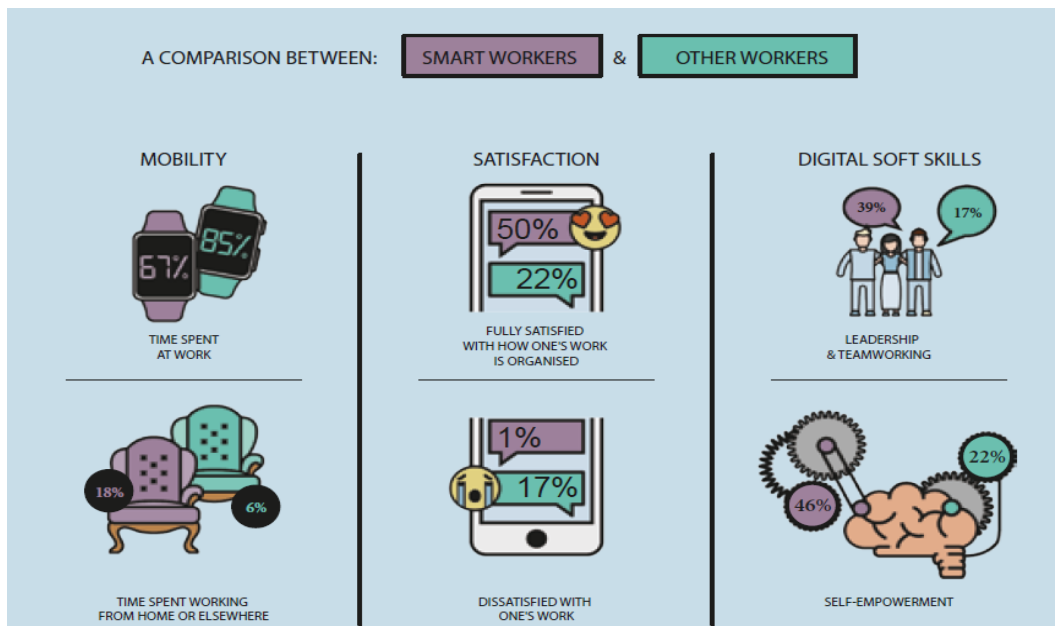
Figure 1 - Smart workers vs. other workers

Digital Innovation Observatory- Politecnico di Milano

Smart Working has benefits to the environment and development in general as well. The decrease in the need to travel daily causes the reduction in traffic volume especially during rush hours, traffic crashes, noise, road damage, and the emission of air pollutants.

Another aspect of smart working affecting the environment is through reducing the organizational and personal carbon footprint, and the amount of paper used through digitalizing processes documents, thus moving to a more sustainable organization.

In brief, smart working contributes to achieving seven of the 17 Sustainable Development Goals set by the United Nations in 2015, including good health and well-being, gender equality, affordable and clean energy, decent work and economic growth, sustainable cities and communities, responsible consumption and production, and climate action. This will be discussed in more details in Chapter 3 that discusses the reduction in costs generated by one less trip to the office.

1.3. Implementation: The Four Dimensions of Agility

Smart Working aims for improving the quality of work, as well as that of the outcomes. For its implementation to be done flawlessly, there are certain steps that a company needs to follow in the process of introducing smart working, one of the steps is offering the appropriate technology for the employee to work remotely, secondly making changes in management and explaining the process to the employees, which can be done through training courses, afterwards monitoring and assessing changes in performance periodically by looking at results (objective-based) instead of efforts put in by employees. Even though this may sound easy, it is still considered to be the hardest part in the transition. Besides that, the company should be able to provide ways for the employees to interact and co-work outside the office.

In fact, achieving agility in the working practices requires the consideration of four dimensions; time, location, role, and source.

When do people work? There are various ways of arranging the working time of an employee ranging from minimum to maximum flexibility. When a company is trying to implement smart working, it should pick the timing conditions that suit it best. Some of the options to consider are: part time working with benefits of full time, job sharing where two or more employees share one role , flextime that requires a certain number of hours to be done in a week according to the choice of the worker, self-rostering allows the employee to choose the time shift, varied working hours with flexible start and finish timing, annualized hours in which a working pattern is variable but an annual number of hours must be covered, staged retirement this is the case when a reduction in the working time is applied before retirement, shift swapping that allows changing shifts with other personnel, compressed hours here the same amount of hours is covered in less days, paid overtime, voluntary reduced time this option reduces staff cost by offering extra unpaid leave, commission outcomes offering a contract with rewards based on performance and outcomes and no fixed hours, seasonal block where the working hours follow the seasonal change in demand, and shift work or team rotation. It's interesting to note that some companies tend to combine one or more of these options to provide more flexibility to the employees.

Location as in where people work; this can also be managed by choosing the location depending on the employees needs or performance. The choices range from owned desk or office, hot desks that offers better mobility in space, quiet areas an example of that is an area with no mobile phones or speaking allowed, touchdown workbenches such as areas equipped with connections for fast access, team tables to join members of a team working on the same issue, renting work hub desks from an outside provider when extra office space is needed, remote or mobile work with no specific base, homeworking where the staff work from their houses for some periods, multi-site that requires the work to be done from more than one or a changing location, to mixed seating where efficiency is gained by placing staff with different roles on the same desk.

The role or what people do can be managed in the following ways, secondments as in roles that are temporary, self-selection where the employee has the freedom of selecting his or her own task, multi-skilling method relies on demand, here the staff is trained to fulfill different kinds of tasks depending on the fluctuation in demand, flexi-teams which represents flexible team formation to meet certain needs instead of a fixed one, job rotation in this role type the employees rotate the tasks between them so that everyone can gain more experience in different activities, and finally the skills based tasking that assigns roles to staff according to competencies.

When it comes to sourcing which is explained by who is employed, there are mainly seven different ways to deal with this issue. The company has the ability to outsource as in making contracts with third-party companies, another option is sharing or partnering what is meant by that is to have a joint labor pool with peers. Also, there is the option of utilizing former employees whenever the demand is high, or crowd sourcing where the company uses volunteers or non-employees when needed, or the staff can be employed for a short-term period and that is called fixed term contracts, freelance is an interesting option as well, and bidding on tasks where organizations and non-employees do free market bidding. (enei, 2013)

1.4. Application and Organization

Obviously, smart working can't be applied to all kinds and levels of jobs, and when a conversion into this method is done there are certain conditions that should be considered regarding this matter, these conditions are mainly the location and time dependency, this can be explained better by an investigation completed by The Equal Opportunities Commission in figure 2 where jobs are mapped against an opposing axes of time and location dependency.

Figure 2 - location and time dependency

The bottom right of the map consists of jobs that are both time and location dependent, those consist 60% of workers, this category is the least paid, and they have no control over their working lives. On the other hand, the opposing group which is in the upper left quadrant makeup 14.3% of the working force and they have minimum time and location constraints, this group is the most paid and they possess more control over their personal and work lives.

However, the question of "what is the best way to achieve Smart working?" remains, and to answer that there is a minimum of six steps that are necessary for proper application.

Step 1: Establish objectives
In this step the company needs to ask questions like: why apply smart working? What will be achieved through that? And how does it contribute to business objectives now and in the future? Here a lot of aspects should be considered, such as the efficiencies that need to be applied, the customers' wants, needs and complaints, the way the staff feel about the work they do, their engagement, talent, and level of motivation, ideal workforce, staff turnover, the ease in which it can recruit, office space utilization, the cost of accommodation and how it can be reduced, the improvements that need to be applied to the technology platform and the way that success and profitability will be measured.

Step 2: Develop a business case
The business case is based on the added benefits and value that smart working is supposed to bring, the company should be clear on the gains expected from this transition from the start, and make sure that they are getting closer to them according to a certain schedule.

Step 3: Develop a new working model
A new detailed model should be developed that considers all different elements that need to be modified and the interaction between those different elements, it should also consider the amount of flexibility that can be achieved in working hours, location, role and source. All of this should be done based on a realistic scale.

Step 4: Create an action plan
This action plan will play the role of a map that will help the company get from where it is now to where it wants to be after the implementation of smart working, it should consider all the changes that should be done on all levels and the way that these changes should be done. It should shed light on the barriers that are faced by each role and the ways to overcome them, plans on the changes in the management, culture and performance measurement, and training requirements should be included, as well as upgraded timetables, communication plans, costs, benefits and ways to measure those.

Step 5: Gain senior management commitment
Senior management should play the part of the role model during this transitional phase and of course sign off on the new program, clear commitment from their part should be visible by the employees because they are the leading example, it should be noted that managing an agile workforce needs more time and effort especially in the implementation phase.

Step 6: Get the support of the employees
To have a successful conversion into the new working conditions, the support of the whole organization is a must, that's why the staff should be kept in the loop, the managers should inform them about all the changes that are going on and show them how this alteration is beneficial for them too. The workers should take part in the proposals for the development of this program to feel engaged. Providing learning courses for the staff is recommended and motivating them through sharing success stories of similar projects that were made. (enei, 2013)

1.5. Difficulties

Adopting enterprise agility can be a challenging task. Companies struggle to get the best out of their investment in the application of smart working.
The most common difficulty is lack of expertise in delivering this new method and lack of follow up and guidance with the team that is new to this change in the working environment. The second difficulty can be the usage of traditional portfolio management and obligations, with this change to agility, there should come a change in management too, otherwise this can lead to a delay in the development. Another challenge is the lack proper technology to help in this transition, the ability to work remotely requires that the employee is connected to the company and can share or view the company's files with ease, also the employee should know how to use these information systems properly. In addition to that, the lack of a culture compatible with smart working can have a

negative impact on the staff such as a decrease in their motivational level and in their performance. Employers should have good communication and trust in their staff to achieve good results since smart working requires a high level of engagement and commitment, therefore, a complete change in the corporate culture where employees should be considered as assets to the company for the best results. (PWC, n.d.)

When it comes to management, monitoring the behavior of employees is reduced when applying smart working, which makes their management a harder task. Thus, the output of the employees should be controlled, there must be an information system that allows the measurement of performance and reporting. Clear performance objectives and measures are required, so that flexibility of the employees doesn't affect the company. Behavioral controls such as monitoring online activities, specifying the exact tasks that are to be performed at home and scheduling regular project meetings between employees and supervisors might be helpful tools in avoiding this issue.

With respect to employees, team members should be treated with respect, encouraged and trusted to take part in the decision-making process, well informed and updated regularly on any developments, considered when applying for promotions, they should know what is expected of them and how their success will be measured, and the proper ways of communicating with their line manager and the company. The lack of any of these components will be a disadvantage and the transition to agile working will be unsuccessful.

Confidentiality and security of data are two other major topics when it comes to taking work outside the office. Some data needs to be locked away or accessed with extreme precaution. Data privacy policies and guidelines should always be respected and protected, otherwise the employee and the company will face a lot of problems.

However, there are certain types of jobs including activities that depend on the work location, such as drivers, farmers, machinery operators, and artisans. Those cannot be transformed into smart working mode yet, at least not with the present working conditions, ways of management, and the current technological development.

1.6. Situation on a European Level

On the 13th of September 2016 the European Parliament showed support towards smart working with a resolution including the creation of working conditions that are favorable for work-life balance. But still there is no single clear definition that is universally accepted of Smart working. According to the Smart working Observatory of Politecnico di Milano "In Europe there are different terms used to describe smart working: flexible working, mobile working, agile working, activity based working and new ways of working are the most common" ; however, the working time standards in EU is regulated by two legal documents which are The Charter of Fundamental Rights and The Working Time Directive; The Charter discusses the rights to limit the maximum working hours and to have working conditions that are suitable for the workers' health, safety and dignity conditions. Whereas the Working Time Directive focuses on organizing health and safety requirements, the maximum working times, and the daily rest period. Even though the resolution of the Parliament was only created in 2016, there have been smart working initiatives in Europe for more than a decade earlier.

Euro found conducted the third European company survey (2013) and found the three most common forms of flexible working which are individual flexible working, part time work and overtime accumulation. Other than that, the survey highlighted the difference between Nordic

countries and Austria where employees have much more flexibility in choosing their working times than other European countries. Also, it's worth mentioning the high percentage of telework /ICT mobile working in Luxemburg, United Kingdom, France and Belgium.

According to the sixth European working conditions survey, only 5% of workers in EU countries admit to having complete flexibility in choosing their working times, compared to 68 % that must comply with hours set by their company with no possibility to modify the schedule. (Corso, Crespi, & Gangai, New Ways of Working: Taking Stock of Smart Working in Europe, 2017)
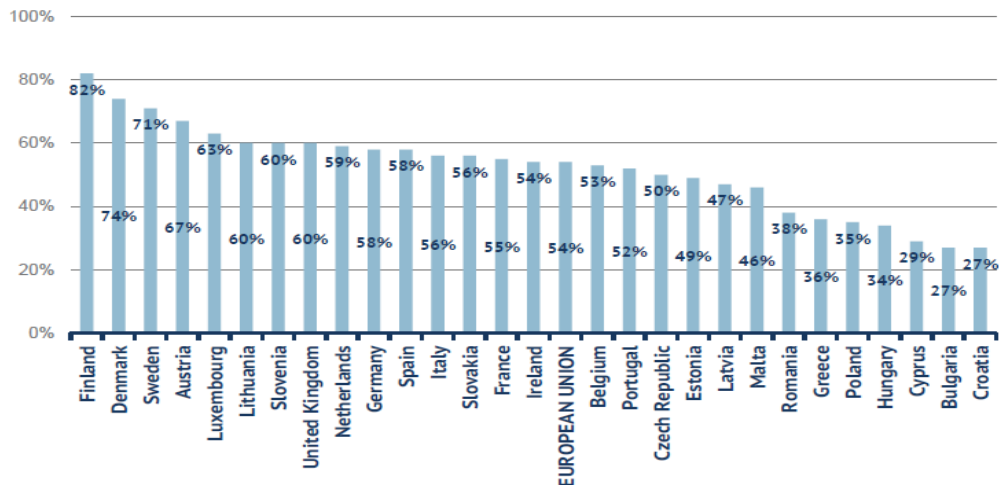

Figure 3 - European companies who adopt individual flexible working times

(Corso, Crespi, & Gangai, New Ways of Working: Taking Stock of Smart Working in Europe, 2017)

The United Kingdom was the first country to create a law that regulates flexible working practices in the year 2014, they are the pioneers in this field. Employees have the right to ask for more flexibility after a minimum of 26 weeks on duty by submitting a request that includes certain information such as their current schedule, the changes they wish to acquire and how it may affect the business, and the employer can accept or decline, but in the later case an explanation must be provided.

On the contrary, Switzerland doesn't have any smart working related laws, although 50% of its employees could work remotely, and 25% are smart workers already. The main drivers behind the increase in smart working practices are the congestion during rush hours, where the transport infrastructures reach maximum capacity, and the attraction of talent.

Belgium can be considered one of the leading countries in this domain too, with initiatives dating back to 2005, with the goal of abolishing time and place restrictions, even though there are no laws regulating this subject. The common name used is New Way of Working and it involves three fundamental components: bricks which has to do with the office layout, bytes that is the part related to technological aspects and communication on the go, and the third element is behaviors that covers the interaction between managers and employees and the leadership styles. Smart working is more spread in large companies than in small and medium enterprises, public administrations are pushing towards it too, the main drivers are reducing peak hour traffic, office related costs, and attracting more talent.

In different circumstances, France focuses on the right to disconnect professionally for a short period of time and has a unique concept of smart working, what they have is a form of teleworking but with less ties i.e. increased flexibility; this is based on the employee's needs, and it doesn't require a contract, an oral agreement can be enough.

The Netherlands is another country with initiatives from 2005, thanks to the widespread of part-time employment, the transition to flexible working was easier, since managers were used to carrying out result-oriented activities without the presence of all the employees. Anyhow, The Flexible Working Act was incorporated by the law only in 2016, this law gives the employee the right to request by writing the change in schedule, working hours, and working place, if they work for more than 26 weeks annually.

Smart working is increasingly spreading throughout Europe with all its different forms and names, this spread has been facilitated by the ongoing technological development and is motivated by different reasons from reduction of traffic, limitations in office space cost, talent attraction to work-life balance depending on each country. Interestingly, only three of those countries have smart working regulations: the UK, the Netherlands and Italy. Anyhow according to the Smart Working Observatory "having a law to regulate the practice does not seem to be a prerequisite for introducing Smart Working, and often organizations do not seem to feel they need one".

1.7. Smart Working in Italy

As mentioned before, Italy is one of the few European countries possessing a law on smart working. In fact, the law, which was approved in 2017, regulates the implementation process and protects the involved workers. Other than that, the Madia bill was also published that same year, with the purpose of defining measures that allow the inclusion of the public sector in the move towards agility by involving at least 10% of the public administrations workers smart working projects within three years. As a result, more companies are launching Smart Working projects and experimenting with it, but to be able to compete with other countries that have more contemporary ways of working, Italy needs to pick up the pace.

The adoption of smart working in Italy has been spreading in large companies better than in small to medium ones (SMEs), the subject has been getting more attention and is being more accepted by Italian companies, this is obvious from the decrease in the number of companies that are not willing to introduce Smart Working from 48 to 27% from 2015 till 2016. Because of the increased popularity of this mode of work, a new law to ensure the rights of smart workers and guide the expansion was necessary. Out of over 5 million employees in Italy that could shift to Smart Working ways (22% of the total employees in Italy), it is estimated that in 2017 around 305,000 (8% of the total working force) were given the option of flexibility in location and working hours, this number doesn't include the self-employed, entrepreneurs or people working in organizations containing less than 10 employees.
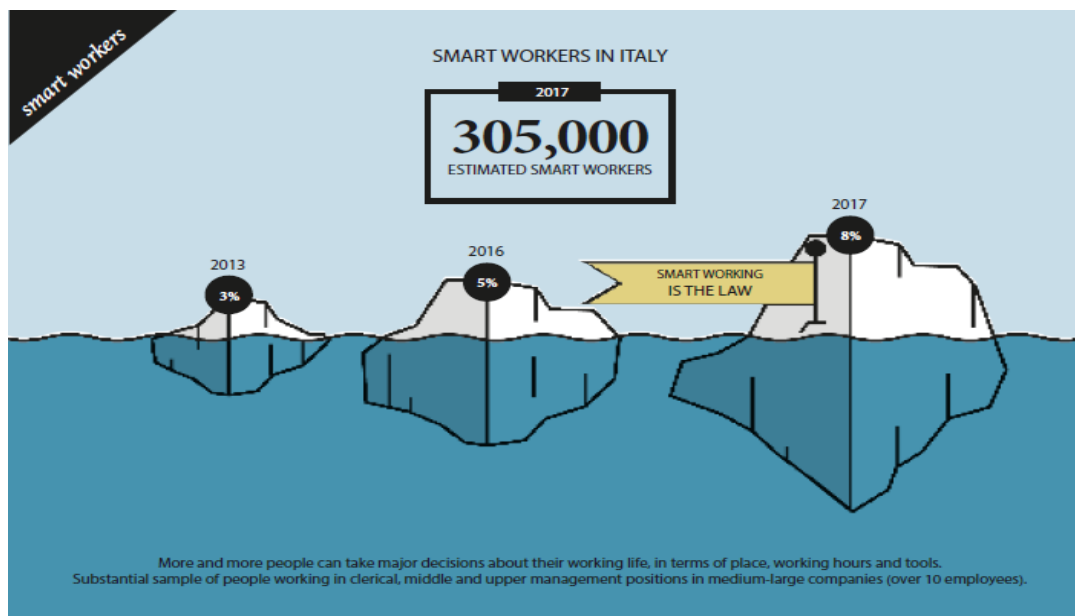
Figure 4 - Smart workers in Italy

Digital innovation observatory-Politecnico Di Milano

In 2016, after the approval and the release of the Smart Working terms by the Senate, large enterprises such as TIM, Gruppo Generali, BNL, Barilla, and Philips either granted large amounts of their employees the ability to work remotely or broadened Smart working projects that already existed and changed the working environment and their ways of management. In addition, the public sector introduced some pilot projects and experiments in this field too, the city of Turin changed the way of interacting with citizens and their activities into smart mode, and the city of Genoa launched a project involving 16 employees. The engagement of the public sector helps in creating a culture that embraces smart working and spreads awareness and has resulted in initiatives in SMBs.

Unfortunately, Smart Working is not spreading out homogeneously throughout Italy, there exists geographical and gender imbalances, where 69% of smart workers in the year 2016 were men (a decrease from 72% in 2013), and there are significantly higher percentages of this spread in the north of Italy than in the south and the islands. Besides people are still worried about the effects of smart working on their advancement in the workplace, their performances, and their work-life balance; but in fact, studies have shown that more flexibility has a positive influence on all those three aspects, it also increases the ability of developing skills and knowledge, improves satisfaction at work, and improves professional performance. Smart working has proved to enhance the workers engagement, contribution, enthusiasm, and creativity in their jobs, not to forget that it also provides them with the ability to better organize their personal life matters.

Therefore, agile working is in fact growing, but it still needs to evolve, the increase in awareness and the change in people's perceptions on this matter will help the spread of this mode of work in a faster and stronger pace. Even with the adoption of flexible policies and models, three elements are required for changing an organization to be more result-oriented; Strategic alignment, i.e. the alignment of priorities, strategies, and the objectives, is the first element. Second comes leadership style, which concerns managers and the decision-making process, and lastly the adoption of new behaviors by employers and employees that focus on developing the skills to achieve positive results in the working mode.

In this Italian context, there are issues that are hindering smart working progress, the Smart Working Observatory considers them to be "construction sites" that require more commitment those are:

In the first place comes focusing on small and medium businesses, with the largest part of the Italian economy depends on those SMBs. As mentioned before, unlike large companies, the spread of the Smart working mode in those is very slow, and the problem seems to be of a cultural nature, lack of innovation and micromanagement approaches (managers controlling the work of employees closely) persist. Even though this change is hard to run and complicated, Italian SMBs need to switch to smart working models.

Second comes the public sector, the benefits of incorporating agile working methods include relaunching the competitiveness of the country, introducing an evaluation logic based on results and services, increasing the attractiveness of working in the public sector (attracting talents), and financial benefits. But the prevalence of vulnerable management and "defensive bureaucracy" as described by the observatory stand in the way.

The third is concerned with introduction of levers, to perceive this change in a systematic manner instead of a passing trend. Opening the doors of debate between managers and employees, rethinking working hours and office space are considered as levers that will make the concept of smart working clearer and awaken a real change in the businesses.

Digital transformation comes in the fourth spot, for smart working to be able to spread out evenly between territories, sectors and professions, new technological solutions and breakthroughs are fundamental.

And finally, the fifth and last stepping stone is expanding smart working to new activities and professions. There are still jobs that are miles away from having the ability to transform into different working methods such as maintenance operating, working in a factory, farming and so on, there should be a change in the professional skills and suitable technological development to make them more compatible with agile working.

Those weaknesses or issues can be turned into the bedrock for the transformation into smarter working conditions, considering them as construction sites helps to broaden our understanding of this phenomenon and allows for a more realistic, meaningful approach on all levels and leads to better results. (Corso, Crespi, & Gangai, Smart Working in Italy, 2016)

1.8. Case Studies

"Lavoro Agile per ilFuturodella PA" is a project of the Department of Equal Opportunities (Dipartimento per le Pari Opportunità) in Italy, it focuses on the innovative practices for a better work-life balance and aims to enhance equality between genders, trigger positive changes, and develop processes that affect the well-being of workers and the efficiency of administrative actions. The project allows for the experimentation with new spatio-temporal modes for the performance of work, and it required the implementation of an action plan with the aim of spreading agile work in the central, regional and local public administrations of the entire national territory; as a result 6 courses of actions were included in the project: cognitive analysis, methods and tools for agile work, national network of strategic actors, pilot projects in the PA, communication, finally information and awareness of agile work days (at least 5 days per month).

The pilot project consisted of 15 PA pilots, all of which were given personalized support through: the analysis of the administrative structure, awareness and information actions, support of agile work path, training activities for employees (especially those in the management department), and by providing tools for monitoring and evaluating the experiment. In addition to that an interactive platform was set up that made it possible to chat, exchange specific equipment and access the documents related to the experiment.

The smart working experiment at the Presidency of the Council (Presidente del Consiglio dei Ministri) included training activities for personnel and management, defining the internal regulation act that was submitted to the CUG (Comitato Unico di Garanzia) opinion and subject to a protocol of understanding with the unions, publishing the announcement for the participation of the staff in the experiment. The Start date of the trial was to be on the 1st of December 2017 till the 30th of September 2018, 10% of employees were included and the selection criteria was based on priority, according to the health conditions of the employee, the family members or cohabitants that needed to be taken care of including children under the age of 12, and employees that need more travel time to reach work.

56 employees were chosen for the project from 4 departments including 8 managers, they were allowed a max of 5 days of smart working per month.

The first outcomes of the pilot program experiment were derived from data obtained by monitoring and through questionnaires made before and after the experiment.

On the bright side, the experiment showed an increased organization of the individuals, better orientation towards the results, improved working environment in terms of planning of activities and organization, higher sense of responsibility and degree of autonomy, better trust in the professional relationships, and greater motivation and personal satisfaction (94% of smart workers would recommend the experience of agile work to their colleagues). The experiment also shed light on some drawbacks that accompanied this change in the working practices, those are difficulties related to the usage of technological equipment, trouble in setting measurable and quantifiable targets when the workers initially plan their activities, and the deviation between planned and implemented activities.

Because of the first Pilot experimentation, a policy was defined for all the PCM structures allowing 10 % of the employees to request a maximum of 5 days of smart working per month, and another experiment is being performed. (Dipartimento per le Pari Opportunita, n.d.)

"Experiencing smart working: a case study on workplace change management in Italy" is a study conducted by Politecnico di Milano with the purpose of sharing the insights gained in the headquarters of an Italian organization going through a workplace management change. Quantitative and qualitative methods were used in data collection, in addition to that walk-throughs, observations, questionnaires, interviews and focus groups were conducted. Recently there has been a trend to downsize in companies, space saving has become a primary issue as in optimizing workspace efficiently. Given that the company's economic impact is composed of the value created by the people and the spaces, companies are moving some or all of their business units to models such as hoteling (booking the desk in advance) or hot-desking (first come, first served) for advantages like economic return and increasing environmental sustainability; this is the case with this organization, they had recently moved to a brand new campus with the goal of downsizing, as a

result the working experience was completely different and resistance was rising from some employees due to the fact that in the former premises the employee desk ratio was more than 1:1, whereas after the change the office was divided into concentration rooms, phone booths, meeting rooms, and spaces for informal meetings without any specific assignment of desks; this created behavioral and territorial problems.

This study concludes that the occupancy rate of flexible work stations and meeting rooms is way below saturation, the precise knowledge of how the company works and its evolution trends is necessary for an accurate pre-design phase, resulting in a different organization of space, also the age and privacy needs of employees are elements to be considered during this phase. Consequently, when it comes to managing the new ways of working the usage of new communication techniques can be beneficial for both the management and the end users satisfaction. Special attention should be given to territorial behavior of employees since it can affect the concentration and the creation of a certain identity within the company. This can be addressed by giving the workers the ability to personalize the working space they occupy (such as the light intensity, colors, and so on) even when it can be shared with other colleagues. Also encouraging people to move within the building leads to the formation of a creative atmosphere where employees know each other well, thus can communicate better and get a flow of ideas, it also enhances their well-being, productivity, mental and physical health. Therefore, a post-occupancy study is constructive when a change in the workspace is in place, to fine tune the performances. (Tagliaro & Ciaramelle, 2016)

The challenges that the managers face when it comes to flexible work arrangements is discussed in "Managing flexible work arrangements: teleworking and output controls". In this paper the research setting was a large financial services firm located in the Netherlands and that offers a wide range of services and products. The sample consisted of 897 individuals some of which could telework, and others that were not. Factor loadings related to emphasis on output controls, in-role behavior, autonomous motivation and controlled motivation were measured. As a result, the study suggests that managers are more likely to allow employees that are motivated to telework, employees who consider themselves well performing are more likely to accept output controls. (Groen, van Triest, & Coers, 2018)

Chapter 2: Mobility Management

2.1. The Concept of Mobility Management

Mobility refers to the movement of people and goods, and managing mobility helps achieve transportation planning objectives such as the reduction in congestion. It is not possible to manage what cannot be measured, however, mobility can be measured through surveys, thus it is manageable. One way of defining mobility management is this: an approach to design and deliver transportation services that start and end with the customer. Mobility management begins with a community vision in which the entire transportation network (public transit, private operators, cycling and walking, volunteer drivers, and others) works together with customers, planners, and stakeholders to deliver the transportation options that best meet the community's needs. It encourages innovation and flexibility, plans for sustainability, assists customers through providing easy to understand information, it also evaluates and adjusts services depending on customer feedback.

Transportation demand management, Smart travel plans, and Sustainable travel are different names of Mobility management. They came as a response to travel problems, these terms are used to describe strategies that lead to a more efficient use of transportation resources, instead of increasing the transport supply system (expanding roads, building parking spaces, etc..), it focuses on the movement of people and goods in a sustainable manner by the use of public transport, ride-sharing or non-motorized ways of travel. Sustainable transport or green transport is any form of transport that depends on renewable sources instead of diminishing natural resources, this kind of transport has a lower negative effect on the environment due to the use of sustainable energy.

The expression Mobility management was conceived in the Germany in 1991, and from there it spread throughout Europe and the world. After holding the European conference on mobility management in Amsterdam in 1997, it was decided to make the conference an annual event, so the second conference (1998) was held in Nottingham in UK. At that time, the need of having a platform to exchange experiences between different countries emerged, resulting in the creation of the European Platform on Mobility Management (EPOMM). The definition of mobility management provided by EPOMM is the following:

"Mobility Management (MM) is a concept to promote sustainable transport and manage the demand for car use by changing travelers' attitudes and behavior. At the core of Mobility Management are "soft" measures like information and communication, organizing services and coordinating activities of different partners. "Soft" measures most often enhance the effectiveness of "hard" measures within urban transport (e.g., new tram lines, new roads and new bike lanes). Mobility Management measures (in comparison to "hard" measures) do not necessarily require large financial investments and may have a high benefit-cost ratio."

To become a member in EPOMM, there are certain obligations to be met if a country wants to join, including the payment of an annual membership fee, having a representing ministry that participates in 2 to 3 conferences per year and that appoints a spokesperson or an organization to represent the

nation. In return, the members get access to the databases of EPOMM that contain information on mobility management, case studies and research projects results, help in the formation of a national network of experts in the field called the National Focal Point that receives tailor made support and exchanges information with EPOMM, participate in European projects, create a positive image and so on.

Italy happens to be an active member of EPOMM, it is represented by the Ministry of Environment, Land and Sea. The ministry aims to boost the sustainable use of natural resources, prevent and control pollution and protect and restore the environment, it has been assisting municipalities and institutions attain better mobility.

Euro mobility has been the NFP since the year 2000, with a mission of creating and spreading a culture on sustainable mobility throughout the country, by encouraging organizations and people to use eco-compatible transport modes and act more responsibly for realizing a better quality of life. Euro mobility plays a role in both the public and private sectors. On one hand its institutional activities cover training and updates, assembling events on the topic of sustainable mobility, promoting mobility management to all parties involved, and being in charge of public relations with the media and other organizations; on the other hand its technical activities consist of providing technical support to public administrations when it comes to campaigns and research, coordinating and communicating innovative services like carsharing and giving operational support when collecting or implementing plans.(EPOMM, n.d.)

2.2. Mobility Management Strategies

Identifying a city where mobility management practices are implemented is characterized by the presence of specific activities that help the user take better transport decisions. Those activities might be as simple as having campaigns that promote the usage of public transport, walking , and cycling, or offering travel assistance that motivates users to minimize car usage or as sophisticated as organizing school-home trips for students by having the school provide a mobility plan with safe walking routes for children from their houses to the school and back, having the employer pay for the public transport of employees trips to work, or connecting building permits to certain specifications that minimize the impact of mobility on development, such as limiting the number of parking spaces available. It is standard to have plenty of these bundles in cities where managing mobility is of importance, and not just one.

There are key roles that mobility management plays are essential when it comes to reaping real results. The first role is to understand and advocate, managing starts with knowing the customers and how to separate them into groups, understanding their needs, hence making it possible to effectively plan a sustainable transportation network.

Second, to convene and facilitate meaning to pursue partnerships and build collaborations that include transportation providers, planners and the community.

In the third place, to design and plan, coming up with innovative solutions on both the local and regional levels that are tailored to the needs of each community.

Number four is launch and sustain, after designing the new solutions, there are certain measures to ensure the success of the launch and its sustainability, testing assumptions, beginning with a limited launch, re-examining services and feasibility, taking the feedback and modifying accordingly, and planning for the long-term sustainability are examples of these measures.

And lastly, the fifth role is to inform and connect, having up-to-date information about the available means of transport, and sharing it with the customers through the proper means, consequently helping them to create their journey by using the travel options that are most suitable for their needs. (National Center for Mobility Management , n.d.)

As mentioned before, one of the main objectives of mobility management is improving the ways of travel, making cities more attractive, efficient and healthy for the citizens. To get closer to these objectives, there are various strategies that can be used.

One of those strategies is improving travel options. Traveling with one's own car or by taxi seems to be the most comfortable, convenient, fastest, and safest way of transport; however, automobile dependency imposes large economic, social and environmental costs, the likes of congestion, pollution, crash risk, parking congestion and so on. Therefore, it is important to support and improve the quality of other kinds of transport, to make travelers shift from driving to riding transit a smooth transition. A way of doing that is by directing people to use greener modes of transport instead of cars, by providing choices such as carpooling, car sharing, park and ride, and similar services, which in turn minimizes the emission of pollutants, reduces congestion, minimizes space consumption, and lowers the risk of accident. A different method is providing real time information concerning public transport vehicle's arrival, departure, delays, routes, fees, problems, and degree of occupancy; this strategy not only improves the travel options, but also makes the service more reliable, and leads to developing a sense of trust in the service and sparks loyalty in the users.

Another strategy is modifying user's behavior such as the mode, frequency, route, or time of trips. This happens to be one of the most fundamental strategies. Changing the way that users think is a difficult task, according to the Transtheoretical Model it's a 5-step-process that starts with precontemplation, the stage where the user is not ready or intending to take action in the next six month, followed by a contemplation phase, meaning that the consumer is getting ready or intending to take action probably in the next six months, the following stage is the preparation, in this phase the user intends to take action in the next six months, is considered ready, the fourth step is taking action by having made lifestyle changes in the last six months, and finally, maintaining the new behavior for more than six month is the last step in the process. For the behavioral change to take place the user should be aware and convinced of the negative effects of his current actions, and the positive consequences of going through the change.

In addition to that, reducing the need to travel is yet another strategy. Smart growth, urban intensifications, transit-oriented development, and compact city are different names that describe this strategy. It means decreasing the number and/or the length of journeys, but it has nothing to do with limiting the freedom to travel. The statement "reducing the need to travel" is often accompanied by the words "especially by car", decreasing journey length implies that the journey can be made by alternative modes such as walking or cycling, or by public transport. Introducing policies that encourage the shift from the car to other modes is an important tool that allows for the reduction in travel; policies such as locating employment close to residential areas and public transport hubs, locating day-to-day facilities in centers, making them accessible by walking and cycling, ensuring easy access to public transport that is well connected to job, leisure, and shopping locations, and encouraging the employment of local workforces. Smart working is very effective in this context; having the ability to work remotely reduces the need to travel to work on daily bases. (Campaign for Better Transport, 2011)

Encouraging non-motorized transportation, which happens to be undervalued strategy in convention planning. Many travel Surveys indicate that non-motorized transportation is unimportant since they only account for 2-5 % of travel. The fact is walking, and cycling have many benefits, they are inexpensive for the users, they decrease costs of congestion, energy consumption and pollution, and they are good for the user's health too. The benefits of these strategies will be discussed in depth later in this chapter, all things considered, when a community is designed to integrate walking and cycling, it becomes more compact, connected, attractive, and more designed at a human scale. Thus, improving accessibility, livability and affordability. Table 1 includes Non-motorized transport strategies. (Litman, 2010)

Improves Transport Options	Price Incentives	Land Use Management	Implementation Programs
Transit improvements	Congestion pricing	Smart growth	Commute trip reduction
Walking improvements	Distance-based fees	location -efficient development	School and campus transport management
Cycling improvements	Parking cash out	Parking management	Tourist transport management
Bicycle parking facilities	Parking pricing	Transit oriented development	Transit marketing
Bike/transit Integration	Pay-as-you-drive	Car-free planning	Non-motorized encouragement
Guaranteed ride home	Vehicle insurance	Traffic calming	
	Fuel tax increases		

Table 1 - Management Strategies that Encourage Non-Motorized Transportation

(Litman, 2010)

And finally correcting distortions in the planning practices, to better identify such distortions, audits and surveys can conducted to find shortfalls at the current situation, only then it is possible to come up with suitable correcting measures. This strategy is crucial when it comes to preparing a local plan, the process includes gathering evidence to identify the troubling issues, developing preferred (more sustainable) options, and then making sure that the new implementations are generating the desired results. An example of this strategy is Re-locating or providing easy access to major trip-generators such as offices, schools, cultural centers, leisure facilities, retail shops and health services.

Table 2 mentions different mobility management strategies that can be implemented:

Improves Transport Options	Incentives to Reduce Driving	Parking and Land Use Management	Programs and Policy Reforms
Alternative work schedules	Walking and cycling encouragement	Bicycle parking	Access management
Bicycle improvements	Commuter financial incentives	Car-free districts and pedestrianized streets	Car-free planning
Bike/transit integration	Congestion pricing	Clustered land use	Commute trip reduction programs
Car sharing	Distance-based pricing	Location efficient development	Market reforms
Flextime	Fuel taxes	New urbanism	Context sensitive design
Guaranteed ride home	HOV (high occupancy	Parking management	Freight transport management

Individual actions for efficient transport	vehicle) priority	Parking solutions	Institutional reforms
Park and Ride	Parking pricing	Parking evaluation	Least cost planning
Shuttle services	Pay-as-you-drive vehicle insurance	Shared parking	Regulatory reforms
Small wheeled transport	Road pricing	Smart growth	School transport management
Taxi service improvements	Speed Reductions	Smart growth planning and policy reforms	Special event management
Telework	Street calming	Transit oriented development (TOD)	TDM marketing
Traffic calming	Vehicle use restriction		Tourist transport management
Transit improvements			Transport management associations
Universal design			

Table 2 - Examples of mobility management strategies

(Litman T. , 2003)

Choosing the set of mobility management strategies to be implemented varies depending on the demographic, geographical and political conditions of a community. Furthermore, the most effective programs are those consisting of a combination of strategies, since the implementation of a single strategy has a low impact, however, multiple strategies can have a cumulative and synergistic impact, which means that the total impact produced is greater than the sum of all individual impacts.

Indeed, applying parking management or building a metro system can decrease automobile travel by 5 %, but when these two strategies are coupled the impact increases to produce a 15 % reduction in urban-peak automobile travel, through the creation of combination of incentives (positive and negative).

To provide an example of coupling strategies, Singapore implemented a variety of mobility management measures in Chinatown area, that range from a smart bike program that provides free bicycle use, closing roads in the evening, planting trees for shade, widening sidewalks, and introducing parking restrictions. (Litman T. , 2003)

2.3. Actors and Interactions

The whole process of mobility management can be divided into three levels: policy level, management level, and user level. As seen in figure 5, each level contains certain aspects, actors or instruments that are involved in this process of sustainability which will be defined separately.

Figure 5 - The Different Levels of Mobility Management
(EPOMM, n.d.)

The mobility manager coordinates mobility management on the governing level, several people can share this role, with the duty of developing and introducing schemes, promoting them, and collecting the support needed. This character embodies the link between the policy and the managerial levels, plays a role in coordinating functions, should have good relations with all present parties when it comes to politics, and should always be informed with the latest experiences, ideas and mistakes related to mobility management.

A mobility center is the operating unit at the urban/regional level, it is the place that initiates, organizes and provides mobility services. This center serves as a platform by concentrating all services, it serves better if it's centrally located, and it can be a permanent, temporary or mobile center depending on demand and events.

The mobility consultant plays the role of a negotiator at the management level, organizes awareness and education campaigns, advises the implementation of a mobility plan, approaches target groups and clients actively and shares information about the positive expectations of the mobility plan.

The mobility office is active on the site level where mobility services are only offered to site users, it is the operating unit, usually connected to a mobility center, and it can be a small helpdesk that can be reached by phone an advice center with offices. The main role of this office is to provide customized solutions for traffic problems and individuals.

Mobility coordinator puts mobility management into practice at the site, with activities starting from investigations with surveys and interviews to coordination of tasks within the site, also among local authorities, transport suppliers, supporting parties and so on.

Mobility Plan is a directive document that indicates how to implement the mobility management scheme that interconnects existing services and integrates innovative concepts. Preparing a mobility plan starts with an investigation or a survey that gives an overview of the travel patterns and the transport conditions in a certain area, the plan will include measures and will also mention how, who and when the implementation process must occur.

Coming down to the user level, the mobility management services are offered to the users on site, those services are the following:

Information and advice, obviously if the users don't know about the service, they won't use it, therefore information is a prerequisite for the customers to use modes of transport other than the car. Advice consists of interacting with the customers to help them choose the best alternatives possible for their needs. These two aspects must be offered in a user friendly, easy to comprehend manner, otherwise it doesn't serve any cause.

Consultation also includes customized advice for individuals and groups but on a broader aspect, they are usually aimed at large traffic generators such as schools, theme parks, and hospitals. Consultation covers assessing the actual situation, coming up with solutions, considering all the different alternatives available, and then making recommendations.

Awareness and education are essential. Mobility management aims to raise more awareness so that the people will realize the effect of their travel behavior and trigger them to change into more sustainable modes of transport. There are various ways of education that differ according to the groups targeted, some examples are mobility education in schools, educating games, and organizing car free days.

Organization and coordination of existing modes and other transport services with the new ones, so that the integration of the new and the old modes is possible and the passenger comfort increases.

Sales and reservations are offered to guarantee easy access to the services, thus limiting potential barriers. Tickets, memberships, and reservations provide insurance.

Products and services push people to change their behavior, they are incentives that simulate the use of sustainable modes such as collecting travel miles and contests. Still, those need to be developed according to a targeted group, and they lead to acquiring loyal customers and attract potential ones. All in one ticket is a great example of this aspect. (EPOMM, n.d.)

2.4. Importance of Implementing SMART Mobility

"Urban mobility becomes smart when smart actors take advantage of smart technology in the context of smart regulations, policies and plans and interactions". Mobility systems become smart when real time data is collected, shared and used by controllers, travelers, infrastructure and vehicles, then this data is integrated and analyzed by decision makers, in order to make short and long term predictions, and then take actions that improve the operating system and the travel experience, while taking into consideration the externalities and reducing them (environmental impacts and consumption of resources). Unfortunately, the technological development in the field of transporting goods and people tends to eliminate the consideration negative consequences, it only focuses on making trips faster and smoother. Considering "Smart" as digital or technologically advanced reduces the meaning of the word and takes away many of its attributes. Smart mobility is affordable, attractive, effective, sustainable, and technologically advanced. Undoubtedly, smart mobility can be attained through the implementation of adequate mobility management strategies. (Fonzone, Saleh, & Rye, 2018)

The importance of mobility management lies in its ability to produce long term benefits, while maintaining a low cost. The adoption of a "Fix it first" mode of action gives priority and funding to maintenance, operations and progressive improvements in the existing transportation facilities, whereas the implementation of major capital projects is only considered if adequate additional funds are available. This condition makes its application favorable, especially in developing countries where funds are scarce, rearranging or fixing the services that are already in place is an effective strategy, and it requires less funds than the installation of new ones.

When it comes to prioritizing travel, the secret lies in basing the evaluation on the value and cost of each trip; the aim is to give higher value trips and lower cost modes priority over lower value and higher cost modes. To clarify, non-motorized means of transport cost the society less in terms of pollution emissions, crash risks, road space, and parking costs, than single occupancy automobile travel; same goes with transit and freight vehicles, they are prioritized over private vehicle transport due to their relatively higher value (vehicle-kilometer).

Having an automobile-dependent transportation system requires every user to have a vehicle which they can operate, roads that are regularly maintained, parking spaces in every destination… Conventional plans allow automobile traffic to dominate the road space, by considering that their velocity, size and the danger that comes along (mainly affecting pedestrians and cyclists), they squeeze out other users, denying them their right to use the public road space. Only by giving priority to high value trips and modes that require less space per passenger-kilometer can efficient management be achieved. Prioritizing is a two-step process, first the base of prioritization is determined by ranking users, trips and modes under various circumstances, then the prioritizing methods are developed in which the higher-ranking user, modes and trips are favored through traffic management, and the allocation of resources.

The following is a list reflecting one way of assigning priority, organized from the highest to the lowest priority: Emergency vehicles/trips → Walking → Cycling → Public transit → Service/ freight vehicles → Taxi → Single occupant cars.

Motor vehicle transportation includes a set of direct and indirect (external) costs, the set consists of : vehicle ownership such as the purchase, registration, and insurance, operation costs like fuel, repair, and maintenance, parking, traffic congestion, services and crashes, negative land use and social impacts (damage to cultural and environmental resources, reduced opportunity for non-drivers…), air, noise, and water pollution, barrier effect that reduces the mobility of pedestrians and cyclists, and finally waste disposal issues when it comes to tires, junk vehicles, batteries…

Fortunately, those costs can be reduced or even eliminated by the implementation of suitable mobility management strategies that encourage the use of non-motorized vehicles and public transport services. The benefits of implementing strategies that encourage non-motorized travel options can be found in table 3.

Improved NMT Conditions	Increased NMT	Shift from Automobile to NMT
Improved User convenience and comfort	Increased public health and fitness	Reduced traffic congestion
Increased travel options	User enjoyment	Road and parking cost savings
Improved basic mobility for non-drivers	Increased community cohesion (positive interaction among neighbors)	Consumer cost savings
		Reduced crash risk to others

		Air and noise pollution reductions
More attractive and livable communities		Energy conservation
		Economic development benefits
Improved local property values		Supports strategic land use objectives

Table 3 - The Benefits of Non-Motorized Transportation (NMT)

(Litman T. , 2010)

However, choosing the policies or the strategies to be adopted depends on the ways in which transportation is defined and measured. A certain project may appear appealing when transportation is measured in a certain way, where as it might seem undesirable if measured in another.

To clarify, one the approaches used is motor vehicle traffic, it is measured in terms of vehicle-kilometer, vehicle ownership per capita, roadway level of service, average traffic speed, etc... From this point of view, anything that reduces vehicle traffic speed is unwanted, whereas increasing the speed is desirable.

Another approach is by assuming that transportation means personal mobility, this is a more comprehensive way of looking at the matter, where measuring is in terms of person-kilometers and person-trips. This approach assumes that movement is the end in itself instead of a mean to reach the end, nonetheless, improving transportation is possible without causing an increase in the total vehicle-kilometer, by the usage of strategies such as rideshare programs and finer transit services. The third and most comprehensive perspective is measuring transportation in terms of accessibility, as in the ability to reach desired destinations, services and goods. By far this is the best way of evaluating transportation for planning purposes, the value of mobility substitutes and more accessible land use patterns are recognized as means to enhance transportation, while simultaneously decreasing total physical travel. Most of the transport policies that use other ways of measuring improve accessibility for some modes yet reduce it for others. For instance, increasing traffic speed or roadway capacity improves automobile access, but also degrades access by other kinds of transport such as walking and cycling. There trade-offs can be diminished by defining transportation in the form of accessibility.

The differences between conventional planning and comprehensive planning (accessibility) are discussed in more depth in table 4 below. It is obvious that comprehensive planning has a wider point of view on every aspect, whereas conventional methods ignore many important variables.

	Description	Conventional	Comprehensive
Selection of options	Range of solutions is considered	Often ignores TDM	Includes TDM options
Investment practices	How funding is allocated, and the flexibility with which it can be used for the best overall option	Favors large investments	Applies least-cost planning

Underpricing	Degree to which vehicle use is underpriced resulting in excessive travel demand	Ignored	Considered
Modeling practices	Whether transport modeling uses current best practices to predict travel and economic impacts	Limited analysis capability	More comprehensive
Measuring transportation	Methods and perspectives used to measure travel (vehicle traffic, mobility or accessibility)	Measures vehicle Traffic	Measures accessibility
Uncoordinated decisions	Whether transport and land use decisions are coordinated to support strategic regional objectives	Not considered a problem	Considered a problem
Generated traffic	Whether planning considers the full impacts of generated and induced travel	Ignores many components	Includes all components
Downstream congestion	Additional congestion on the surface streets that results from increased highway capacity	Ignores for individual projects	Includes
Consumer impacts	Techniques used to evaluate the consumer impacts of changes in the transport system	Travel time changes	Consumer surplus analysis
Vehicle costs	Whether all vehicle costs and savings are considered including long-term costs	Only short-term operating costs	All affected vehicle costs
Parking costs	Parking costs, including costs borne by motorists, businesses and governments	Only if paid by motorist	Includes
Construction impacts	Whether increased congestion delays during construction periods are considered in evaluation	Ignores	Includes
Non-motorized travel impacts	Accessibility, convenience, safety, comfort and cost of walking and cycling	Ignores	Includes
Transportation diversity	Quantity and quality of travel options (particularly those used by non-drivers) are considered	Limited analysis	Comprehensive analysis
Environmental impacts	Impacts on air, noise and water pollution; greenspace preservation and community livability	Limited analysis	Comprehensive analysis
Impacts on land use	The degree to which each option supports or contradicts strategic land use objectives	Ignores	Includes
Equity impacts	The degree to which each option supports or contradicts community equity objectives	Limited analysis	Comprehensive analysis
Safety and health impacts	How safe and health risks are measured	Per veh-mile crash risks	Per-capita health risks

Table 4 - Comparing Conventional and Comprehensive Planning

(Sustainable transport: A sourcebook for policy-makers in Developing cities) (Litman T. , 2003)

Implementing the right strategies that match the needs of the location in question can produce a wide range of benefits, including congestion reduction, environmental protection, increasing road safety, road and parking savings, efficient land use, and the list goes on… Table 5 shows the benefits of different travel impacts; the presence of a sign indicates a positive impact, whereas the absence of one means one of two things, the lack of an impact or the mixture of positive and negative impacts. (Litman T. , 2003)

Objectives	Reduced Traffic Speeds	Shift Trip Time	Shorter Trips	Shift Mode	Reduced Veh. Trips	Reduced Veh. Ownership
Congestion Reduction		√	√	√	√	√
Road Savings			√	√	√	√
Parking Savings				√	√	√
Consumer Savings				√	√	√
Transport Choice				√	√	√
Road Safety	√		√	√	√	√
Environment Protection				√	√	√
Efficient Land Use			√		√	√
Livability	√				√	√

Table 5 - Benefits of Different Travel Impacts

(Litman T. , 2003)

2.5. Employee Trip Reduction Programs

Employee reduction programs (also called commute trip reduction CTR) are programs designed to give commuters the incentives and resources to reduce their need to travel. These programs consider the needs of the employees and the fact that these needs are diverse and always changing. When provided with suitable incentives, many employees are willing to undergo a part-time switch from private automobile transportation into other alternatives, such as carpooling, commuting by bike in certain seasons, and telecommuting a couple of days per week or month.
The fact that most peak period congestion is caused by commuters, turns these programs into a priority. When implemented, they can reduce congestion and pollution problems.
Typically, Commute trip reduction programs include the following strategies:

- Smart working, teleworking and alternative scheduling to reduce the need to physically travel and increase the flexibility of working times
- Walking and cycling encouragement and improvement, providing bicycle parking
- Commuter financial incentives such as transit allowances and parking cash
- Ride sharing and guaranteed ride home
- Reducing the need to drive for errands by providing worksite amenities
- Managing parking and their pricing
- Providing company policies for travel reimbursement that not only covers automobile mileage but also other forms of transport (bicycle and transit mileage)
- Eliminating the need to drive to work by the use of company vehicles

The impacts resulting from those strategies can be measured through the modal split in which the dispersion of passengers between different modes of transport is measured, such as, the portion of trips done by single occupancy vehicles, the number of people using ridesharing, walking or cycling.

 A second way of measuring the impacts is the average vehicle occupancy, measured in terms of the total number of users travelling in private vehicles divided by the number of private vehicles trips. Average vehicle ridership is yet a different way. It includes all trips done by the users including walking and transit, divided by the number of private vehicles.

Finally, the last way to be introduces is vehicle trips or peak period vehicle trips, that is the total number of private vehicles arriving at a work site.

To insure the effectiveness of commute trip reduction it is best to make these programs diverse and flexible, include both travel choice improvements and incentives to reduce driving, ensure the engagement of executives and employees in planning process, and encourage the concentration of employment into large commercial centers making it easier to provide good transit services. (Litman T., 2003)

Smart working is a commute trip reduction program that affects mobility directly. By having the ability to work from home 4 to 5 days per month, the number of trips to the office and parking space requirements are reduced. The introduction of flexible work time also reduces the peak hour congestion and the pollution resulting from that. In addition, the different organization of the office space, such as having shared desks, is known to bring the employees closer to one another, which might encourage them to share rides to the office.

Chapter 3: Cost Model

3.1. The Function of the Cost Model

In this chapter the consequences of applying smart working in terms of costs will be quantified, the question posed is: how can the implementation of 1 day of smart working per week, i.e. four smart working days per month affect the company?

The Cost Model is part of the Smart Working Package. It was created to help a company estimate the costs and benefits of applying this method of working. It is a tool that will aid the company, by determining the cost related to the implementation and application of smart working, also the savings that can be achieved from it. Keeping in mind that every company is different from the other, and may implement smart working to a certain extent, thus it will be affected differently. For this reason, the numbers associated to each element are considered as the average change in cost.

The main actors to be considered in the calculations are three: the company, the employee, and the environment. Each actor includes a set of variables, for simplicity, the most relevant variables are taken into consideration. The changes in these variables are determined according to studies on smart working, previous experiments on the topic, and real-life examples from companies that have already applied this technique.

According to the smart working observatory of Politecnico di Milano if 70% of those who are eligible choose to use smart working in Italy (70% out of 22% of the total working force), the average productivity increase would be around 13.7 billion Euros.

And for every day working remotely a smart worker saves around 60 minutes of traveling time, assuming this happens only once per week, 40 hours can be saved annually. And assuming they travel 40 km to get to work, the carbon dioxide emissions can be reduced up to 135 kg per person.

The benefits are too significant to be ignored. (Corso, Crespi, & Gangai, Smart Working: Below the Tip of the Iceberg, 2017)

Therefore, the importance of this cost model lies in determining not only the benefits, but also the costs associated to smart working. It is customized in a way that considers the characteristics of each company, the office, the number of employees that can switch to smart working, the average distance traveled by the employee to reach work, and other data; making the results specific for each company.

3.2. Variables to be Considered

For precise calculations, there is a set of variables that need to be filled out by the company as input. Precise information is required, that'll allow the cost model to be molded according to the

company's characteristics. The variables are: the number of employees that will become smart workers, the office area, and the office rent.

Other than that, the variables to be considered in our Cost model are divided into two major groups: the benefits and the costs; each of which is divided into 3 sections: company, employee and environment.

When it comes to the environment and the employee there are no additional costs, only benefits exist. Therefore, the additional costs are not ignored, but instead they are equal to zero.

Here is a list of all the variables to be considered:

A. Benefits:
    a. Company
        i. Increase in productivity / amount of work
        ii. Increase in efficiency / quality of work
        iii. Space saving
        iv. Decrease in property cost
        v. Decrease in fuel cost
        vi. Reduction in parking space
        vii. Reduction in parking cost
        viii. Extension in business hours
        ix. Increased motivation/ innovation / engagement
        x. Decrease in absenteeism
        xi. Reduction in travel problems
        xii. Attraction of high-quality talent
        xiii. Ability to match fluctuating demand / meet customer's expectation
        xiv. Drop in attrition
        xv. Decrease in hiring cost
    b. Employee
        i. Reduction in travel time
        ii. Declined stress and frustration
        iii. Drop in distraction level
        iv. Autonomy and satisfaction (work-life balance, increase in trust, wellbeing, health, and happiness)
        v. Enhanced digital skills / ability to solve complex problems
    c. Environment
        i. Decrease in carbon monoxide emissions
        ii. Decrease in carbon dioxide emissions
        iii. Decrease in nitrogen oxides emissions
        iv. Decrease in volatile organic compounds
        v. Decrease in methane emissions
        vi. Decrease in particulate matter
        vii. Reduction in carbon footprint
B. Costs:
    a. Company
        i. Contribution to buy an electric car
        ii. Contribution to purchase an electric bike
        iii. Contribution to buy a traditional bike
        iv. Company shuttle services
        v. Organizing a carpooling service
        vi. Contribution to use public transport

<ol type="i" start="7">
<li value="7">Contribution to pay for parking
Fuel coupons
Providing an internet connection at home
Providing stationary
Measures to ensure confidentiality and security of company files
Workshops / courses to improve communication skills
Workshops / courses to communicate and monitor work
Changes in the office space (hot desks, stations, meeting rooms)
Providing appropriate tools / appliances to work from home.

3.3. The Company

When it comes to measuring productivity of an employee, a new research by Voucher cloud (UK's largest money saving brand) suggests that an office worker is only productive for two hours and fifty-three minutes out of an eight-hour working day. In this research respondents admitted that they get distracted often in the office, on average the office worker spends 1 hour and 5 minutes reading news websites, 44 minutes checking social media, 40 minutes discussing out of work activities with colleagues, 26 minutes searching for new jobs, 23 minutes on smoking breaks and the list goes on. The research suggests that it is easy for the employee to feel like he/she is not doing enough work from home, when only three hours of work is the equivalent of working from the office. (Vouchercloud, n.d.)

Therefore, the cost model considers the productivity of an employee to be three hours per day instead of eight.

According to a research done by Movesion, the profit or the productivity of a regular employee per day is on average equal to 30.45 Euros per day, whereas the productivity of a manager per day is approximately equal to 75.78 Euros per day. Since only three hours of productive work are accomplished per day, the productivity of an employee will be considered as 10.15 Euros per hour and 25.26 Euros for a manager.

In addition, in a year the amount of 200 working days is considered, and 48 working weeks; so, considering that every employee does 1 day of work out of the office per week, that amounts to 48 smart working days per year, whereas if the employee does 1 day per month, the total would be 14 days in a year. The amount of smart working days allowed can vary according to the company's demand.

Changes in the office space are taken into consideration as well, with smart working comes a new way of arranging the working space. Smart work advices the usage of high-density seated areas, with fewer private offices. Usually teams can be placed within the same space, seats and desks are not assigned, and working spaces are more open and interactive. The density is reduced from 14 meters squared per employee to 5.6-7.4. A reduction in office space means a reduction in rent and costs which will be part of the benefits in the cost model. (Simmons, n.d.)

The calculations of the benefits for the company will include all the variables below. Their estimation was based on various studies on the topic of smart working, and many real-life examples

of its application. Please note that these are averages and approximations, the real values may vary from one company to the other. The values for the considered benefits are the following:

- 6% increase in the amount of work done (productivity)
- 8% increase in efficiency or the quality of work
- 7.6 m² space reduction per employee in the office
- 20% reduction in property cost
- Decrease in fuel consumption depending on the average distance traveled by employees
- 11.52 m² pace reduction for every car space eliminated
- 5% reduction in the cost of parking space
- Extension in business hours estimated as 2 hours per smart working day per employee
- 30% increase in motivation, innovation and engagement
- 60% decrease in absenteeism
- 0.5 hours of reduction in travel problems per smart working day for each employee
- Attraction of high-quality talent estimated as 2 hours per smart working day
- 30% increase in the ability to match fluctuating demand and meet customer's expectations
- 26% decrease in attrition
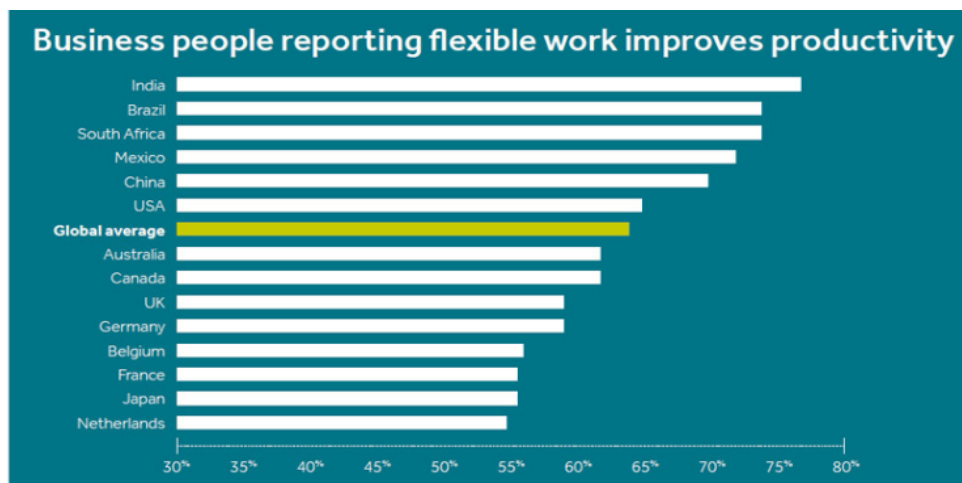- Decrease in hiring related costs approximated as 3500 Euros per employee

Figure 6 - Respondents across key geographies that think flexible working improves productivity

(Regus, 2017)

On the other hand, the cost of applying smart working paid by the company is an important on the other hand, the cost of applying smart working paid by the company is an important factor in determining whether this change will bring profit to the company, or the contrary. Shifting to smart working would only be a smart move if the benefits are higher than the costs. It is important to notice that there are costs that will apply only once in the beginning of the process such as the changes in the office space. Converting the office from a regular working space into a smart working space includes creating meeting rooms, stations, hot desks and so on. The related cost is paid once, but it helps in decreasing the office space, and therefore the rent. In our calculations this cost will be considered once in the first year only and will be eliminated afterwards. The values related to the costs are the following: (note that the unit is Euros per employee per year unless a unit other than Euros is mentioned)

- 200 Euros for providing an internet connection at home
- 170 Euros for providing stationary

- 100 Euros for software and measures to ensure confidentiality and security of company files
- 50 Euros for workshops or courses to improve digital skills
- 50 Euros for workshops or courses to improve communication skills
- 100 Euros for the installation of a platform to communicate and monitor work
- 25 Euros/m² for changes in the office space
- 10 Euros for increased cost of amenities at home for each smart working day
- 300 Euros for providing tools/appliances to work from home

3.4. The Employee

When it comes to the employee, only benefits are considered in the cost model. The costs related to the employee are very few and hard to quantify; an example of a cost would be the invasion of personal life by work, but that is only possible when the employee doesn't manage time the right way and cannot be generalized. Therefore, all similar costs are conditional and dependent on the behavior of the employee, thus they cannot be considered. In addition to that, the increase cost of amenities, stationary, devices, providing a stable internet connection, and courses for improving are covered by the company and added to the company cost.
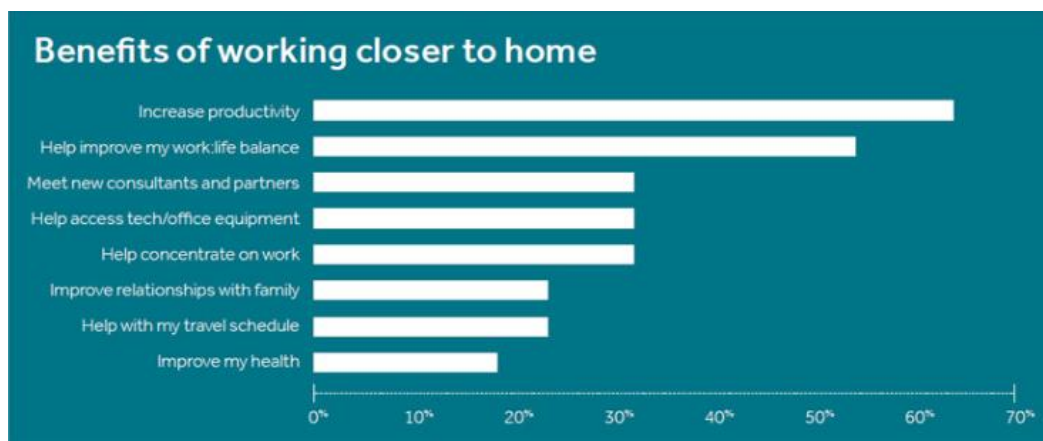

Figure 7 - Key benefits of working from locations closer to home
(Regus, 2017)

The values related to the benefits of an employee are the following:
- 1.5 hours reduction in travel time (can vary according to the average driving time to work)
- 1.5 hours declination in stress, frustration and distraction level
- 150 Euros per employee per year from enhanced digital skills, communication skills, and problem-solving abilities
- 55 % increase in autonomy and satisfaction including work-life balance, increased wellbeing, trust, health, and happiness
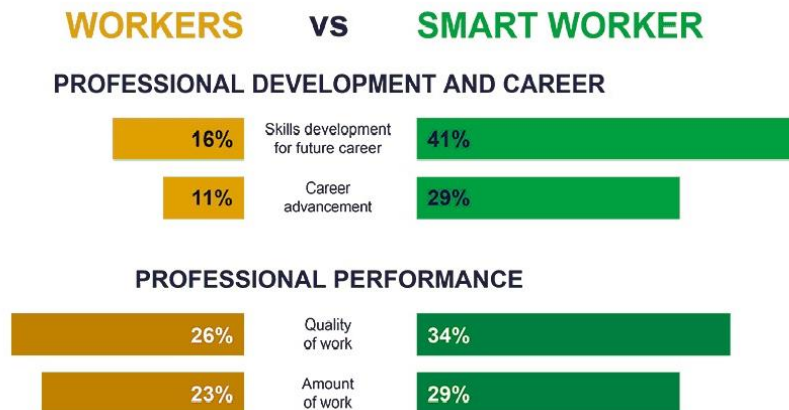
Figure 8 - Smart worker vs. regular worker in Italy

Digital innovation observatory-Politecnico Di Milano

3.5. The Environment

The major source of air pollution in megacities is that produced by the vehicle traffic. Combustion gas consists of nitrogen (N_2), water vapor (H_2O) except for pure carbon fuels, and carbon dioxide (CO_2). These are not toxic or noxious, even though carbon dioxide is a greenhouse gas that affects global warming. On the other hand, a small part of the combustion gas consists of undesirable, toxic or noxious substances, the such of carbon monoxide (CO) that results from incomplete combustion, Hydrocarbons (C_xH_y) from fuel unburnt, particulate matter, and nitrogen oxides (NO_x) from excessive combustion temperatures.

The greenhouse gas carbon dioxide CO_2 emissions are known to be causing the climate change on our planet. And according to the European Union, 20 percent of carbon dioxide emissions are caused by motor vehicles. Therefore, carbon dioxide emissions of cars are limited and regulated according to European emission standards.

Mono-nitrogen oxides NOx (such as NO and NO_2) form nitric acid vapor by reacting with moisture, ammonia and other compounds. The inhalation of nitrogen oxides increases the risk colorectal and lung cancer, these particles can penetrate deeply into sensitive lung tissue and damage it, in extreme cases they can cause premature death. The largest NOx emissions come from road motor vehicles. Road vehicles are also the second primary source of volatile organic compounds (VOCs) after solvent use, these compounds react with nitrogen oxides in the presence of sunlight to form ozone at ground level. Ozone is only beneficial in the upper atmosphere, but when it is produced at ground level it causes the formation of smog, negative effects on the ecosystem and health problems such as the irritation of the respiratory system.

In addition, mobile vehicles are also responsible for 52 percent of carbon monoxide (CO) emissions, which is known as the silent killer because it is colorless, tasteless and odorless yet extremely toxic. The most fatal type of fatal air poisoning is that caused by CO. carbon monoxide can bind with hemoglobin in the blood reducing its ability to deliver oxygen to the body. Furthermore, damages to the bone marrow, depression of the immune system and blood cancers can be the result of long term exposure to benzene(C_6H_6). Besides, health conditions such as asthma, cardiovascular problems, lung cancer and premature death can be caused by particulate matter (PM_{10} and $PM_{2.5}$) which can penetrate to the deepest parts of the lungs due to the size of their particles.

The benefits related to the environment are calculated in terms of the decrease in the amount of emissions. For every kilometer saved by smart working, the decrease in the emissions is calculated with the help of the production rate, and afterwards the social cost is considered and included in the process. For the production rate, the values are extracted from a medium petrol car with Euro 4 classification to simplify the calculations.

Air Pollutant	Production Rate (Gram/Km)	Social Cost (Euro/Ton)
Carbon Monoxide (CO)	0.9185	143
Carbon Dioxide (CO$_2$)	220.46	41
Nitrogen Oxides (NOx)	0.0588	9500
Volatile Organic Compounds (VOCs)	0.07337	698
Methane (CH$_4$)	0.0179	3000
Particulate Matter (PM)	0.022811	159000

Table 6 - Production Rate and Social cost of Air Pollutants

In addition to air pollutants, the carbon footprint of the company is considered as well. A carbon footprint is a social cost related to the amount of carbon dioxide produced by a certain human activity. Measuring the carbon footprint can be applied to an individual, a family, an organization, or the entire nation, and its unit is tons of CO_2 per year. When calculating the carbon footprint of a company there are various factors to be taken into consideration such as the number of employees, heated office area, heating type (natural gas, heating oil, wood), cooling system, power consumption, type of power (green power), number flights, number of hotels, food consumed (vegetarian and non-vegetarian meals, snacks, coffee, tea...), material and waste (paper, newly purchased computers, electronic waste, recycling).

There are many ways to reduce the carbon footprint the likes of reducing energy use, flying less frequently, reducing fuel use, recycling and producing less waste.

Calculating the carbon footprint of our hypothetical company was accomplished using the carbon footprint calculator provided by www.myclimate.org.

The environmental benefits are listed in table below:
- Decrease in carbon monoxide emissions
- Decrease in carbon dioxide emissions
- Decrease in nitrogen oxides emissions
- Decrease in volatile organic compounds emissions
- Decrease in methane emissions
- Decrease in particulate matter emissions
- 25 % decrease in carbon footprint

3.6. Full View of the Cost Model

For a better understanding of the cost model a full preview will be provided in two cases. The first case will consider the possibility of only one smart working day per month (thus a total of 14 smart

working days per year), whereas the second case will consider the possibility of having one smart working day per week (48 days per year). Afterwards the difference in productivity, benefits and costs will be compared.

To perform the calculations, first some input values are required. The following values were used:
- Number of smart workers: 25
- Number of Smart Working days: 14 and 48

Other Parameters to be checked:
- Total number of employees: 100
- Office area: 1000 m²
- Office rent: 120 euro/m²
- Parking rent: 6000 Euros
- Average distance traveled by an employee per day: 80Km

First Case: One Smart Working Day Per Month

	List of Benefits	Value	Unit	Unified Unit (Euro/year)
Company	Productivity /Amount of Work (6% Increase)	36	hr/employee/year	9135
	Increased Efficiency /Quality Of Work (8% Increase)	48	hr/employee/year	12180
	Space Saving	7.6	m2/employee	133 m²
	Decrease in Property Cost	20	%	24000
	Decrease in Fuel Cost	1.465	euro/L	3169.52
	Reduction in Parking Space	11.52	m2/car	48m²
	Reduction in Parking Cost	5	%	300
	Extension in Business Hours	2	hr/SWday/employee	7105
	Increased Motivation/Innovation/Engagement (30 %)	1	hr/SWday/employee	3552.5
	Decrease in Absenteeism (60 %)	18	hr/employee/year	4567.5
	Reduction in Travel Problems	0.5	hr/SWday/employee	355.25
	Attraction of High-Quality Talent	2	hr/SWday/employee	7105
	Ability to Match Fluctuating Demand/Meet Customer's Expectation (30% Increase)	105	hr/year	1065.75
	Decrease in Attrition	26	%	
	Decrease Hiring Related Cost	3500	euro/employee/year	22750
Employee	Reduction in Travel Time	1.5	hr/SWday/employee	213.15
	Declined Stress, Frustration and Distraction Level	1.5	hr/SWday/employee	213.15
	Enhanced Digital Skills /Ability to Solve Complex Problems/Communication Skills (25% Increase)	150	Euro/employee/Year	21315
	Autonomy and Satisfaction 55% (Work-life Balance; Increase in Trust, Well Being, Health, Happiness)	7.7	hr/employee/year	1953.875
Environment	Decrease in Carbon Monoxide (CO)	0.0257	ton/year	3.677674

List of Benefits	Value	Unit	Unified Unit
Decrease in Carbon Dioxide (CO2)	6.1728	ton/year	253.088
Decrease in Nitrogen Oxides (NOx)	0.0016	ton/year	15.6408
Decrease in Volatile Organic Compounds (VOC)	0.0020	ton/year	1.434
Decrease in Methane (CH4)	0.0005	ton/year	1.504
Decrease in Particulate Matter (PM)	0.0006	ton/year	101.554
Reduction in Carbon Footprint (25% Decrease)	22.075	ton/year	526

Table 7 - List of Benefits - One Smart Working Day Per Month

	List of Costs	Value	Unit	Unified Unit (Euro/year)
Company	Providing an internet connection at home	200	euro/employee/year	5000
	Providing stationary	170	euro/employee/year	4250
	software and Measures to ensure confidentiality and security of company files	100	euro/employee/year	2500
	Workshops/courses to improve digital skills	50	euro/employee/year	1250
	Workshops/courses to improve communication skills	50	euro/employee/year	1250
	Installing a platform to communicate and monitor work	100	euro/employee/year	2500
	Changes in the office space (hot desks, stations, meeting rooms)	25	Euros/m2	25000 Euros
	Increased cost of amenities (electricity/heating/air conditioning) 10 Euros/day	140	euro/employee/year	3500
	Providing appropriate tools/appliances to work from home	300	euro/employee/year	7500

Table 8 - List of Costs - One Smart Working Day Per Month

Second Case: One Smart Working Day Per Week

List of Benefits		Value	Unit	Unified Unit (Euro/year)
Company	Productivity /Amount of Work (6% Increase)	36	hr/employee/year	9135
	Increased Efficiency /Quality of Work (8% Increase)	48	hr/employee/year	12180
	Space Saving	7.6	m2/employee	133m²
	Decrease in Property Cost	20	%	24000
	Decrease in Fuel Cost	1.465	euro/L	10866.945
	Reduction in Parking Space	11.52	m2/car	48m²
	Reduction in Parking Cost	5	%	300
	Extension in Business Hours	2	hr/SWday/employee	24360
	Increased Motivation/Innovation/Engagement (30 %)	1	hr/SWday/employee	12180
	Decrease in Absenteeism (60 %)	18	hr/employee/year	4567.5
	Reduction in Travel Problems	0.5	hr/SWday/employee	1218
	Attraction of High-Quality Talent	2	hr/SWday/employee	24360
	Ability to Match Fluctuating Demand/Meet Customer's Expectation (30% Increase)	360	hr/year	3654
	Decrease in Attrition	26	%	
	Decrease Hiring Related Cost	3500	euro/employee/year	22750
Employee	Reduction in Travel Time	1.5	hr/SWday/employee	730.8
	Declined Stress, Frustration and Distraction Level	1.5	hr/SWday/employee	730.8
	Enhanced Digital Skills /Ability to Solve Complex Problems/Communication Skills (25% Increase)	150	Euro/employee/Year	73080
	Autonomy and Satisfaction 55% (Work-life Balance; Increase in Trust, Well Being, Health, Happiness)	26.4	hr/employee/year	6699
Environment	Decrease in Carbon Monoxide (Co)	0.0882	ton/year	12.61
	Decrease in Carbon Dioxide (Co2)	21.164	ton/year	867.73
	Decrease in Nitrogen Oxides (NOx)	0.0056	ton/year	53.63
	Decrease in Volatile Organic Compounds (VOC)	0.00704	ton/year	4.92
	Decrease in Methane (Ch4)	0.0017	ton/year	5.155
	Decrease in Particulate Matter (Pm)	0.0022	ton/year	348.19
	Reduction in Carbon Footprint (25% Decrease)	22.075	ton/year	526

Table 9 - List of Benefits - One Smart Working Day Per Week

List of Costs		Value	Unit	Unified Unit (Euro/year)
Company	Providing an internet connection at home	200	euro/employee/year	5000
	Providing stationary	170	euro/employee/year	4250
	software and Measures to ensure confidentiality and security of company files	100	euro/employee/year	2500
	Workshops/courses to improve digital skills	50	euro/employee/year	1250
	Workshops/courses to improve communication skills	50	euro/employee/year	1250
	Installing a platform to communicate and monitor work	100	euro/employee/year	2500
	Changes in the office space (hot desks, stations, meeting rooms)	25	Euros/m2	25000 Euros
	Increased cost of amenities (electricity/heating/air conditioning) 10 Euros/day	480	euro/employee/year	12000
	Providing appropriate tools/appliances to work from home	300	euro/employee/year	7500

Table 10- List of Costs - One Smart Working Day Per Week

Chapter 4: Ranking Model

4.1. Defining the Ranking Model

The Ranking model is an instrument that was designed to help the company choose its smart workers. It is best described as a filter that can pick the most compatible employee to become a smart worker. The filtration process is achieved simply by having the employee fill out a survey; the survey looks for certain personal characteristics and separates the workers into three categories: very suitable, suitable, and slightly suitable.

The survey is made from two parts, a simple part that asks for personal information such as age, level of education, job description and such; whereas the second part consists of made up scenarios that were especially designed to investigate personal preferences, attitude, behavior, and personal characteristics.

This model is most useful for companies that are starting to apply the smart working method, especially when the startup program specifies granting this opportunity to a subset of its employees. Choosing the right employee to work outside the office is essential when the company is looking for its best interest, but it is a time and energy consuming process. A smart worker must be able to work from any location without being distracted and must have the ability to stick to deadlines and be result oriented; in addition, there are certain traits that make a smart worker more productive such as creativity, responsibility, independency, developed computer skills, problem solving abilities, and good communication skills. The ranking model takes all of this into account by considering each of the employees, their situation, needs, attitudes, preferences, behavior and reactions to certain events. Then, it filters them accordingly, making the assignment of smart working employees easier and more systematic. Another constructive use of this model can be when a company already has smart working, but without an increase in productivity. It can determine whether the right person is placed in the right place, and maybe suggests better options of employees who are more compatible with this mode of work.

4.2. Simple Survey

There are certain methods to be used when considering who should be a smart worker. First, the type of job performed by the employee can either facilitate or hinder the request, for instance if the employee works in IT or is a manager there is the possibility of consideration, whereas if the employee is a driver or a salesperson the possibility doesn't not exist. The method most commonly used in determining smart workers is based on necessity. Employees with health conditions, family responsibilities, or those who travel a long distance to get to work are first considered. Afterwards conditions like vehicle ownership, computer skills, age, number of working hours per week and duration of employment are considered. As seen in this method smart working is assigned to the people who need it the most, to help them achieve better work-life balance, increase their productivity and their level of satisfaction.

The employee characteristics to be considered are the following:
1) Age
2) Gender
3) Level of education
4) Marital status
5) Number of children
6) Number of people living in the house
7) Number of infants living in the house between the age of 0-4
8) Number of people that require special care
9) Health conditions that may affect presence in the company
10) Distance traveled to reach work
11) Estimated time to reach work
12) Job level/position/role
13) Job category/ sector
14) For how long have you had this job?
15) Number of employees in the company
16) Is this a public or a private company?
17) Number of working hours per week
18) Vehicle ownership
19) Time per day spent watching TV/ using a Smartphone
20) Computer skills
21) Can this job/role/activity be performed outside the office?
22) Allowed to participate in different work modes such as working from home(if yes, percentage of working hours allowed)
23) Level of satisfaction in current work mode
24) Level of satisfaction in current workspace
25) Do you know what smart working is? (with or against)

4.3. Survey with Latent Variables

The second survey to be used is more complicated than the simple survey, it is composed of different scenarios, each one with a real-life like situation where the employees must choose the action or their attitude towards a certain event. The term latent variable is used because the attitudes of the employees towards a specific issue are quantified by using psychometric indicators, what is meant by that is the following, instead of asking a direct question related to the work environment, a scenario with similar issues is created outside the work context. It is believed that this method yields better results by aiding the employees to give honest answers. If work related questions were to be asked the employees would most likely choose the answers that the company would like to hear, instead of stating how they truly feel.
A latent variable is an unmeasured variable or one that is hard to quantify, there is no perfect measure for it and one question cannot fully capture it. Determining the latent variable requires the usage of several different aspects to help measure it. In the context of surveys, the intended variables to measure can have multiple dimensions, the scenarios created can help measure all those

dimensions and avoid errors. Some common errors that can be avoided are the noise and biased errors. Noise or random errors are generated when the questions are difficult to understand, and when lack of attention is present. To overcome this problem the scenarios are designed in a simplified manner, using events that are encountered regularly in day-to-day basis. In addition, biased errors are the result of under-reporting or selective reporting of certain behaviors; this error is eliminated by using questions that are not related to work. Smart working is not mentioned in the survey, even after answering all the survey questions it is difficult to relate any of them to smart working which is the subject of this research. This helps in avoiding the Hawthorne effect that causes people to modify their behaviors when they know they are under observation, affecting their attitudes and the results of the survey. (Tagliaro & Ciaramelle, 2016)

On the bright side, a model of latent variables is very helpful in survey research. For starters, a latent variable model can help shorten the survey while maintaining reliability, it increases the reliability of the scale by separating measurement errors from the variance due to latent variables, it removes the measurement error that can distort relationships with other variables, and finally, it helps in evaluating if the variables function to measure the targeted latent variable, and eliminates the items that are not working.

The survey results will be used as a screening process, to help determine which employees are most suitable for smart working. It is suggested that after this, the usage of a different consideration tool such as taking the opinion of experts, such as HR managers, or psychologists to better determine the suitability. This can be beneficial for future research in this field.

The survey starts with an opening question, the following are two examples of opening questions:

- Would you like to answer some questions (that help us understand your likes and dislikes) that can improve your work environment?

- Can you tell us more about yourself by considering the following scenarios and providing honest answers?

Afterwards seven scenarios are to be chosen and assigned to the employee to answer. Each scenario is designed to measure a certain trait, preference or personal behavior of the employee. The seven scenarios measure the following latent variables: work related environment, distraction, behavior towards a deadline, creativity, problem resolving, productivity, and efficiency from home. The assignment of the scenarios will be associated to the personal characteristics taken from the simple survey. An example of that would be assigning the seventh scenario that measures efficiency from home to employees with infants that need care.

First Scenario: Work Related Environment

Please consider each of the following scenarios and try to your best of your abilities to visualize how you would react given different situations. Please answer as best to your judgment – there is no single correct answer.

You are trying to learn a new language. You have the choice of attending regular classes or doing an online course.
Please answer the following questions regarding your choice by selecting one of the choices
(😃 being the most and 😖 being the least favorable)

1. I prefer the flexibility of studying at any time during the day or night

2. I like to pace the speed of my learning according to my abilities.

3. I like to be able to choose the place where I study (home, library, etc.)

 4. I like the presence of a teacher to help me throughout the learning process

5. I prefer being able to learn through practicing and communicating with other

6. I consider that homework and exams are necessary

Second Scenario: Distraction

You are on the metro reading a book that you enjoy. Consider each of the following statement and answer by selecting one of the choices (being least likely to stop reading and being most likely to stop reading)

1. You hear the sound of a crying baby

2. You hear someone playing loud music nearby

3. You hear two people chattering loudly nearby

4. An old man/ woman climbs into the metro

5. A pregnant women gets into the metro

6. You hear some soft music in the background

😀 🙂 ☹️ 😖

Third Scenario: Behavior Towards a Deadline

Summer is here, and you need to leave for summer vacation in two weeks, please choose the alternative that you are most likely to do.
How likely are you to?

a. You wouldn't need to pack as you would have already done that

b. Start packing things two weeks earlier

c. Get your mom/friend/ or hired help to help you

d. Forget about it until two days before

e. Keep putting it off until the last day

f. Pack a couple of things, and buy what you need during the trip

Fourth Scenario: Creativity

You are writing a novel, you are stuck, and you need to boost your creativity.
please choose the alternative that you are most likely to do.
How likely are you to?

a. Lock yourself inside a room alone until you get ideas to write

b. Meet a friend who will help you brainstorm

c. Go to the park/ beach / mountains and work there

d. Listen to music while trying to get ideas to write

e. Take a long break, then resume working

f. Ask someone to come up with ideas for you.

Fifth Scenario: Problem Solving

You are writing/ working on your laptop, and it stops responding. Please consider these following lines of action you might and choose the alternative being the most favorable.

a. You try to fix it yourself (Google it)

 b. You ask a friend/professional for help

 c. You get angry and stop working

 d. You go to a library and use a computer there

 e. You borrow/rent a computer

Sixth Scenario: Productivity

You are learning how to use a new appliance, such as a new watch or phone. please rate these lines of action you might take with a face (😃 being the most and 😖 being the least likely)

1. You read the whole manual before you start

😃 🙂 🙁 😖

 2. You use trial and error method experimenting with things on your own

😃 🙂 🙁 😖

3. You learn few new functions everyday

😃 🙂 🙁 😖

4. You wait until someone you know teaches you all the tricks

😃 🙂 🙁 😖

5. You search online and find helpful resources to help you learn

😃 🙂 🙁 😖

6. You go to a professional/ an expert to help you

😃 🙂 🙁 😖

Seventh Scenario: Efficiency from Home

You are writing a report for work/school at home. Consider each of the following statement and answer by selecting one of the choices (😃 being most likely and 😖 being least)

1. Your favorite TV show starts. How likely are you to stop working and watch it?

😃 🙂 🙁 😖

2. A friend comes over for coffee. How likely are you to entertain your friend?

😃 🙂 🙁 😖

3. You feel like eating a snack. How likely are you to go to the kitchen to get something to eat?

😃 🙂 🙁 😖

4. You feel a little tired. How likely are you to take a nap?

😃 🙂 🙁 😖

5. You hear a loud crash on the street. How likely are you to go check out what happened?

😃 🙂 🙁 😖

6. You remember you need to put some clothes in the washing machine. How likely are you to get up and do that?

😃 🙂 🙁 😖

7. You phone rings. How likely are you to answer?

😃 🙂 🙁 😖

8. You see a message pop up on your notification. How likely are you to check it?

😃 🙂 🙁 😖

4.4. Calculations and Operations

As mentioned before, the simple survey is used to prioritize the employees that need to be smart working according to their health, age, and life situation in general. Whereas the real ranking occurs in the second survey, a scale system was created to help separate the employees into three categories. Creating a scale consists of assigning a mark or a certain value between zero and three (0,1,2,3) to each answer given by the employee, with zero being the least favorable trait or answer, and 3 being the most favorable trait to be a smart worker.

Building the rank model starts by summing all the values chosen on each scale given, and then by dividing the sum by the number of questions answered. The following procedure was created to avoid the cases where the company or the employee decide to skip or eliminate one of the questions.

Consequently, three ranks are established:
0 to 1: slightly suitable
1 to 2: suitable
2 to 3 very suitable

The tables 11 and 12below show the assignment of the scale to each question provided, notice that the scale is inverted if the question is asked in the opposite connotation, and the same value of the scale is set when the traits have the same equivalence.

Scenario	Question	a	b	c	d
1	1.1	3	2	1	0
	1.2	3	2	1	0
	1.3	3	2	1	0
	1.4	0	1	2	3
	1.5	0	1	2	3
	1.6	0	1	2	3
2	2.1	3	2	1	0
	2.2	3	2	1	0
	2.3	3	2	1	0
	2.4	3	2	1	0
	2.5	3	2	1	0
	2.6	3	2	1	0
6	6.1	3	2	1	0
	6.2	3	2	1	0
	6.3	3	2	1	0
	6.4	3	2	1	0
	6.5	3	2	1	0
	6.6	3	2	1	0
7	7.1	0	1	2	3

	7.2	0	1	2	3
	7.3	0	1	2	3
	7.4	0	1	2	3
	7.5	0	1	2	3
	7.6	0	1	2	3
	7.7	0	1	2	3
	7.8	0	1	2	3

Table 11 - Scale system for scenarios 1, 2, 6 and 7

Scenario	Choice	3	4	5
Ranking	a	3	3	3
	b	2	1	2
	c	0	3	0
	d	1	2	2
	e	0	1	1
	f	1	0	-

Table 12 - Scale system for scenarios 3, 4 and 5

Discussions and Conclusion

The Cost Model

By Comparing the two cases studied in this paper, the first being one day of smart working per month and the other being one day of smart working per week, the importance of smart working is revealed.

The results of the cost model show that smart working can be very beneficial to all three actors considered. The benefits to the employee and the environment are not negligible, and to the company the benefits outweigh the costs.

When looking at the results of the cost model, it is important to realize that the difference in costs between the first and the second year is due to the office changes, which will only be performed the first year. The estimated cost of the office changed in both cases was equivalent to 25000 euros.

It is interesting to notice the high difference between the benefits and the costs in the results of this model. In the first case the benefits were about 2.3 times higher than the costs in the first year and 4.3 times higher than the cost in the second year. Where as in the second case, the benefits were 3.8 and 6.4 times higher than the costs in the first and second year consecutively.

From a different point of view, when comparing the benefits of the two cases we realize that the benefits of one smart working day per week are 1.6 times higher than the benefits of one smart working day per month for the company, 3.4 times higher for the employee and 2 times higher for the environment. In total, having one smart working day per month is 1.94 times more beneficial than having only one day per month. On the other hand, the difference between the cost in the two cases is not very significant, with a ratio of 1.16 in the first year and 1.3 in the second.

	1 SW Day Per Month		1 SW Day Per Week	
	Benefits	**Costs**	**Benefits**	**Costs**
Company	95285.5	52750.0	149571.4	61250.0
Employee	23695.2	-	81240.6	-
Environment	902.9	-	1818.2	-
1st Year Total (Euro)	119883.6	52750.0	232630.3	61250.0
2nd Year Total (Euro)	119883.6	27750	232630.3	36250

Table 13 - Total Benefits and Costs

Looking at all the variables related to the change in productivity of the company, it is possible to transform some of the variables into one, these variables being : increase in productivity (amount of work), increase in efficiency (quality of work), extension in business hours, increased motivation/

innovation / engagement, decrease in absenteeism, reduction in travel problems, attraction of high quality talent, ability to match fluctuating demand (meet customer's expectation), drop in attrition and decrease in hiring cost.

When considering all the variables of productivity together, in the first case with 14 smart working days per year the increase of productivity of the 25 smart workers increases by 45 % in year, and the productivity of the whole company increases by 11%. In the second case with 48 working days per year the increase of productivity of the 25 smart workers increases by 75 % in year, but the productivity of the whole company increases by 19% only. The possibility of raising the productivity of the whole company by 75 % is possible if all the 100 employees of the company are smart workers.

The results of this cost model prove that smart working works for the benefit of the company. Even though there are costs included, this revolutionary method of working still produces more profit than losses.

More importantly, by looking at the environmental benefits, around 900 euros in social costs can be saved by having 25 employees work from home once per month, whereas the equivalence of 1800 Euros can be saved if they work from home 4 times per month. Even though this number doesn't appear to be extremely high, imagine how much more it will be if thousands of employees become smart workers. Better yet, imagine how significant it will be if a whole country turns to smart working.

The Rank Model

The survey was translated to Italian and filled out by 33 employees from Movesion company.

After looking at the survey correspondence, it is interesting to point out that in the first scenario 85 % of the respondents (28/33) prefer to have the flexibility to perform a task at any time during the day or the night and like to learn through communicating with others, 94% (31/33) preferred to follow their own pace and to have the ability to choose the location, 91% (30/33) prefer to have someone to guide them around and think that testing abilities is important.

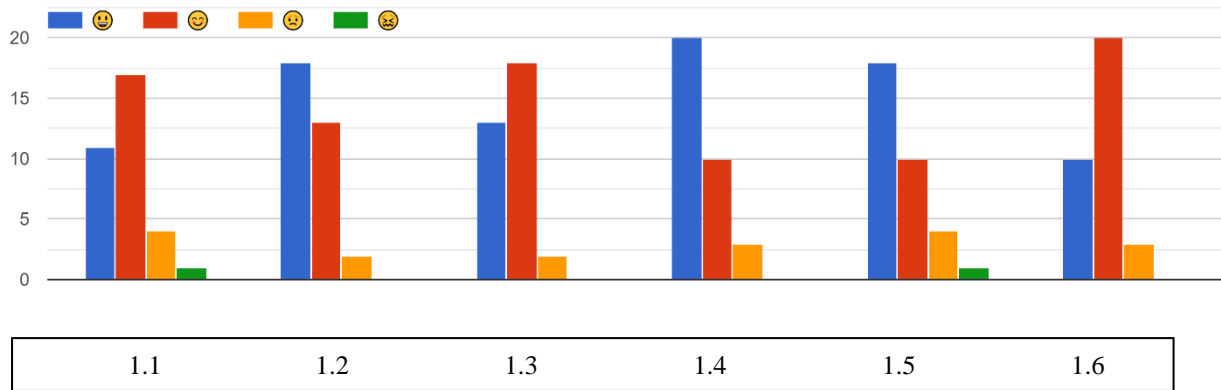Those preferences are illustrated in figure 9.

Figure 9 – Employees choices in the first scenario

In the second scenario, more than 50 % of the employees would stop the task they are doing, reading in this case, if they hear a baby crying (17/33), hear loud music nearby (24/33), or have loud chatter nearby (20/33), however more than 50% said they wouldn't be bothered if they have old people(25/33) and a pregnant lady around (28/33), or hear soft music in the background (29/33). The last result suggests that employees of Movesion may like to have soft music in the background. Figure 10 displays those results.
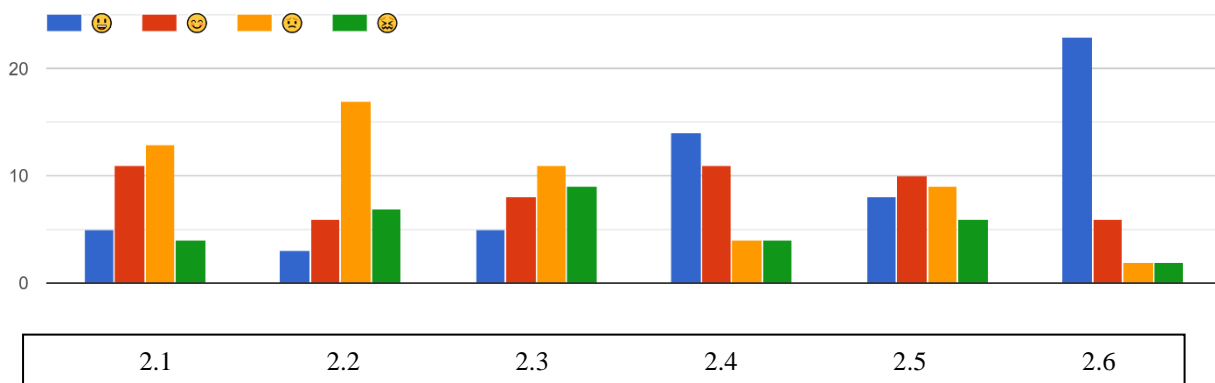
Figure 10- Employees choices in the second scenario

The results of the third scenario can sound alarming. When asked to choose the most likely time to pack before a summer vacation with a deadline, 85% of the respondents admitted that they are most likely to put it off until the last one (14/33) or two days (14/33), only 15 % said they were most likely to start the task two weeks ahead of time. On the bright side, no one asked for external help, or decided to postpone until after the deadline. This can be seen in figure 11.
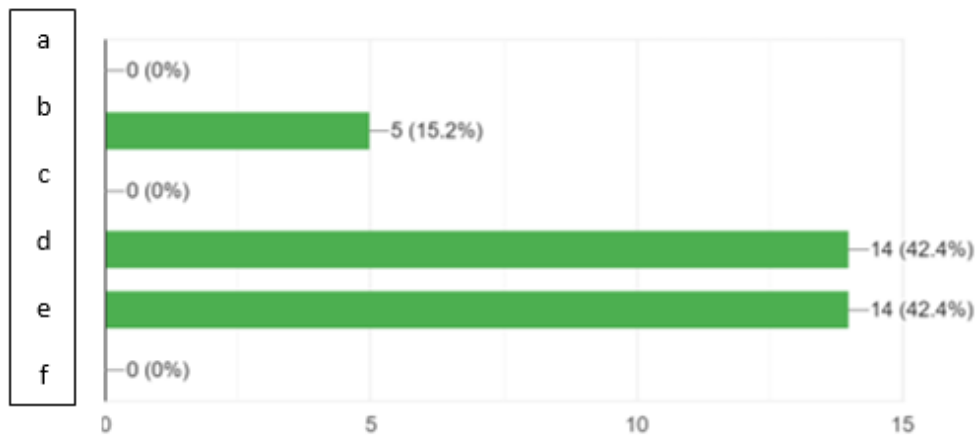
Figure 11 - Employees choices in the third scenario

When asked about ways to boost their creativity, in the fourth scenario, 27% (9/33) said they are more likely to go to the beach, mountains, or a park, 39.4% (13/33) were more likely to take a long break then resume working. It is important to note that only 6 % (2/33) chose to lock themselves in a room to get ideas, and no one chose to ask someone for ideas. In further studies, it is suggested to update the choices. Figure 12 shows those choices.
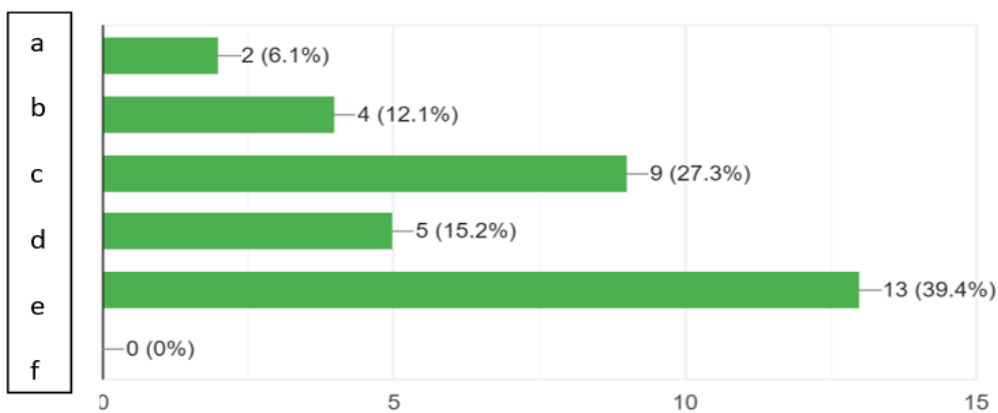

Figure 12 - Employees choices in the fourth scenario

The fifth scenario tested the behavior when faced with a problem (problem resolving), 76% of the employees are more likely to fix it by themselves (probably by searching online). Only 3 percent choose to stop working or go to a library, and none choose to borrow or rent. The behaviors can be viewed in figure 13.
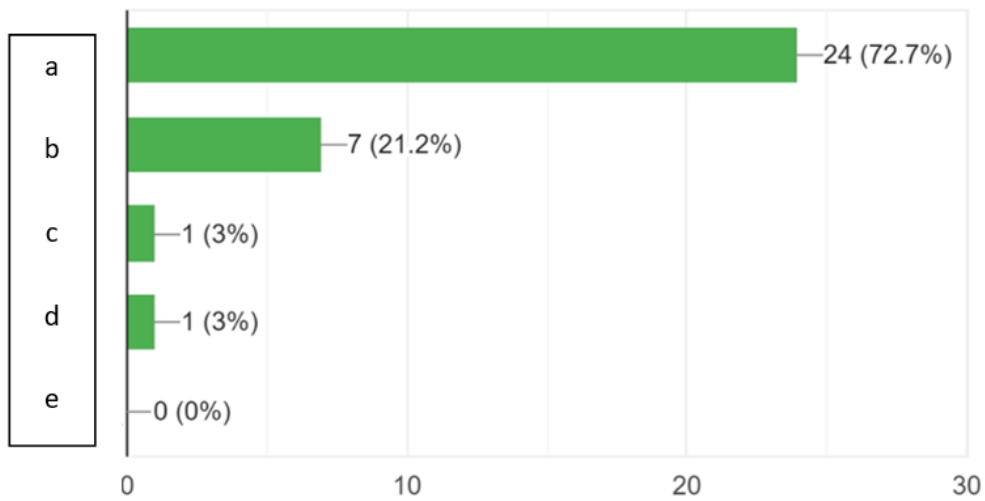
Figure 13 - Employees choices in the fifth scenario

In the sixth scenario, many chose not to read the manual (23/33) before using a new appliance, however the majority chose to use trial and error method(27/33), learn new functions every day(24/33), not to wait for someone to teach them everything(31/33), to search online for resources (25/33) and not to go to an expert for help(30/33). The results of the sixth scenario are present in figure 14.
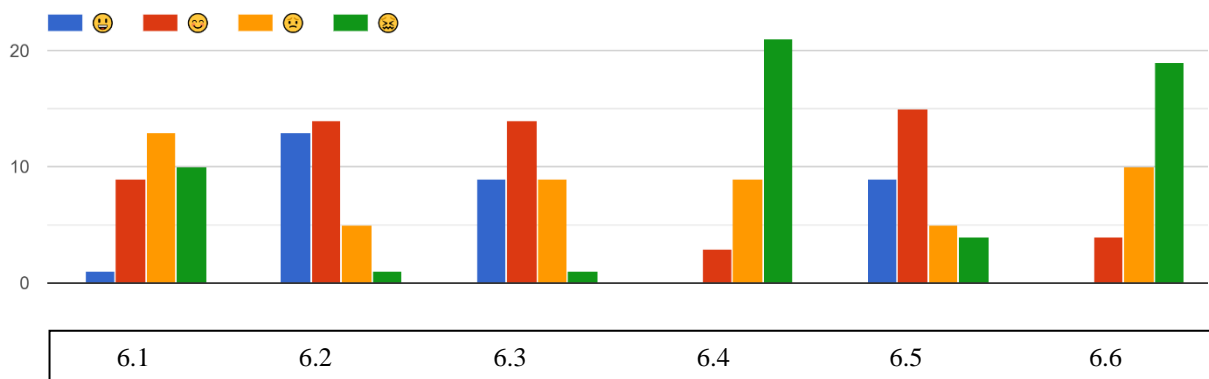

| 6.1 | 6.2 | 6.3 | 6.4 | 6.5 | 6.6 |

Figure 14 - Employees choices in the sisth scenario

Finally, in the last scenario that measures efficiency from home, (22/33) won't stop working to watch their favorite show, almost half (17/33) of the employees would stop working to entertain a friend,(27/33) would go for a snack, (25/33) would not take a nap if they feel tired, (23/33) would check out what happened if they hear a loud crash, (19/33) would interrupt the task at hand to do their laundry, (21/33) would answer the phone if it rings, and (17/33) will check if they get a message notification. Figure 15 explains these choices.
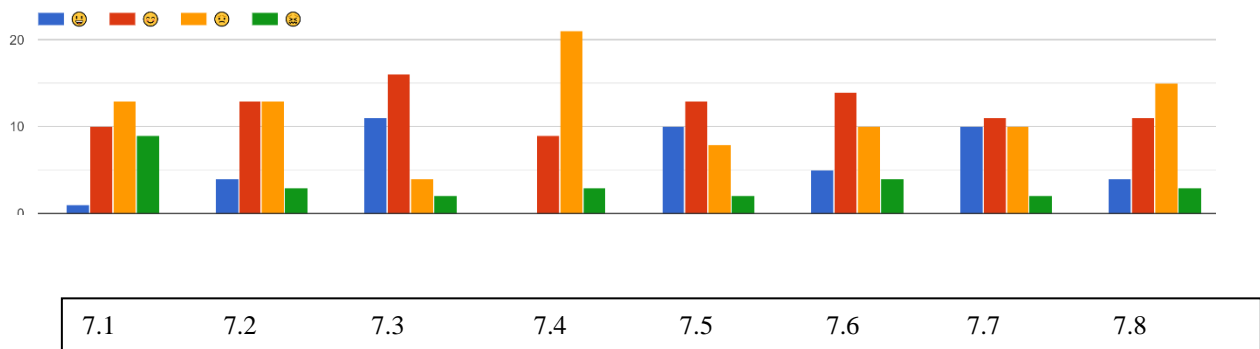
Figure 15 - Employees choices in the seventh scenario

To validate the results, experts including CEOs, HR professionals, and experts in the fields of sociology and smart working in Italy gave a ranking to the survey questions. Those ratings were considered in calculating the results which are shown in table 14.

Employee	Result before	Result after	Rank
1	1.48	1.5	Suitable
2	1.1	1.28	Suitable
3	1.38	1.48	Suitable
4	1.66	1.75	Suitable
5	2.7	2.26	Very Suitable
6	1.62	1.73	Suitable
7	1.62	1.75	Suitable
8	1.31	1.45	Suitable
9	1.97	2.1	Very Suitable
10	1.17	1.34	Suitable
11	1.31	1.44	Suitable
12	1.45	1.5	Suitable
13	1.31	1.46	Suitable
14	1.79	1.9	Suitable
15	1.27	1.37	Suitable
16	1.28	1.37	Suitable
17	1.14	1.23	Suitable
18	1.48	1.51	Suitable
19	1.45	1.49	Suitable
20	1.38	1.46	Suitable
21	1.45	1.53	Suitable
22	2.03	2.21	Very

			Suitable
23	1.69	1.79	Suitable
24	1.55	1.63	Suitable
25	1	1.13	Suitable
26	1.59	1.74	Suitable
27	1.48	1.62	Suitable
28	1.4	1.5	Suitable
29	1.62	1.72	Suitable
30	1.48	1.58	Suitable
31	1.55	1.67	Suitable
32	1.69	1.81	Suitable
33	1.62	1.71	Suitable

Table 14 - Smart Working Survey Results before and after the inclusion of expert's opinions

According to the Rank model, 9 % of the employees were very suitable for smart working, whereas the rest 91% fall in the suitable range.

In any case, implementing smart working is a gradual process that takes time and effort. Even if the number of "very suitable" employees is not high, this doesn't imply that the company is better off without smart working. Instead, it means that with the right effort and motivation, all the employees can become very suitable smart workers.

For further development, the rank model can include more questions to measure other characteristics such as commitment, self-regulation, and attitude towards social media platforms and their usage.

Conclusions

"*Smart Working is no longer just "an opportunity", but it is an indispensable lever for harnessing that energy and those talents needed today to give new momentum to national competitiveness.*"- Smart Working Observatory

In this paper, smart working proves to be rewarding on all levels, for the company, the employee, and most importantly the environment.

As engineers, it is our job to make the least environmentally-damaging modes of transport more appealing in cities, even if that option is not the most rewarding financially. It is time to put the needs of the environment and people above all.

Pollution has always been a major problem, but now it is more threatening than ever. If we seriously consider the effects of pollution on ourselves, families, society and the environment, our daily choices will not be the same.

Trip reduction programs, such as smart working, can be part of the solution, with the hope that our future cities will become healthy environments with sustainable practices that promote the well-being of all.

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