Masaryk University
Faculty of Economics and Administration

Operations Management: Seminar Work

Utilization (application) of the Theory of Constraints (TOC), Critical Chain Project management (CCPM) as a Project Management Methodology based on TOC principles.

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Content:

A.   How would you apply CCPM and TOC tools for the planning of Santa's Christmas delivery project? Can you name the main project risks? Do you know how to diminish these risk factors?

The Theory of Constraints is a methodology used for identifying the most important limiting factor (constraint, also referred as bottleneck) that stands in the way of achieving a goal and then systematically improving that constraint until it is no longer the limiting factor. (Lean Production)

As the ultimate goal of most companies is to make profit, both in the short and long term, TOC provides a powerful set of tools for helping achieving that goal, outlined by Goldratt in his 1984 book "The Goal", that specifies that the management of the organization's constraints is addressed by the following **5 focusing steps**

1.   Identify the system's constraint
2.   Decide how to exploit the system's constraint
3.   Subordinate the rest of the system to the decisions made above
4.   Elevate the constraint
5.   Go back to Step 1

For analysing the cause and effect relationships, Goldratt has developed a set of tools, that are known as the thinking processes: Current Reality Tree, Evaporating Cloud, Future Reality Tree, Prerequisite Tree and Transition tree.

The thinking process are mainly used to answer the following questions, that help managers decide. (THEORY OF CONSTRAINTS INSTITUTE)
1.   What needs to be changes?
2.   What should it be changed to?
3.   What actions will cause the change?

The Critical Chain Project Management has its roots in Goldratt's Theory of Constraints, and represents a methodology for planning, executing and managing projects in single and multi-project environments.

It was mostly developed in response to many projects being dogged by poor performance manifested in longer than expected durations, frequently missed deadlines, increased costs in excess of budget or less deliverables than originally promised. CCPM covers such problems as:
1.   Student syndrome - not starting the task until the last moment
2.   Parkinson's Law - Delaying the completion of the task
3.   Bad Multitasking

And the 2 objectives it tries to achieve are to improve the reliability of the delivery of the projects and to reduce the cycle time for project development

But in order to analyse how TOC can be applied to our "Mission Possible" project we need to first answer what is a project?

Simply put, *a project is a series of tasks that need to be completed in order to reach a specific outcome. A project can also be defined as a set of inputs and outputs required to achieve a particular goal.*

Project management on the other hand is the application of knowledge, skills, tools and techniques to project activities to meet the project requirements. (Project Management Guide)

Project Name: Mission Possible.. The Big Delivery

So let's look at Christmas from the project and project management perspective: A lot of people think that Santa and his Team work only one day a year, but the truth is that this is far from their reality. In order to get ready for Christmas and the work involved in delivering gifts worldwide, the months leading up to the holiday are filled with toy building, toy sourcing, list making, list checking, flight planning and reindeer training.

Projects have a defined start, finish and end and Santa's Christmas delivery project has a specified deadline - Christmas Eve. It takes a year-round preparation for that one big night and the project wouldn't be realized without the ultimate Project Manager - Santa Claus. Just think about it, he bridges the gap between the production team (elves and their assistants at the North Pole) and the clients (the children over the world) in an effective, efficient and responsive manner and makes sure the ultimate goal is achieved: ensuring that every child on his Nice list have their gifts on Christmas Eve.

The Santa's Christmas Delivery Project should definitely follow a plan to make sure it meets the desired deadline. The plan that helps Santa to pull of Christmas is described further:

1. Plan and evaluate every day leading up to the Big Give
- Review "The List"from past years to see how many gifts were given and predict how many kids will make it to the Nice List this year. Customer Database Management
- A market research is necessary to predict/guess what toys will be in high demand this year
- Also there is a need to calculate the workload compared to how many elves are employed this year and then see if it's necessary to hire additional help to meet Santa's goals.

2. Consider every voice, big or small
Children send their letters 365 days a year and Santa has to read what they have to say and take into consideration their letters. Hear and actually consider what every child has to say and than take a decision.

3. Prepare to changes to "The List"
Sometimes children tend to change what they want, or jump back and forth between Naughty and Nice, therefore the number of toys that have to be produced changes accordingly. Analyze your project's risks and plan how you will deal with them ahead of time.

4. Manufacturing and Distribution
Santa needs small, precise hands to make millions of toys and fortunately he has his own personal workshop filled with hard-working elves, but still not enough to directly address the growing demand for toys on Christmas Eve. So he has to make sure that the elves with the right skills are assigned to the right task (gathering raw material, toy production, reindeer care or day to day maintenance of the workshop)

5. Human Resource Department

You need lots of elves to make lots of toys and they don't come cheap. One of the most crucial departments is the mail department. The elves sit through tons of letter from children and ensure Santa reads all of them. There are elves that wrap, elves that track the weather and elves that pack the sleigh, even singing elves. On Christmas Eve, they prepare Santa's sleigh for the most important journey of the year. Few chosen elves accompany Santa and help him deliver presents.

6. Marketing and Promotion

Christmas is more popular than ever before and there is a reason behind that. In the months leading up to the "Big Day", Santa is glad handing all over the world, like for simultaneously entertaining children in more than 900000 malls.

7. Transportation and Logistics

Santa doesn't have a problem to navigate the whole lobe in one night. As well as entering in everyone's house. Santa's sleigh is helping here as it's not an ordinary vehicle. Equipping the leigh with everything needed for accomplishing the magical mission is part of the plan.

8. The right tools make a world of difference

Santa's main distribution center implies a real-time warehouse management system that combines dozens of Distribution center activities (putaway, replenishment, order picking, sleigh loading).

Based on the Plan, the Total Length of the Project will be 365 days, 12 months or exactly one year with at least 8 hours of work/day, that will increase up to 12 hours of work/day during December, just in time to plan out his itinerary and build up his inventory of gifts. The Project will start on December 26, second day of Christmas, and as described before it's a very meticulous project that needs a lot of planning. The project deadline is December 25 when all the gifts should be delivered to children on the Nice List.

The magnitude of the project still allows for TOC to be applied. As the methodology is used for identifying the most limiting factor (constraint) that stands in the way of achieving the goal (The gift delivery), for Santa's Christmas Delivery project the first constraint will be the ultimate impossible schedule that seems unachievable. There's a need to talk about the deadline and especially the fact that Christmas Eve is the milestone when the project has to be delivered - one night to visit millions of destinations and deliver tons of gifts, and missing the deadline would most likely stop his existence.

Everyone has deadlines to meet: preparing the gifts, make sure the gifts were wrapped on time, also if the gifts were loaded on the sleigh on the seted date and of course carrying distribution without missing the deadline.

Second constraint would be constantly managing the fluctuations of "The List" - Children grow out of believing in Santa, new ones arrive; also children can move up or down the Naughty or Nice continuum. His achievements is not only identifying all children on the planet, but his ability to determine if they have been naughty or nice.

Third Constraint is definitely the continuous change in gifts: Santa has to keep up to date with fashion and stock only the latest and greatest toys.

Fourth Constraint: Team Management - Getting all of the presents made, wrapped and loaded for delivery is not an easy task and needs a very clear and effective communication process so everyone knows who's in charge for what.

Task Management: Keeping track of who's doing what is a tough task to handle using just pen and paper. The list of the regions Santa has to cover, from which region Santa should begin the distribution, which gifts the elves need to load.

Budgeting: Sometimes the escalating production costs and also the parent's budget stagnating, Santa needs considering producing all of the presents that the children request without running out of money or breaking the bank. Not to mention that the expenses for dealing with the manufacturing North Pole, and especially the heating bills are enormous.

Because we're talking about Project Management, then definitely there is a need to talk about Risk Management.

The PMBOK 5ed(2012) defines Project Risk Management as, *the knowledge area that includes the processes of conducting risk management planning, identification, analysis, response planning and controlling risk on a project.*

A common definition of risk is an uncertain event that if it occurs, can have a positive or negative effect on a project's goals.

A project risk can be defined as any event that prevents or limits the achievement of the project objectives as defined the outset in the project charter. (Burke 2013)

For Santa's Christmas delivery project there are plenty of risks that can be assessed:
- Time Scheduling
- Delivering on time and on budget
- Lack of communication with the elves
- Misunderstanding the children's wishes
- Delivering the wrong gifts to the children
- Issues because of too much pressure of being on time with the gifts delivery
- Bad weather conditions
- Increasing rate of change in children's tastes
- New children are born every year so estimating the new names and toys is getting more difficult
- New Technologies being developed every day makes it more difficult to keep it up with the youth
- Costs of upgrading the workshop
- Not all children celebrate Christmas

Once these risks are identified it's easy to develop a response that can help either eliminate, mitigate, deflect or accept the risks and therefore control them.

The project's success can be achieved by pursuing opportunities to gain competitive advantage.

The Risk Management Process can be briefly described as following:

Figure 1: Risk Management Process

Once Santa learns how to apply a systematic risk management process and puts into action the 5 core risk management process steps, then the Gifts Delivery Project will run more smoothly and will become a positive experience for everyone involved.

By **identifying the risk** Santa and his elves team uncover, recognize and describe risks that might affect the project and its outcome-the Gift Delivery.

Taking a step further, Santa of course is **analyzing the risks**, which will most likely help him determine their consequences, by developing an understanding of the nature of each risk and its potential to affect the project goals and objectives.

Later on, by **evaluating or ranking the risk**, Santa can determine the risk magnitude and can make decisions about whether the risk is acceptable, therefore dividing the risks into categories and assign probabilities of happening.

This leads to **Risk Response Planning**, or in other words Santa treating the risks by setting up a plan to modify the highest ranked risks to achieve acceptable risk levels, therefore minimize the probability of the negative risks and enhancing the opportunities.

Last but not least, Santa necessarily has to **Monitor and Review the Risk** by tracking them and evaluating their effectiveness during the project.

So how this Risk Management Process can actually help Santa exploit his opportunities and diminish as much as possible the project's threats? We already made sure that the biggest Risk for Santa is the Wrong Time Scheduling and Missing the Deadline which is a huge Threat as in case it materializes Santa will not be able to deliver the gifts on time and will disappoint millions of children on the planet.

The Risk of Misunderstanding children's wishes can affect the kids perception of Santa and Christmas in general, as this is a holiday of spreading joy and happiness, and this kind of misunderstanding might lead to disappointment and dissatisfaction.

The Lack of communication with the elves can affect the productivity of the workshop, thus meaning that tasks will not be distributed accordingly, and in result affect the Project's schedule.

Delivering the Wrong gifts to children can decrease the trust kids have in Santa, thus their expectations will not be meet and they will not achieve the desired level of satisfaction.

Too much pressure because of the tight schedule and the one day delivery goal, can affect the project in 2 ways: first, negatively as it can lead to issues in Santa's relation with his elves, affecting emotionally, causing stress and leading to santa to divert from his normal routine and normal decision-making, making him react wrong to certain issues. Second, a pressured situation can also be seen as an opportunity to shine, learn and develop, and can be used as motivation to succeed, and instead of dwelling on problems, pressure might help Santa prioritize the things that need to be done and where should he focus his energy mostly.

Increasing rate of change in children's taste might affect the way dealing with their gifts, impacting the no of gifts produced, so some elves might be left jobless

Estimating the no of children and therefore the no of toys can also be tricky, as Santa really wants to fulfill everyone's wishes and sometimes he will not have all the necessary gifts for them, and also he doesn't want to have too many toys in the workshop as he hates wasting materials. But this can also have a positive impact, as Santa will learn to better deal with estimating by always using a database for the nice children which will help him keep track of everyone on his list.

Cost of upgrading the workshop are high and if Santa doesn't do that, than it's getting harder and harder to keep up with the new technology, new gift demands and toy preferences.

Because not all children celebrate Christmas, and not all countries celebrate Christmas on December 25, it's also hard to do estimates on how many toys should be built, and considering also the differences in the time zones this can either affect negatively the delivery process, or positively by taking advantage of the time difference and start delivering from east to west and in this way dealing with his schedule/deadline.

B.   What kind of effects do you expect by possible using buffers (time buffers) during the chosen project? Can you explain what is the time buffer? How can you measure a reached result (used metrics such as time, resource capacity, costs, good-will and so on)

As described in the beginning, Critical Chain Project Management tries to achieve 2 key objectives, which are improving the reliability of the delivery of the projects and reducing the cycle time for development projects, and uses three types of buffers to achieve that.

Project Buffer that is inserted at the end of the project network between the last task and the completion date and it aims to absorb any delays that may occur during the realization phase of the project leaving the finishing date unchanged, which is exactly what Santa needs.

The Feeding Buffers are those that feed into the critical path,to protect against delays of tasks that can delay a subsequent task in the Critical Chain and are inserted between the last task on a feeding path and the Critical Chain.

And last, the **Resource Buffers** are set alongside the Critical Chain to ensure that the appropriate people and skills are available on the Critical chain Tasks as soon as possible.

In Project Management, there is another type of Buffer used, which is the **Time Buffer**, used to prevent Murphy's Law Consequences - the extra time added into a time

estimate to keep a project on track, usually added during planning at the end of the project or after some critical points in order to avoid not delivering in time. This Safety Time is considered essential for Santa's delivery Project. We can call it rapid-tasking - it's not doing too much at once, but switching between tasks, priorities and work modes far too quickly, implementing buffers can help avoid utter chaos. Because without giving yourself time to stop, think and prepare for the next task, at some point are no longer working, but just reacting. (Lifehacker)

So how can the Time Buffers improve the project itself?

Because the Critical Chain Project Management Method focuses on the only important date-the project completion date, and this is critical for Santa's project, by implementing a buffer, the Parkinson's Law might be eliminated. So even if the project itself has a 365 days timescale, it will not use all of it, as CCPM comes to solve the problem of using all the time dedicated to the project, by building a delivery schedule that takes an estimate with a 50 % risk coverage. (Izmailov et al. 2016)

As it's almost impossible to accurately estimate the time needed to complete each task of the project, there is the need to first take a very thorough analysis of the risks that might affect the project's outcome and approach them in a proactive way so their effect on the project decreases.

Santa's Delivery Project is a complex one and involves a lot of actors responsible for lots of different tasks, so in other words the success of the project depends mostly on a very well organized team work and nicely distributed tasks for each elv in the team, and of course Santa- the one and only responsible for organizing the workload.

To make the project's schedule as realistic as possible, it is necessary to consider first that the milestone of the project is the Christmas Eve, so there will be necessary to add buffers after the main key activities, such as building "The List", manufacturing, and of course distribution of all the built gifts. Not to forget that it's highly recommendable to have buffer at the end of the project, to make sure it's protected by unpredictable risks.

So the first step for Santa would be to apply Goldratt's method of calculating the buffer by multiplying the total length of the project by 50 %. In such a case Santa can take use of the time buffer to protect his project from risks and it will allow him to deliver all the gifts on time. Since he keeps only 50% of the risk coverage in each individual task estimate, he can expect that 50% of the tasks will be completed earlier, and 50% will be completed later than estimated, and in this way Santa can use the advantage of the early tasks completion. In regard to the delayed tasks, they will be compensated by the project's buffer on the end of the critical chain

Activities	January	February	March	April	May	June	July	August	September	October	November	1st week Dec	2nd week Dec	3d week Dec	4th week Dec	Christmas Eve
Review the "Nice and Naughty" List	■															
Research the market for which toys are in high demand	■	■														
Read all letters to know which toys to build		■	■													
Buffer				■												
Adjust the list according to fluctuations					■	■										
Gather Raw Material						■	■									
Buffer								■								
Manufacture the toys									■	■	■					
Sing Christmas Carols (also buffer)											■	■	■	■	■	
Wrap the Gifts											■	■				
Buffer													■			
Promote Christmas Worldwide											■	■	■	■		
Pack the sleigh with the gifts													■	■		
Buffer															■	
Navigate the Globe in one Night and deliver all the gifts																■

Table 1: Gantt Chart

C. Can you specify by use of Thinking Process Tools Santa's Personal bottleneck. Create CRT and create a list of Undesirable Effects.

One of the thinking processes logical tools is the *Current Reality Tree*, and as the name says, it depicts the current reality in a series of dependent logical cause-and-effect relationships, starting from the Undesirable Effects down to one or a few critical root causes. It can be built following some easy steps: Identify the most relevant Undesirable Effects, Explore other Undesirable Effects, List a set of root causes that led to the Undesirable Effects and Explore the relationship between the Undesirable Effects and the root causes, so that one (or two) core constraint(s) could be identified. (Matchar, Patwardhan)

For our Santa's Delivery Gifts Project the following list of Undesirable Effects can be identified:

UDE 1: Lack of time, or more precisely meet stiff/tight deadlines (24 hours only to deliver all the right gifts to all the kids on the planet and bring a smile on their face) carrying distribution without missing the deadline
UDE 2: High Expectations (Sometimes Children have high expectations about the gift they want)
UDE 3: Lack of delegation at the key moment (While Santa's elves help with all the project preparation work, he seems to have delegation issues when it comes to the big night and the project delivery)
UDE 4: Overwhelming Pressure
UDE 5: Fluctuations of "The List"
UDE 6: Wrapping Gifts on time
UDE 7: Task Management (keeping track of who's doing what is a tough task to handle using just pen and paper)
UDE 8: Delay in gift Distribution
UDE 9: Confusion created by keeping track of all activities and tasks just using a paper calendar
UDE 10: Confusion regarding the regions Santa has to cover, from where he should begin with the distribution
UDE 11: Miscommunication with the elves
UDE 12: Missing the deadline
UDE 13: Problems with the Workshop's Operations
UDE 14: Confusing the tones of received letters
UDE 15: Loss of Focus on the end result because of the monotony of doing the same thing all year, every year
UDE 16: Children Stop believing in Santa Claus
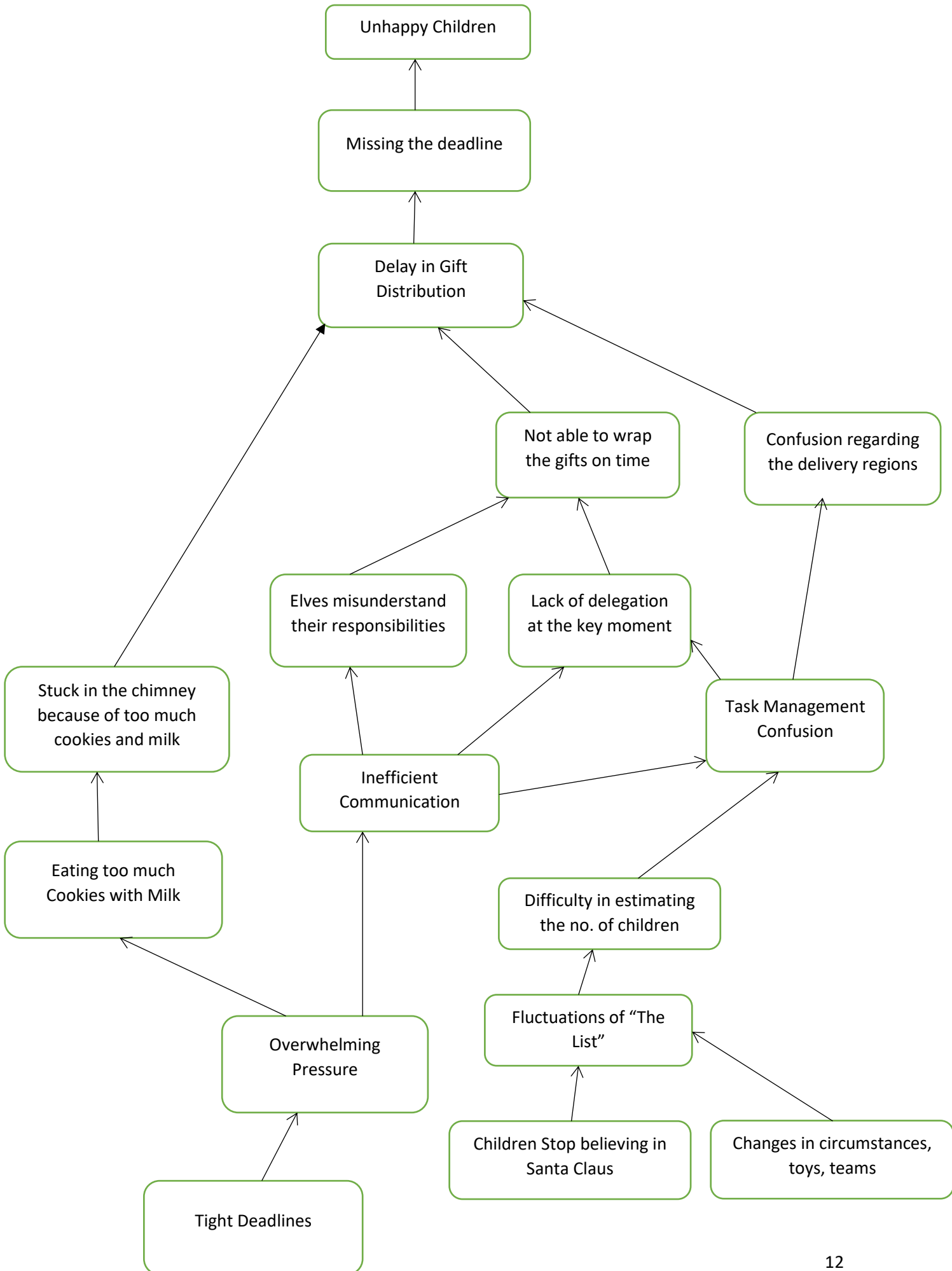UDE 17: Difficulty in estimating the no of Children as every year millions of babies are born
UDE 18: Costs of Upgrading the Workshop are growing every year
UDE 19: Changes in circumstances, toys, teams
UDE 20: Stuck in the chimney because of too much milk and cookies
UDE 21: Elves misunderstanding their responsibilities
UDE 22: Children are Unhappy

Unhappy Children

Missing the deadline

Delay in Gift Distribution

Not able to wrap the gifts on time

Confusion regarding the delivery regions

Stuck in the chimney because of too much cookies and milk

Elves misunderstand their responsibilities

Lack of delegation at the key moment

Task Management Confusion

Eating too much Cookies with Milk

Inefficient Communication

Difficulty in estimating the no. of children

Overwhelming Pressure

Fluctuations of "The List"

Tight Deadlines

Children Stop believing in Santa Claus

Changes in circumstances, toys, teams

D. Create with use of already existing set of UDE's Ishikawa fishbone diagram and put some weights meaning numbers specifying an importance for the assigned reason. Based on the set of the assigned scores create Pareto Lorenz Curve. Specify most important reasons. Compare with Root Problem found by use of Current Reality Tree

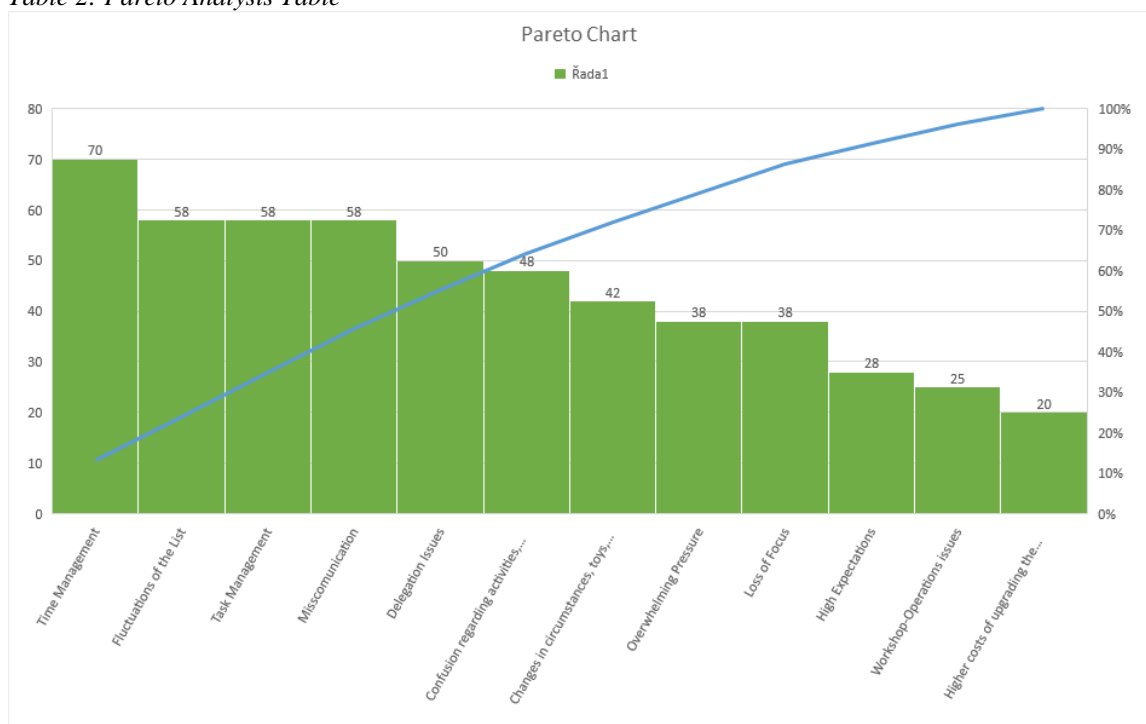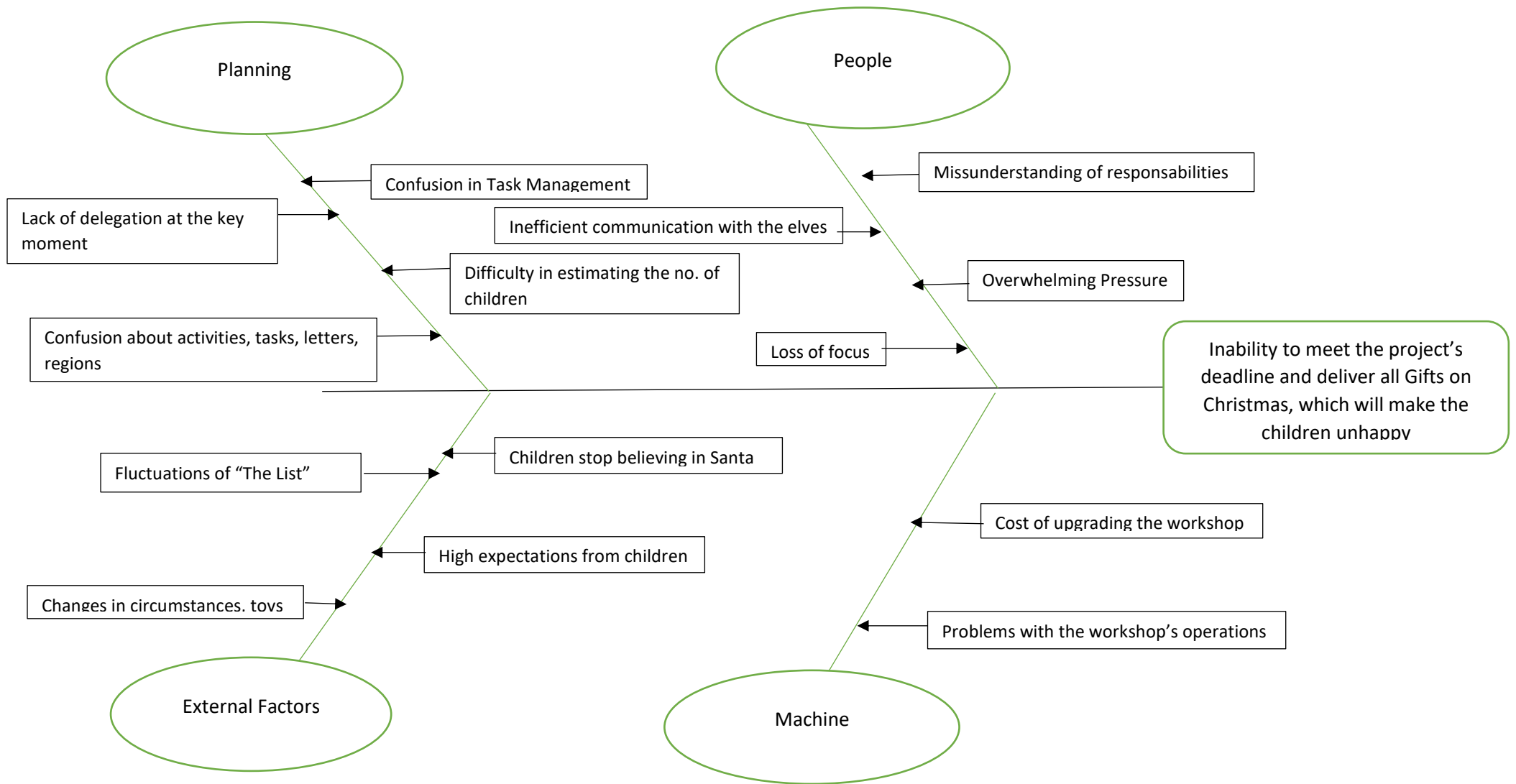| UDE	Import ance	Cumulati ve count	%	Cum ulative %
Time Management	70	70	1 3,13321	13,13 320826
Fluctuations of the List	58	128	1 0,8818	24,01 500938
Task Management	58	186	1 0,8818	34,89 681051
Misscomunication	58	244	1 0,8818	45,77 861163
Delegation Issues	50	294	9 ,380863	55,15 947467
Confusion regarding activities, tasks, letters, regions	48	342	9 ,005629	64,16 510319
Changes in circumstances, toys, teams	42	384	7 ,879925	72,04 502814
Overwhelming Pressure	38	422	7 ,129456	79,17 448405
Loss of Focus	38	460	7 ,129456	86,30 393996
High Expectations	28	488	5 ,253283	91,55 722326
Workshop-Operations issues	25	513	4 ,690432	96,24 765478
Higher costs of upgrading the workshop	20	533	3 ,752345	100

Table 2: Pareto Analysis Table

Figure 2: Pareto Chart. Lorenz Curve

13

Figure 3: Fishbone Diagram

Planning

Confusion in Task Management

Lack of delegation at the key moment

Difficulty in estimating the no. of children

Confusion about activities, tasks, letters, regions

Fluctuations of "The List"

High expectations from children

Changes in circumstances. tovs

External Factors

People

Missunderstanding of responsabilities

Inefficient communication with the elves

Overwhelming Pressure

Loss of focus

Inability to meet the project's deadline and deliver all Gifts on Christmas, which will make the children unhappy

Children stop believing in Santa

Cost of upgrading the workshop

Problems with the workshop's operations

Machine

E.   State clearly suggestions on how to improve Santa's Delivery Project and related benefits.

Outsourcing
Santa's elves are making all the toys in Santa's Workshop but maybe Outsourcing would be better and it will help them save time, effort and delegate the tasks more accurately.

Skillful Resource Management
Of course Santa has a lot of elves working with him, but this is still not enough to directly address the growing demand for toys on Christmas Eve, therefore he needs to be very smart in managing his talented resources. Especially there is a need to make sure that Santa is assigning the right task to the elves with the right skills, because in his position of having limited resource time and overwhelming pressure to meet the demand, the productivity of Santa's workshop becomes the deciding factor.

Custom Roles within each elf to easily distribute work, so every elf knows what to do and confusion is avoided. Santa could create tasks lists and assign them to individuals; For ex: one elf in charge of children's list, Another one managing toy making activities, A group of elves responsible for keeping Santa's secret village hidden from the outer world etc. By doing so, elves will concentrate on their list and will make sure that Christmas gift distribution will go smooth as planned.

By taking suggestions from his elves by creating a discussion topic, Santa will collaborate with them so everyone now could share their ideas on what they have in mind for Christmas. This would involve also planning the gift distribution, meaning spending more time on doing things than actually arranging meetings and discussing them. This would assure Santa's peace of mind that everyone is on the right track.

Schedule all the activities accordingly by using a Gantt Chart using a start and end date, so each elf has an idea about by which date they must finish their tasks, so they can easily adjust their speed for tasks in accordance with the deadlines. It will help Santa keep track on how many toys the workers completed and wrapped.

Implement a Customer Database Management for managing the "Naughty or Nice" List and adjust it according to the fluctuations, instead of building it from the scratch every year.

Motivate the elves: Milk and cookies for the cold season is definitely a good idea, but will not keep them motivated for a long time, so Elv of the month and some promotions are highly recommendable if Santa wants to have a happy team that spreads joy while working.

Last but not least, no project ever goes as according to the plan, that's why Santa Claus needs to learn to adapt and manage changes if needed.

In Conclusion, by delegating tasks, Santa would spend more time with Mrs Claus, and that's the ultimate goal of Christmas, spread happiness in the world and spend some quality time with our families.

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