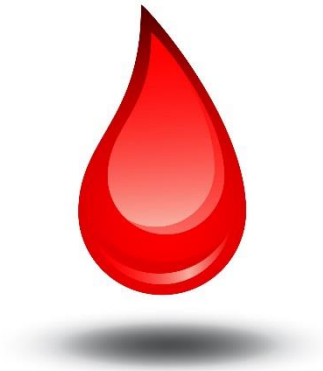




RIED-BOLTON Value Engineering Paper

**“BLOODY” FUNCTIONS
- Synthetic Blood is flowing**



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“BLOODY” FUNCTIONS-SYNTHETIC BLOOD IS FLOWING

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Anna Schandl became Associated Value Specialist (AVS) in April 2014, after she got acquainted with Value Methodology, during her B.Sc. years. She wrote her thesis about Japanese Cost Management System and compared it with VM. She is going to publish her study “*The QFD-TC (Quality Function Deployment – Target Costing) process – new Japanese “miracle” or re-make of Value Methodology*” in the Hungarian Value Analysis Review 2014. Miss Schandl is studying M.Sc. at Budapest University of Technology and Economics in the faculty of Finance and Accounting. In the near future, she wants to get Ph.D. degree and do further research related to Value Methodology.

In her free time she likes to experiment with flavor trends of foreign kitchen and practice the newest aerobic exercises.

INTRODUCTION

Have you ever heard about synthetic blood? Maybe the answer is **YES**, but I wasn't satisfied only hearing about it, I wanted to know more and get closer to this grandiose substance which **could save millions of lives**.

The reason why I chose this topic is not only due to the fact that it is a real opportunity, but synthetic blood is related to Hungary. According to a scientific article in Hungarian Minds¹, Dr. István Horváth, a biomedical scientist born in 1938, conducted further research beyond the original synthetic blood research in the USA. The difference lies in the fact that instead of other liposomes, the Red Blood Cells (hereinafter RBC) are encapsulated in cholesterol to make sure synthetic blood's effect is long-term since cholesterol cannot be degraded by any enzymes. Prof István Horváth extracted free oxygen-carrying molecules from the RBC of Hungarian Grey Cattle.

According to one of the articles of Index.hu which came out on 17th of October 2014², it is highly recommended at most Hungarian Hospitals to obtain blood from relatives before undergoing elective surgery. Delaying surgeries due to blood shortage is a very well known significant problem, not only in Hungary, but around the globe. Less volunteer blood donors and more transfusion dependence is a global issue **and thus synthetic blood could be a solution for patients needing urgent surgery**.

¹ <http://magyarelme.blogspot.hu/2012/04/szintetikus-ver-muver-horvat-istvan.html>

² http://index.hu/belfold/2014/10/17/mutetet_akar_elobb_intezzen_maganak_vert/

BACKGROUND INFORMATION - GOOD TO KNOW ABOUT SYNTHETIC BLOOD

Synthetic blood is not a new invention as it was developed by the Institute for Research and Development at The Pentagon department for wounded soldiers. Using synthetic blood for the human body is not legal at this time (except in the Republic of South Africa), but because licensing procedures are currently in progress, this gave me the reason to further investigate this real topic for a Value Engineering study. The benefit of synthetic blood is that it is a better oxygen-carrying transporter compared to human blood which is very important in preventing infection.

The purpose of my technical paper is to try and utilize the Value Methodology to draw attention to the most important functions of synthetic blood as well as minimize the potential risk factors.

FAST DIAGRAM

Function Analysis System Technique Diagram has two major types of diagrams; one is the technical and the other is the customer FAST Diagram. A Technical FAST diagram is usually used with products. The aim of a FAST Diagram is to visualize the interrelationship of functions. The hierarchy can be followed step by step by using “how” and “why” questions. You must also ensure the logic from the lower order function to the higher order function and in the other direction as well along the critical path. The lower order and the higher order functions define the scope of the project. Customer FAST Diagram are more common to be used in the service industries. It shows also the hierarchy of functions established between the higher order function and the lower order functions. As result you could see a “Function Family Tree” with 3, 4, or 5 vertical levels required to priority the functions based on customer demands.

CHOOSING THE RIGHT VALUE METHODOLOGY STUDY TEAM

My first job was to seek out the right cross-functional team to study this issue and ensure the team became knowledgeable with the current research in this area of synthetic blood. I decided to first select a current medical student from my university whom had more knowledge in this subject than I did as a Master of Science in Finance and Accounting student. In addition, I selected an experienced healthcare professional whom was well known in the community for her knowledge of synthetic blood and the benefit it could bring to the patients once approved by human beings. Finally, I selected another Associate Value Specialist from my university whom I knew understood the Value Methodology process.

The teamwork was really efficient, I am glad to cooperate with such a great team on the top line. Below is the final team whom studied this issue:

Technical Paper:	"Bloody" Functions - Synthetic blood is flowing
Name:	Anna Schandl
Age:	24

All team members information

	Names	Current certification status
1.	Anna Schandl (Team Leader)	AVS
2.	Róbert Tóth	AVS
3.	Mrs. Károly Schandl	(Healthcare Professional)
4.	Kinga Kecskés	(Medical Student)

Figure 1 - Value Methodology Team

The first step of our teamwork was to collect the customer requirements per the information phase described below, then develop major random functions of synthetic blood for organization into a technical FAST diagram. To get closer to our purpose we ranked the functions with a Paired Comparison Matrix and based on the hierarchy we established the final list with risk factors using a Combinex Matrix to understand which factors are the upmost important. During workshop we will not concentrate on trying to cost functions, because these elements are secondary when we call attention to the highly prioritized function that synthetic blood could SAVE LIFE. Focusing on reducing risk factors and satisfying customer preferences for synthetic blood could be really a huge project with critical importance in the 21 century.

WORKSHOP ACTIVITIES FOR SYNTHETIC BLOOD

Information phase: We collected most of all customer requirements as stakeholder demands. We then filtered the demands and developed them in terms of random functions, such as Minimizing Pain, Minimizing Side Effects, Save Human Life, Minimize Damage, Transport Oxygen, Transfer Carbon Dioxide, Transfer Decomposing Product, Maintain Cleanliness, and Prevent Infection.

Function Analysis phase: The main purpose of the FAST diagram is to present graphically the interrelationships of the required functions. To establish our technical FAST the team developed functions using an active verb followed by a measureable noun based on stakeholder demands as indicated in the information phase above. Next the team organized the random functions on the critical path from Highest Order to Lowest Order function to ensure the 'How – Why' logic was maintained going in both directions as indicated in red per **Figure 2** below.

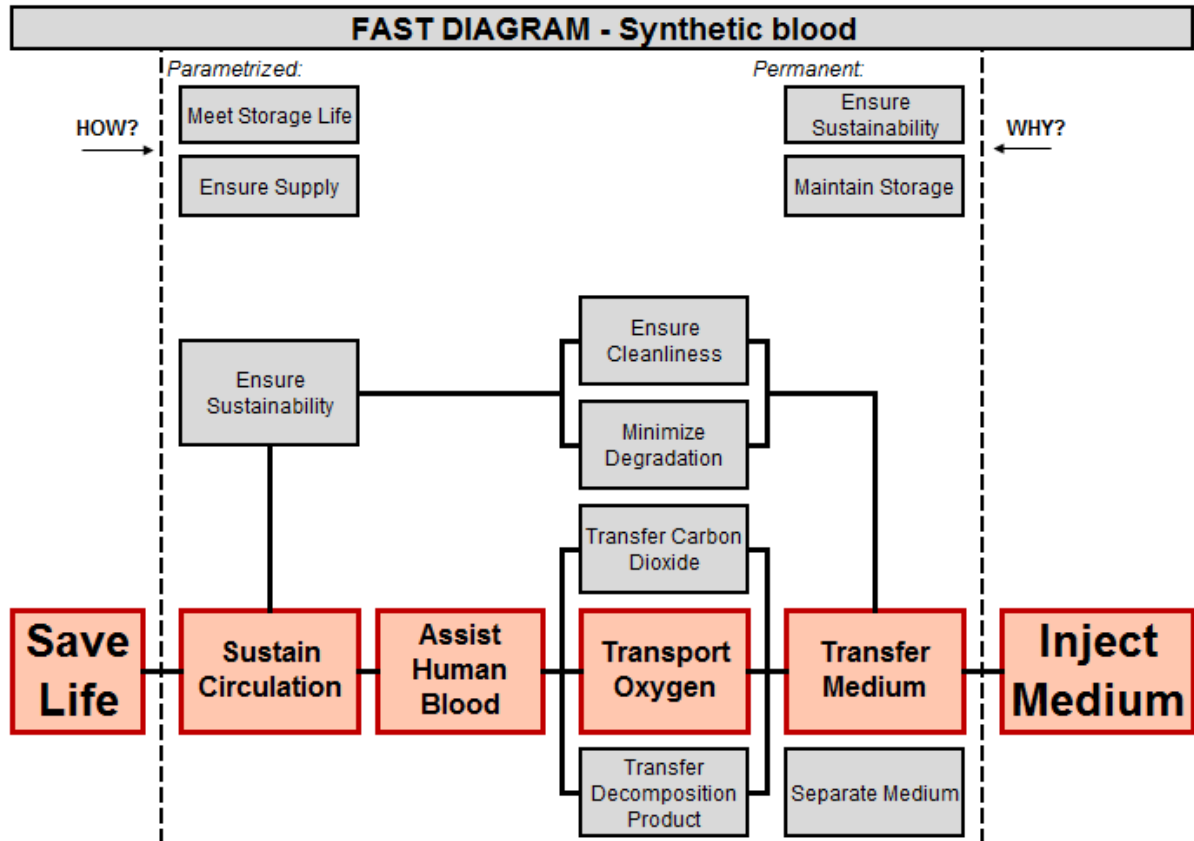


Figure 2 – F.A.S.T. Diagram

The critical path shown is what Dr. István Horváth discovered in his research, the ‘how’ and ‘why’ to encapsulate synthetic blood in cholesterol. Secondary functions answer the question why is it advantageous to lock the RBC in cholesterol instead of other liposomes. Following the critical path we can realize that synthetic blood has to “Assist Human Blood” – not to substitute, but assist it in order to “Sustain Circulation” and thus fulfill the Highest Order Function, “Save Life”.

On the upper right of the FAST Diagram, ‘All the Time’ customer requirements of “Ensure Storage” and ‘Ensure Compatibility’ are important functions under all circumstances. On the left above, the team developed some ‘Design Functions’ such as “Maintain Storage” and “Minimize Degradation” which may be cost drivers.

Creative and Evaluation Phase: In this phase of the Value Methodology, the team established the function priority using the Paired Comparison Matrix and settled the importance between two functions at the same time. As you can see in **Figure 3**, if there was no difference (considering the importance) among the paired functions, both functions would get a 0.5 point.

Function of Synthetic blood – Paired Comparison Matrix

Functions	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Sum	Total	%	Rank
1. Save Life	A	A/B	A/C	A/D	A	A	A	A	A	A	A	A	A	A	11,5	11,5	12,92	1
2. Sustain Circulation		B	B/C	B/D	B	B	B	B	B	B	B	B	B	B	11	11,5	12,92	1
3. Assist Human Blood			C	C/D	C	C	C	C	C/I	C	C	C/L	C	C	9,5	10,5	11,80	2
4. Transport Oxygen				D	D/E	D/F	D	D	D	D	D	D	D	D	9	10,5	11,80	2
5. Transfer Medium					E	E/F	E	E	E/I	E	E	E/L	E/M	E/N	6,5	7	7,87	4
6. Inject Medium						F	F	F	F	F	F	F	F	F	8	9	10,11	3
7. Transfer Carbon Dioxide							G	G/H	G	G	G/K	L	G	G	5	5	5,62	5
8. Transfer Decomposition Product								H	H	H	H/K	L	H	H	4,5	5	5,62	5
9. Separate Medium									I	J	I	I	I	I	4	5	5,62	5
10. Ensure Compatibility										J	J	J/L	J/M	J	3	4	4,49	6
11. Maintain Storage											K	K/L	M	N	0,5	1,5	1,69	10
12. Ensure Sustainability												L	L/M	L/N	1	3	3,37	8
13. Ensure Cleanliness													M	M	1	3,5	3,93	7
14. Minimize Degradation														N		2	2,25	9

A: More Important - 1 point
 A/B: Equal Important -
 0,5 point

100%

Figure 3 – Paired Comparison Matrix

As result, there wasn't a very clear picture about priority because many functions received the same percentage. The first five highest priority functions are "Save Life" (12.92 %), "Sustain Circulation" (12.92 %), "Complement Human Blood" (11.8 %), "Transport Oxygen" (11.8 %) and Lowest Order Function, "Inject Medium" (10,11 %). Other functions received less than 8 % rating, thus quite far behind the 5 most important functions. I would like to draw attention to the issue that this hierarchy is from the customer perspective, thus we should calculate other factors (risk, cost, access) to analyze further.

Development Phase: We started development by considering only a short list of ideas (functions above 4 %) and in order to focus on which functions we have to improve and ways to improve them. We came to the conclusion that eliminating the risk of synthetic blood is crucial. The team brainstormed the risk factors of using synthetic blood. We took into account not only the risk of the finished product but the risk of preparation. The team brainstormed four (plus one) risk factors and weighted them as follows: **risk of infection (18 %), risk of rejecting (41 %), risk of intervention (26 %) and risk the synthetic blood doesn't complement with human blood (10 %)**. An additional risk factor (weighted of 5 %) was established to collect any other risk factors not previously thought about. To determine the weighted percentage, each team member estimated the risk for every factor and then a mathematical average was calculated and geared to 100 % with respect to proportionality. The next step is to assign points for all

functions above 4 % considering the importance based on the Paired Comparison Matrix to set the final hierarchy in Figure 4.

Combined Risk Matrix							
Risk Factor:	Risk of infection	Risk of rejecting	Risk of Intervention	Not match with human blood	Others		
Risk Factor (%):	0,18	0,41	0,26	0,10	0,05	1	
Function:						SUM	Rank
Save Life	80 14,4	90 36,9	90 23,4	80 8	60 3	85,7	1.
Sustain Circulation	80 14,4	70 28,7	90 23,4	90 9	60 3	78,5	3.
Assist Human Blood	85 15,3	85 34,85	90 23,4	90 9	60 3	85,55	2.
Transport Oxygen	80 14,4	70 28,7	85 22,1	90 9	60 3	77,2	4.
Transfer Medium	75 13,5	80 32,8	80 20,8	65 6,5	60 3	76,6	6.
Inject Medium	90 16,2	60 24,6	80 20,8	75 7,5	60 3	72,1	8.
Transfer Carbon Dioxide	70 12,6	65 26,65	75 19,5	80 8	60 3	69,75	10.
Transfer Decomposition Product	75 13,5	65 26,65	75 19,5	75 7,5	60 3	70,15	9.
Separate Medium	80 14,4	65 26,65	85 22,1	75 7,5	60 3	73,65	7.
Ensure Compatibility	70 12,6	90 36,9	60 15,6	90 9	60 3	77,1	5.

Figure 4 – Combined Risk Matrix

In my mind, the Combined Risk Matrix is the best way to obtain a precise value. The team **agreed to use between 60 and 90 points for each function** based on the risk factors. After that, **every value was multiplied by the weight of the risk factors to get a final value what represent the hierarchy of functions weighted elements of risk**. We should sum up horizontal these final values to get final rank of functions. It's succeeded to set a percentage to the first ten ideas without equality. Final values are vary from 69.75 % up to 85.7 %. As you can see the “Assist Human Blood” function received higher priority than “Sustain Circulation” which means assisting human blood (85.55 %) is almost as important as the “Save Life” function (85.7 %). As for the manufacturers of the biological active substance, they have to pay the most attention on how synthetic blood should be harmonized with human blood to reduce any of risk factors. It is also good to take notice that the function “Ensure Compatibility” only received a 4.49 %

ranking from the customer point of view but according to Combined Risk Matrix, it is in the 5th place at 77.1 %, which almost equals the function “Transport Oxygen” at 77.2 %. This indicates the particular risks in implementing this function of “Ensure Compatibility”. This surprised the team but ensured the team that using the Value Methodology with functions was helpful in coming to this conclusion.

FURTHER ANALYSIS

For further analysis with more expert Value Methodology research, the team should take into account the cost factors or the access of functions, but at this point of research we set the priority functions of synthetic blood in consideration of risk factors. In the next step, we should be having a brainstorm on how to reduce the elements’ risk to fulfil any of customer demands for all it is worth. However, this might be a topic for another technical paper with a new research team.

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