SERAPHYM

ALL TERRAIN EMERGENCY SERVICE VEHICLE FOR HARSH WINTER CONDITIONS

by

RJ PICCIONI

Submitted in partial fulfillment of the requirements for the degree of

Bachelor of Industrial Design

Faculty of Applied Sciences &Technology
Humber Institute of Technology and Advanced Learning Supervisors: Catherine

Chong and Sandro Zaccolo

Consent for Publication in the Humber Digital Library (Open Access)

Consent for Publication: Add a (X) mark in one of the columns for each activity

Activity		Yes	No
Publication	I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public	☒	☐
Review	I give consent for review by the Professor	☒	☐

Student Signature

SUSTAINABLE AL EMERGENCY SERVICE VEHICLE FOR HARSH WINTER CONDITIONS

RJ PICCIONI

Bachelor of Industrial Design

Faculty of Applied Sciences &Technology
Humber Institute of Technology and Advanced Learning

2021

Abstract

Harsh winter climates provide a difficult environment for first responders to work efficiently. Places in the Nordic environment have access to emergency care and services but those products and vehicles are inefficiently equipped to deal with the harsh climate. One of the biggest obstacles first responders face is the roads that are unforgiving to current vehicles. There are a great number of deaths per year due to winter roads being in an undrivable state. How can the product design industry mitigate these fatal injuries as well as save lives with new and improved innovations to our EMS workers? Current EMS workers who work in the industry will have provided feedback in this study, pertaining to what they think their equipment currently lacks, User observation is documented, and how well their current products work and what challenges they face every day. This thesis provides an in-depth study of conditioning factors that make up the products used in rescues today for paramedic and other first responder occupations that live in harsh winter climates. Data collection is used to provide information on the number of injuries related to harsh winter climate conditions such as, harsh roads, fires, lack of time. Rural areas that are located in northern more secluded parts of the world will undergo study as to why they are in need of more support. Data collection on where in Nordic environments are there an increase or a decline, proportionately, to the population. As well as how many successful versus unsuccessful operations are listed. Why do current solutions not work? What are the current setbacks that the

product industry faces to help? Ergonomic detail will be provided in a full body interaction display, and a solution can be made to provide successful operations within the EMS work force in the harsh winter climates.

Acknowledgements

I'd like to acknowledge Zack Cattapan and anonymous advisor for agreeing to help me with my research, Thank you

I'd like to acknowledge Stephen for his 3D printing services, Thank you

I'd like to acknowledge my classmates, for the advice, Thank you

I'd like to acknowledge Sandro and Catherine for guiding us through this process, Thank you.

I'd like to thank the class of 2021 for motivating me to be better every year, Thank you.

Contents

«

Figure 1 Figure 1.1 Retrieved from https://www.google.ca/url?sa=i&url=https%3A%2F%2Fsnowbrains.com%2Fwhat-is-ablizzard%2F&psig=AOvVaw1D7QktKJ5KcA7K0l5HsK2W&ust=1607479213301000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCIi5gOkve0CFQAAAAAdAAAAABAD

CHAPTER 1: PROBLEM DEFINITION

The purpose of the problem definition is to find underlying issues in the current ecosystem that are the experiences of first responders who work under the unkind winter conditions of the northern hemisphere. There is a difference nuance and accessibility to patients who inhabit homes just outside the outskirts of cities in rural areas that need emergency services just as much as the inner cities. Defining that problem and understanding the context of what the issues are is the main goal of the problem definition development.

How may we help first responders work more efficiently in harsh winter conditions?

1.1 Problem Definition »

The problem definition is understanding the current development of level of care in rural areas under harsh winter climate, and finding a way to combat their unforgiving climate. There are approximate 156,000 car accidents annually due to icy roads, more than 1,300 suffer fatalities and another 116,000 injured. Rural areas are affected more than urban areas proportionately due to their isolation. It is paramount they receive the same level of care due to the higher potential of inefficient rescue. Current EM<S vehicles are designed for inner cities and do not function to the same level of expertise as they do more north and more secluded. This thesis report will examine how EMS workers facilitate their job and interact with the current climate that is heavily occupied in

frozen precipitation. The research and content listed will aim to blossom a design that can combat this unforgiving reality with better efficiency, it is essential to make the product sustainable and it is paramount to make the solution ergonomic.

1.2 Rationale and Significance

This thesis report will consist of data that empathizes with working paramedics to understand their trials and tribulations and as well as concerns for their current equipment. Obtaining data from them will be crucial in developing a product that blends well in their product ecosystem and becomes intuitive to their work flow. The aim of these research questions is to develop an understanding of the struggle paramedics have in the winter environment but in cohesiveness with their products and own personal workflow. Reducing injury as well as increasing work efficiency and equipment sustainability is the goal. A research plan was put into full affect. The purpose of this research plan is to provide a formal schedule regarding the contact of research advisors for this thesis topic about helping first responders in harsh winter conditions. It is possible that although these issues may coincide with paramedics' experiences in urban areas, focusing on rural areas and paramedic experts who work in rural areas will be the focus for the study. The goal is to interview experts from paramedics and their experiences working in the field with their current equipment. This document will be used to summarize and explain resources such as, online resources, expert contacts, paramedic departments as well as forum groups and paramedic academics. The main influence to be drawn out of these professionals is the improvement product design can make on their current experiences in the industry, dissect the main issues they face, then find a solution.

1.2.2 Research Plan

Research elements:

Time: Time required to interview contacts as well as to make the product. Before the model can undergo construction, concept developing as well as design advising and principle matching need to be considered with the advisor's reassurance.

Equipment: The amount of equipment used every day by the paramedics undergo wear and tear. It is possible their equipment needs improvements in design or they are lacking a design which can cover two objectives at once.

Victims: Victims play a key role in the paramedic's daily work life. There may be a product, problem, and or solution revolving around the existence of a victim that paramedics can save. How can we mitigate the severity of danger that victims encounter daily?

Pricing and material: The price of the current products used. The material of the products being used is also important due to people's health and possible medical conditions revolving around certain material. Allergic reactions can occur.

1.2.3 Research Sources and Methods

- Humber Library Services
- Google Scholar
- Surveillance Videos
- Observation of Paramedic Operations
- Survey Questions Distributed
- Contact Interviews to undergo experience study for further improvements to be made on current equipment.

- Online Forum Groups
- Personal Relationships with Paramedics - Networking within the paramedic industry - Paramedic Departments.

1.2.4 Interview/Survey Based Questions

1. What are the steps in becoming a Paramedic?
2. What is the standard equipment you use everyday?
3. What would you say is the biggest struggle paramedics face in the cold environment?
4. Do you think Paramedics need an equipment upgrade or a more mentality upgrade or do you think the industry is overall in a good place when it comes to efficiency?
5. Where do you think efficiency could be improved in the occupation or industry?
6. What are the more typical injuries people face on the job?
7. What are the more typical injuries paramedics face on the job?
8. What are the main issues when dealing with incidents in a harsh winter environment?
9. What incidents do you feel could've been handled better had there been a product made for that specific situation?
10. Which equipment items do you wish worked a little more efficient?
11. What is your opinion on the current vehicles used for paramedical services?
12. Have you ever had equipment malfunction or break during a time of need? Which was it?
13. What is a piece of equipment you couldn't operate without?
14. What is one weather condition you never operate on and why?
15. Which piece of equipment is the hardest for clients to use?

1.2.5 Advisor Initiative

Contacts	Job Description
Zack C.	Paramedic In Toronto
Erika D.	Paramedic Northern Canada
Ottawa Paramedic Services	Paramedic Department
Online Paramedic Survey	Paramedic forum groups

1.2.6 Videos

Title	URL
Here's how paramedics prepare for winter	https://www.youtube.com/watch?v=6mKUDqPZUlQ&ab_channel=41ActionNews
Need for EMTs increase during winter	https://www.youtube.com/watch?v=8XuOunhu81g&ab_channel=41ActionNews
Ada County Paramedics See increase in 9-1-1 calls this winter	https://www.youtube.com/watch?v=HVp6tTpCKII&ab_channel=IdahoNews6

Special Report: Paramedics fear for patients as NHS "struggles" with winter demand	**https://www.youtube.com/watch?v=EADwtOuQuc&ab_channel=SkyNews**

1.2.7 Schedule

Task	**Date To be Completed**
Interview Zack	**October 4th + October 22nd**
Interview Erika	**October 22nd**
Interview Sean	**October 22nd**
Ottawa Paramedic Services	**October 29th**
Online Form Survey	**Survey to end for results before November 2nd**

1.2.8 Survey Intro

Hello,

My name is RJ Piccioni and I am a student at Humber College studying product and automotive design, I'm in my 4th year and am currently doing my thesis on paramedics working in harsh winter conditions. I would like to learn more about the trials and tribulations of the work being done in the paramedic industry. My goal is to research this in depth, and to come up with a solution to reoccurring problems that paramedics face so I can help mitigate these issues, and bring a more positive outcome to those issues that may or not be volatile. My aim is to find a solution that can help the people who save lives, continue to save them, and hopefully add more efficiency to the paramedic services as well as help the victims of those unfortunate events. If there is someone you know who can guide me

down the right path of designing such product, please, I would like to speak with them to learn more about this endeavor. Have you a moment of your time, I have a survey that may also help me find a solution to these conditions posted below.

Thank you,

RJ PICCIONI

In order for this assessment to be properly conducted, enough surveys need to be answered. If they aren't an in-depth interview with paramedics who work in harsh winter conditions needs to be committed. Interpersonal interviews with the contacts listed above will put the design on a path to success. The main focus is on the paramedics listed above who have experience working in harsh winter conditions, rural area as well as urban areas. The most challenging part about this topic is to come to a consensus on which is the most ideals problem that can be addressed using product design. Fortunately, networking leads into other networking opportunities, Paramedical services in Canada will be a great asset to this topic, as one can study firsthand experience, and possibly obtain videos that may or not be

1.3 Background / History / Social Context

Emergency service workers are an essential part of our functioning society. Presently there is a lack of efficient tools to combat the worlds cold climate in the EMS industry. This can put many lives at risk. Not only the patients but the paramedics serving us as well. There is a current concern regarding the lack of a suitable vehicle for the harsh winter conditions in the EMS industry. This can put a burden on the product industry to provide a service to society in properly equipping EMS workers with the tools they need to conquer every call. Challenges exist within the timeframe of production. Ergonomics of products meant for use and for patients to use need to be made for the majority but also function on a singular basis. There are disasters in the north and the winter conditions make it harder for EMS workers to obtain favorable time. There are fires, crashes, And other injuries that maty even require helicopter landings. Between 2013-2017, U.S. fire departments responded to an average 160 home fires that started with Christmas trees per year. These fires caused an average of three deaths, 15 injuries, and $10 million in direct property damage annually. Current trends involve stretchers that are able to load and unload

passengers automatically which takes astrain off the paramedics back. Current stair chairs also only incorporate one passenger. Current stretchers have been designed relatively the same for decades. There can be a massive improvement to the efficiency of the vehicles EMS workers use to better suit their needs in travel time.

Figure 2.1 Retrieved from https://www.google.ca/url?sa=i&url=https%3A%2F%2Fwww.bas.ac.uk%2Fmediapost%2F115024%2F&psig=AOvVaw1G2Fi2XYgfDEGwK2uuV0hn&ust=1607480245618000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCJDJ8Nyove0CFQAAAAAdAAAAABAQ

CHAPTER 2: RESEARCH

2.1.1 User Profile – Persona and Demographics Primary

EMS services in Cold winter climate. (Primary) age 20-45

They are equipped with traditional vehicles and equipment that work proficiently in environments without heavy winter climate.

Medical personnel in Arctic and Antarctic facilities (Secondary)

The peak of the globe on either side are far away from most civilization, having an EMS product could help save lives that in other cases wouldn't be saved.

Rescue services in heavy rocky terrain (Tertiary)

-An all-terrain product or vehicle will benefit rescue missions in not only winter areas but also desert or rocky areas

Persona

Name: Zach Sedona

Age: 37

Occupation: Paramedic

Income: $100,000 CAD/Annual Salary

Education: Bachelor's Degree – Paramedical Studies

Relationship Status: Single

Location: Toronto, Ontario

Career/ Volunteer: Career

Years of Service: 8

Social: Paramedic Squad daily interaction Frequency

of Activity:

Hobbies: Volleyball, Strength Training,

Profile: Zach Sedona is a 32-year-old Caucasian male He attended College to obtain his Bachelors Degree in Paramedical Studies He earns a yearly of $100,000 and has been working as a Paramedic for 8 years. Zach went straight into the work force shortly after he graduated.

User Behavior: At approximately 21 calls a week Zach is very active, and needs to be on high alert for a majority of the time he is working. This can be very strenuous on the mind and body. Zach is a great team motivator which is important for a team morale to maintain height in unfortunate situations.

He happily serves his community well with his head held high

Zach's relationship to his PPE: In a medical profession your PPE is everything. When paramedics undergo training, they have to be familiar with all of they're equipment so they know which item to equip for a task at any time. He needs to be able to recognize which equipment is used in certain situations.

Paramedics can be put under a lot of stress in their job considering the amount of lives that are on the line at every operation in their career. The work of a paramedic is paramount for communities of all sizes. In order to perform their duties properly they need to be equipped with the tools necessary for any bout they encounter with aftmost safety. There is a number that would be better of diminished to provide accurate description on lives lost of both the paramedics and the patients they save each year. For a deeper understanding about the people who work in this profession this report consists of a user profile of an average paramedic. The three main users for a paramedic int his scenario are the paramedics themselves, the victims and other medical personnel on board. An image search will be used to research in formation on the users and their appearances. Data collection and other literary searches will undergo investigation to better understand current demographics.

User Demographics

Age, gender, ethnicity, income and level of education as well as class are measuring factors when targeting the demographics of these paramedics.

Image search for General Demographic Characteristics.

1. Paramedic
2. Paramedic Squads
3. Paramedic Department
4. Volunteer Paramedic
5. Paramedic Rescue Squad

IMAGE	**DEMOGRAPHIC INFORMATION**
 *Figure 1: Oneida Nation Paramedic Services. Retrieved from. https://oneida.on.ca/oneida-nation-paramedic-services-2/*	Age: 21-45 Gender: mixed, predominantly male Culture: MIxed Income: uncertain Educational background: College Career/ Volunteer: Mixed

 Figure2: Universite de Montreal paramedic advanced care academics. Retreived from https://www.cbc.ca/news/canada/montreal/advancedcare-paramedics-1.4707820	Age: 21-30 Gender: mixed, predominantly male Culture: White Income: uncertain Educational background: College Career/ Volunteer: Career
 **Figure 3: Norfolk County Paramedic Services members Sarah Page (Chief), Nick Wheeler, Cassie Barrett, Josh Breedyk, Chris Takacs and Randy Godelie (Commander).**	Age: 28-45 Gender: mixed, predominantly male Culture: White Income: uncertain Educational background: College Career/ Volunteer: Career

Literature Search for Demographic Data

A literature search contained within the resources of the Humber Library was used to find statistical data regarding relevant paramedical teams and occupations. The following items were searched:

1. Paramedic Data
2. Paramedic Survey
3. Paramedic Statistic Canada
4. Gender Data on Canadian Paramedics
5. Paramedical Averages in Canada
6. What are the gender differences of Paramedics?

Findings: TO summarize some of the income changes as well as the gender ratios within the industry, Graphs and other sources of percentages are shown to depict the ratios of gender differences as well as how paramedics climb the economic ladder.

Income: The salary range in Canada for Paramedics averages around $95,000 with the low end being approximately $50,700 and the highest being $146,000

Figure 4: Salary Distribution, http://www.salaryexplorer.com/salarysurvey.php?loc=38&loctype=1&job=964&jobtype=3

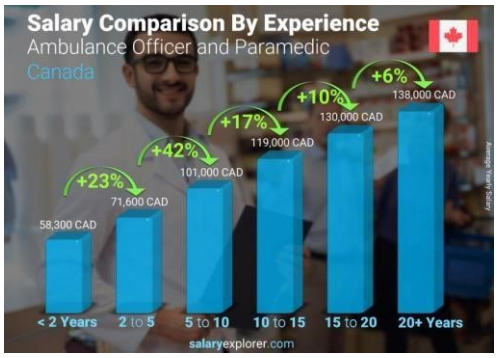


Figure 5: Salary Compensation by experience chart retrieved from

http://www.salaryexplorer.com/salarysurvey.php?loc=38&loctype=1&job=964&jobtype=3

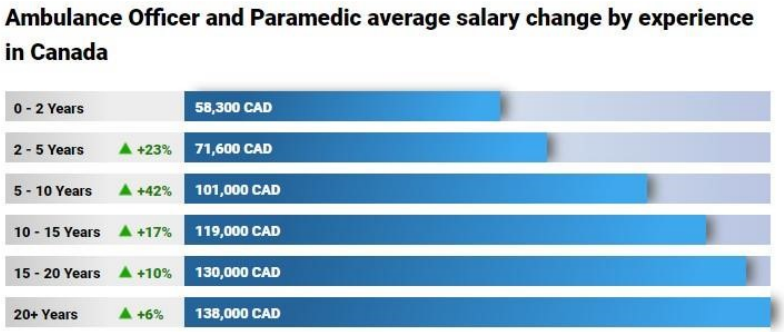


Figure 6: Ambulance Officer and Paramedic Average Salary Change by Experience In Canada

http://www.salaryexplorer.com/salarysurvey.php?loc=38&loctype=1&job=964&jobtype=3

Education:

Figure 7. Ambulance Officers and Paramedic Average Salary Difference by Education Level in Canada

http://www.salaryexplorer.com/salary-survey.php?loc=38&loctype=1&job=964&jobtype=3

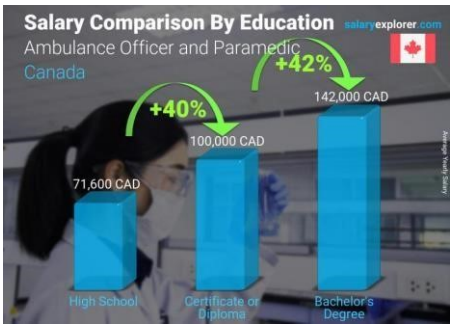


Figure 8 Shttp://www.salaryexplorer.com/salary-survey.php?loc=38&loctype=1&job=964&jobtype=3

Gender:

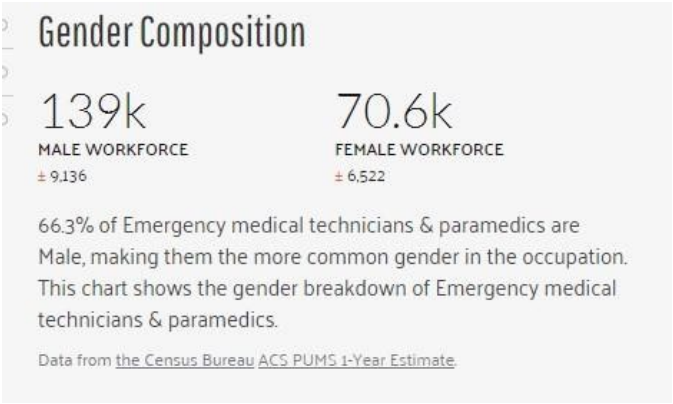
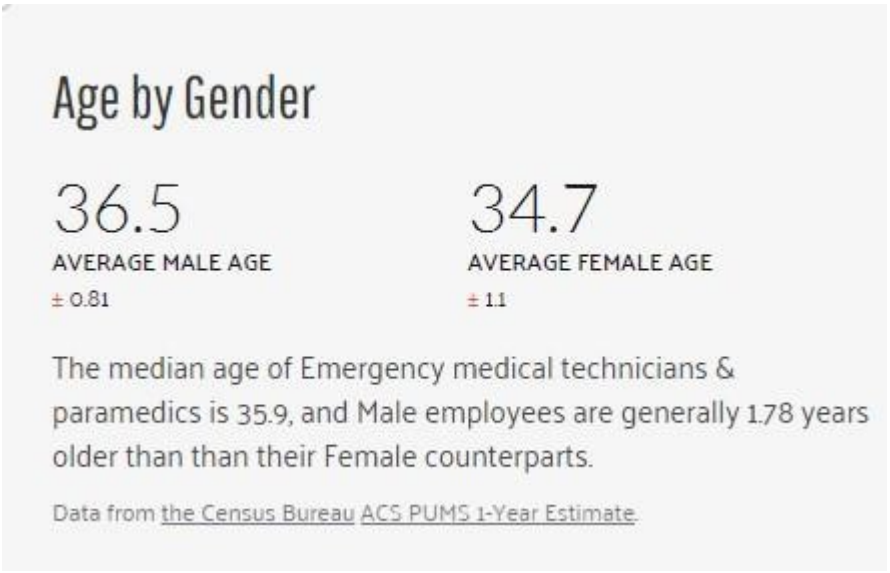


Figure 9: In the US there are 2 Male for every 1 Female Paramedics. https://datausa.io/profile/soc/emergency-medicaltechniciansparamedics#:~:text=Gender%20Composition&text=66.3%25%20of%20Emergency%20medical%20technicians,common %20 gender%20in%20the%20occupation.

Age: In Canada, you must be at least 18 years of Age to be a paramedic However the distribution of age by gender in the US consists of 2:1 in favor of Males



.Figure 10: Average Age of American Paramedics separated by Gender [https://datausa.io/profile/soc/emergency-medicaltechniciansparamedics#:~:text=Gender%20Composition&text=66.3%25%20of%20Emergency%20medical%20technicians,common %20 gender%20in%20the%20occupation](https://datausa.io/profile/soc/emergency-medicaltechniciansparamedics#:~:text=Gender%20Composition&text=66.3%25%20of%20Emergency%20medical%20technicians,common%20gender%20in%20the%20occupation)

Race and Ethnicity:

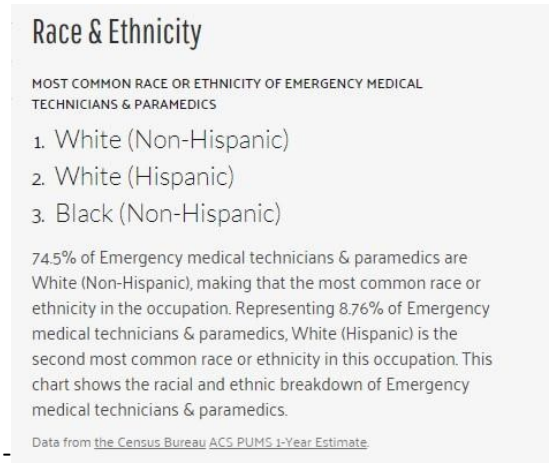


Figure 11.

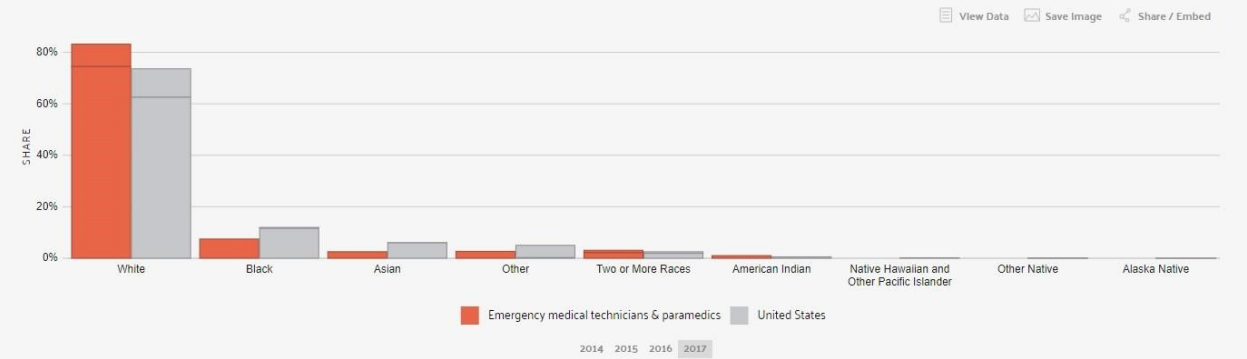


Figure 12:

Discussion / Conclusion:

Closely related to the median are two values: the 25th and the 75th percentiles. Reading from the salary distribution diagram, 25% of Ambulance Officer and Paramedics are earning less than 63,300 CAD while 75% of them are earning more than 63,300 CAD. Also, from the diagram, 75% of Ambulance Officer and Paramedics are earning less than 111,000 CAD while 25% are earning more than 111,000 CAD The overall Ethnicity is approximately white but it is still interracial. In the US it is less interracial. There is a noticeable increase in pay within increase of education. In Canada it appears to be a much more welcoming experience outside of high school to try and compete for a position within the paramedical industry based on age and numbers.

Demographics of Paramedic

Age	18-45
Gender	2:1 Male – Female Ratio in the United States
Ethnicity	Americans: White Canadians: Multi cultural
Income	50,000-145000 CAD
Education	In Canada, Highschool, Diploma, Bachelor's Degree and PHD

Primary User: Paramedic

Secondary User: Victim of endangerment

Tertiary User: Other medical crew and personnel

User Behavior

A literature search was initiated to monitor the usage behaviour of paramedics and how they operate. Google searching and the Humber Library were resources used to properly obtain user behavioural data. Some of these searches included:

1. Paramedic Daily Shifts
2. Paramedic Yearly Report
3. Paramedic Operational Statistics
4. Paramedic Locations
5. Physical Condition of Paramedics

Activity Frequency

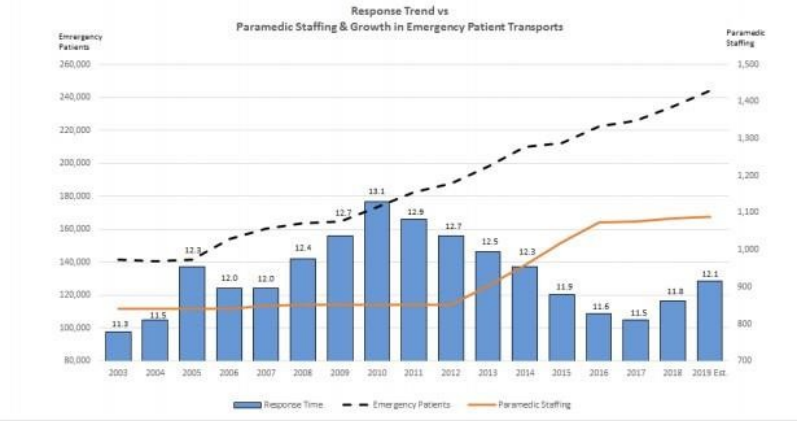


Figure 13: retrieved from https://www.toronto.ca/legdocs/mmis/2019/ec/bgrd/backgroundfile-133014.pdf

Due to new resources not being added in 2016 and onward, response time has deteriorated and is expected to continue falling as demand for the service is going to continue to increae

Table 2

Factors Impacting Time-on-Task				
	En Route to Call	**At Scene of Call**	**En Route to Hospital**	**In-hospital**
Year-to-Year Changes in Time-on-Task (90th Percentile, in minutes)				
2011	13.40	23.53	17.08	69.63
2012	13.22	23.90	15.88	72.53
2013	13.50	25.00	17.13	71.72
2014	15.63	31.52	22.27	93.92
2015	15.13	31.83	21.80	90.32
2016	14.90	31.83	21.63	89.60
2017	14.77	31.83	22.07	87.27
2018	15.95	31.80	21.98	88.10
2011 - 2018	**19% increase**	**35% increase**	**28% increase**	**26% increase**

Figure 14 (Retrieved from https://www.toronto.ca/legdocs/mmis/2019/ec/bgrd/backgroundfile-133014.pdf) shows the different factors that impact each segment of an ambulance call and the changes from 2011 to 2018 that have contributed to an overall increase in time-on-task of 37%

4%

age

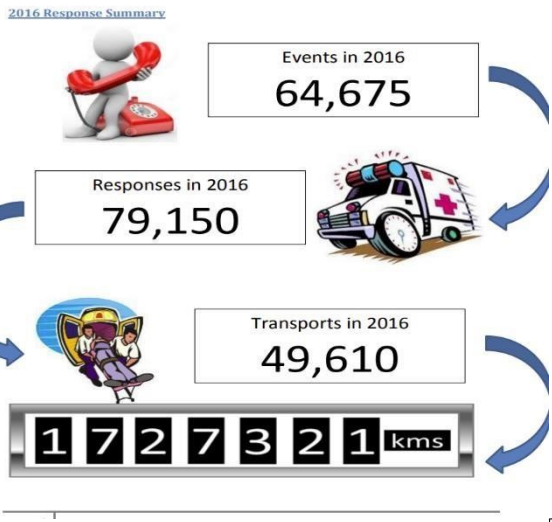


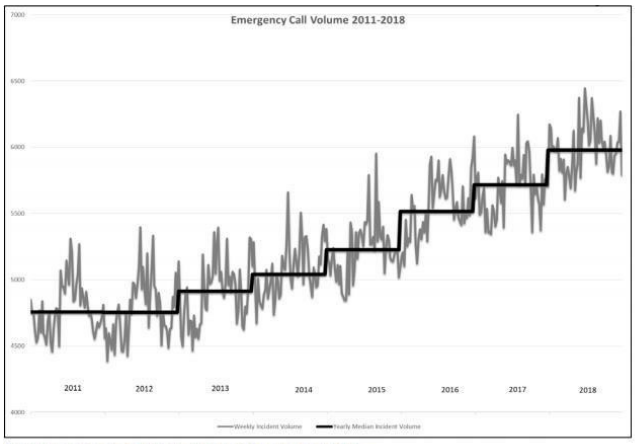
Figure 15 Hamilton Ontario 2016 Events for Paramedic Occupations

https://pubhamilton.escribemeetings.com/filestream.ashx?DocumentId=125527

Figure 16: Retrieved from

https://www.toronto.ca/legdocs/mmis/2019/ec/bgrd/backgroundfile-133014.pdf

Indicates the demand for EMS services in Toronto, ON. The average growth of calls has been increasing by annually. Data is showing that after the of 55 paramedical use has increased exponentially.



DRIVERS OF EMERGENCY CALL DEMAND

*

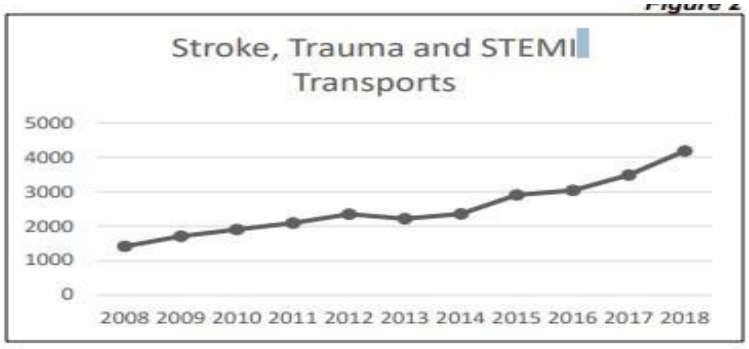


Figure 16. Stroke Trauma and Stem Transports [image] (2019)Retrieved from https://www.toronto.ca/legdocs/mmis/2019/ec/bgrd/backgroundfile-133014.pdf

Shows that there is a greater need for specialized caree and that stroke trauma had an increase of

17% in 2018 and with the rising population, these services were expected to treat 11% of city's population by 2019.

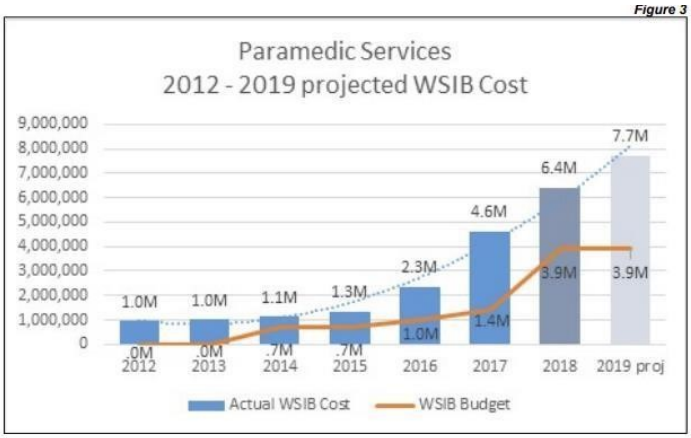


Figure 17 Paramedic Services 2012-2019 projected WSIB Cost [image] (2019) retrieved from:

https://www.toronto.ca/legdocs/mmis/2019/ec/bgrd/backgroundfile-133014.pdf

Work Related Injuries projections and costs for paramedical WSIB increasing from 2012-2019

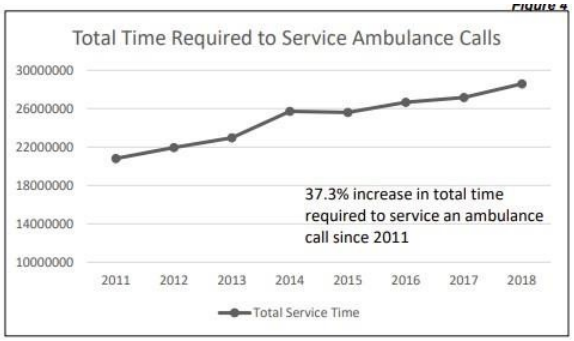


Figure 18 Total Time Required to Service Ambulance Calls [image] (2019) Retrieved from

https://www.toronto.ca/legdocs/mmis/2019/ec/bgrd/backgroundfile-133014.pdf

Over the last 7 years, improvement in operations has made course, so that paramedics can imitate their optimal care at an efficient rate as the years pass.

Table 2

Factors Impacting Time-on-Task				
	En Route to Call	At Scene of Call	En Route to Hospital	In-hospital
Year-to-Year Changes in Time-on-Task (90th Percentile, in minutes)				
2011	13.40	23.53	17.08	69.63
2012	13.22	23.90	15.88	72.53
2013	13.50	25.00	17.13	71.72
2014	15.63	31.52	22.27	93.92
2015	15.13	31.83	21.80	90.32
2016	14.90	31.83	21.63	89.60
2017	14.77	31.83	22.07	87.27
2018	15.95	31.80	21.98	88.10
2011 - 2018	**19% increase**	**35% increase**	**28% increase**	**26% increase**

Figure 19 Factors impacting Time-On-Task [image] (2019) Retrieved from https://www.toronto.ca/legdocs/mmis/2019/ec/bgrd/backgroundfile-133014.pdf

Social:

In order for operations to conduct smoothly, paramedics need to be able to cooperate in a team environment. There is no paramedic who engages everyday operations without their team. Especially with the increase of times on their operations, they cannot afford to be slowing down due to selfish performance gripes. “With demand for services increasing, there has been a notable role shift towards non-urgent care and a need for enhanced clinical decision-making and critical thinking on the part of paramedics” (Johnston, 02, 2016) Tania M Johnston explains how sociological tendencies happen and are applied into the work force of paramedics depending on all of their data being increased or decreased as shown above. This last quote indicates that due to a response and demand time increasing, in order to compensate for these paramedics are taking on a more critical role. This refers back to the essence of team work where being critical in a timely manner while being under a lot of stress is important. Sometimes one may not be able to think straight. Which is where the more critical thinking role part of the team would arrive into the coordination.

Lifestyle & Personality:

Paramedics have to remain a certain level of physical condition to work actively on duty. A

moderate level of physical training is required in Canada to obtain titles regarding the occupation. It is likely those who are in the industry also have active hobbies outside of the workforce.

Income Level: In Canada the average Paramedic makes $90,000 CAD annually with the low end being around $50,000 and the higher end being $146,000

Location:

Paramedics are located in every major city across the country. Sme provinces have different provincial laws that allow them to work outside of Canada or outside their current province.

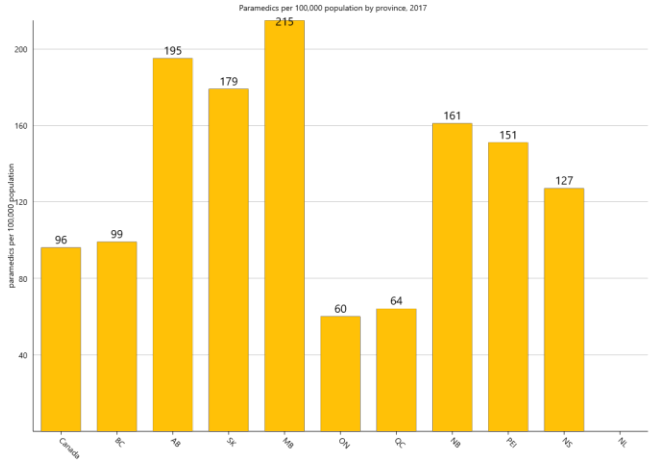


Figure 20. Paramedics per 100,000 population by province 2017 retrieved from https://www.linkedin.com/pulse/how-manyparamedicscharlene-vacon-ph-d-pcp [image] (2019)

Conclusions:

Paramedics are a very fluid professional group of people. Their readiness to be on high alert year-round is astonishing. As well as recruiting new and improved minds to bring forth more volume to the industry will further the growth of the efficiency of the occupation.

Demographics		User Behaviour		Personality		Cognitive Aspects	
Age	18-45	**Frequency of Use**	On Call 20 times a month	**Locus of Control**	+	**Technical Skill**	+
Gender	1:1 Male-Female	**Duration**	30 min-12 hours	**Self Efficiency**	+	**Prerequisite Knowledge**	+
Ethnicity	Mostly White, Canadians are interracial	**Social**	High-Social	**Changeability**	+		
Income	Middle Class	**Level of Focus**	Intense	**Uncertainty Avoidance**	-		
Education	Highschool Diploma, Bachelors Degree, Masters Degree PHD	**Location**	Residential Urban and Rural				

User Interviews:

User Interview Survey Questions

1. **What are the steps in becoming a Paramedic?**

To become a paramedic one has to go to college and enrol in a paramedic program. If you have previous healthcare experience or have had previously educated in health and sciences, you have hgher chance of being accepted into the program. Majority of the programs are 2 years long. Courses include Med math, Paramedic theory inclass and inlab, fitness, pharmacology, biology, pathology.

After graduating paramedic school you have to get your certification as a paramedic for Ontario, this is called the Advance Emergency Medical Care Assistant (AEMCA) certification. The test consists of scenario based multiple choice questions that are based on controlled acts and standards that paramedics across Ontario go by.

Once one has an AEMCA certification you can start applying for jobs. Most job-hiring test consists of written testing, interview testing, scenario testing, and driving testing. Once one is hired with a service, one has to get testing and certified by that services base hospital. A base hospital is the what gives permission for paramedics to do the controlled acts .

2. What is the standard equipment you use everyday?

With my service we use pagers, radios, electric stretcher, LifePak (LP)15[cardiac monitor], suction, oxygen tanks, response bag, stair chair, #9 stretcher, blankets, sheets, and pizza blankets.

3. What would you say is the biggest struggle paramedics face in a colder environment?

I believe that the biggest struggle that paramedics face in a colder environment would be extrication of the patient and heat management.

4. In terms of efficiency, do you feel the industry needs an equipment upgrade, or an upgrade in another area particularly?

I do believe that the industry needs an equipment upgrade in many places to make pt care as efficient as possible. It if the little things that would make a world of a difference,

5. Where do you think efficiency could be improved in the occupation or industry?

Efficiency could be improved response times to calls and response time for back up crews.

6. What are the more typical injuries people face on the job?

Back injury, shoulder injury, knee injury, and mental injury

7. What are the more typical injuries paramedics face on the job? What about victims?

Back injuries, shoulder injury, knee, wrist, neck, ankle, mental injury

8. What are the main issues when dealing with incidents in a harsh winter environment?

Accessibility to the pt, visibility, warmth of the pt, equipment being able to function properly. An example of this would be like a stretcher wheeling digging into the snow, stair chairing and a foot falling into the snow, brings up increase chances of dropping a pt, snow drifts and bringing pt out onto the road where equipment is left due to accessibility issues.

9. What incidents do you feel could've been handled better had there been a product made for that specific situation?

If there was a product that was like a sled type device that was like a scoop or a spinal board that was collapsible and would allow the crew to be able to slide the pt ontop of snow to make it to the stretcher. I believe a device like this would have greatly impacted the way a call would go, it would also benefit the amount of scene time a crew could have, decrease the risk of injury to pt and to paramedics, hopefully reduces the need for allied agencies (in my service to call for back up may take from 10-20 minutes as there is one base per community and only one crew working days and one crew working nights).

10. **Which equipment items do you wish worked a little more efficiently?**

    I wish the stretcher would work more efficiently with snow, like the wheels don't sink into the snow. When this occurs it can cause the stretcher to tip over causing injury to pt and crew. Battery like of the stryker stretcher does not do well with cold environments as the battery gets drained faster. One time I was working on a refusal in the winter time probably around 11 pm (around -26 degrees C) and stretcher was outside of the house for 10-15 minutes and the battery was almost drained.

11. **What is your opinion on the current vehicles used for paramedical services?**

    I believe that the vehicle that my service uses can be better fitted for the winter weather. I believe that if we had trucks with higher clearance, fitted with AWD or 4WD options (as the trucks we use are RWD), winter tires for the front pair.

12. **Have you ever had equipment malfunction or a break during a time of need? Which was it?**

    I have never had a item break in a time of need however I have had the stryker loader malfunction on a call where we were offloading the pt to ORNG helicopter crew. The loaders prongs were not able to lower itself and disconnect the stretcher. This caused the stretcher to be held in the air with the pt on it. It was quite embarrassing as the ORGN crew was waiting for the pt and staring at us. However, we found a way to override the system and manually lower the loading prongs and offload the pt.

13. **What is a piece of equipment you couldn't operate without?**

    Stretcher

14. **What is one weather condition you never operate on and why?**

We operate in all conditions. The most challenging weather to operate in would be slush or when the snow melts and refreezes. This makes it very challenging for us to manuver the trucks as our roads are gravel roads and there is a big hill that is right before the hospital. It also increases the chances of us getting stuck going to a call and leaving the residence.

15. **Which piece of equipment is the hardest for a paramedic to use with a patient?**

I believe that the hardest equipment to use is the stair chair. But not by any design flaw, mostly pt condition and environment factors.

16. **What are the similarities and differences between rural area operations versus urban area operations?**

The biggest difference my service and a service down south is that we have to deal with longer wait times for back up. As there is only one working crew on days and one working crew on nights at each base. If we require another crew, we have to request an up staff from the supervisor. In the wintertime an ice road connects all 5 communities. Therefore, times for waiting on scene for an upstaff could go from 5-30 minutes. This is a seasonal road that is built in the wintertime the runs the length of James Bay. During the summer and winter time there are no roads connecting the communities. We have to deal with longer winters due to the snow not melting as quick as down south.

User Empathy Map

User Journey Map

	Planning	Preparation	Task 1	Task 2	Task 3	Task 4	Goal	Finish
User Action	Uniform Check/ Equipment check, Meal Prep, Travel Time Prep	**Setting up Work Truck 20-30 minutes, no damages or equipment missing, functioning**	Navigation to destination. Dodging traffic, possible sirens. Possible rough road conditions	On Scene	Oncene to hosptial	Triaging Information to hospital officials, nurses, doctors etc.	Arriving Safely At hospital	Clean up and paperwork
User Thoughts	**"don't want to under prepare" Forced to use government administrative gear**	Making sure everything is ready, don't want to be unprepared for a call.	Mental checklists. Thinking what equipment, we need for the call based on call details. Driving as safe as possible	Maintaining professionalism is important because you may be treating felons. Possible moral compromising situations. Separating self from situations. Having to accept that it is your job no matter who the patient is.	Patient management	**Trying not to forget key health information. AKA relevant health history, medication. Treatments the paramedics did for the patient**	**Mentally Recap the call before leaving hospital.**	Most important part of the process. Only record of the call. Proper documentation, Legally liable
Storyboard Photos								
User Experience	Neutral	Neutral	Neutral/ Anxious	Neutral/Alert/Attentiveness	Neutral/Alert/Attentiveness	Neutral/Alert/Attentiveness	Urgency	Relieved, Less anxious
Problems/Changes	**Under prepared/ Unofficial gear, legality issue**	Something may be important to the call that would be forgotten, unable to treat patient	Rough wehther donciditons in the north prevent timely arrivals	Sometimes having to save felons, desensitizations, morally obligated to comply	Patient could die on the way there	In order to provide the offical nurses and doctors with proper informationm a good memeory on how you treated the patient and telling them how is important	This is a state where if you can overdose someone if theyre not treated properly.	In order to properly record your work you need to docxument, in court it is needed because it is the only proof of the call
Takeaways	The less overthinking the better	Be extra diligent	Pay attneiton to detail and be safe		Keep patients warm	Speak clearly, explain yourself	Double check your own backtracks	Protect yourself

Product #1

Type 1 Ambulance

https://www.aev.com/aev-ambulance-types/type-I-ambulance-trucks

Promotional Piece *(Highlight the Benefit)*

1.2. CUSTOM TYPE I AMBULANCES

At AEV, we offer countless ways to build your ambulance that will cater to the needs of your crews, meets or exceeds safety standards and answer the community's call. Here, the only way you'll find two ambulances alike is if you ask for it.

1.3. IT ALL STARTS WITH A FEASIBILITY STUDY

Our buying process is a personal one-on-one experience that starts with a feasibility study, because relationships and individualized solutions are what we build first. From custom conveniences for your crew to graphics schemes unique to your company, no detail is overlooked.

1.4. A DETAILED VISUAL MANUFACTURING PROCESS

Starting with an exclusive Mickey-manufactured body, AEV builds each custom unit using a detailed visual process — a board stocked with parts and tools specific to that ambulance to ensure we meet your every spec. American crafted at AEV.

Features *(Highlight the Features)*

Body

C/S upper windows: Standard, tint fixed

Drip rails: Bright finish aluminum

Fasteners: AVK for attachment of door panels

Fender flares: Aluminum

Flooring: Choice of optional colors

Fuel fill: Aluminum housing behind rear axle

Headliner: One-piece front to rear, gloss white

KKK/CAAS package: To present revision

Paint: OEM white industry match

Pass-thru windows: Sliding Lexan with bellows

Patient floor: Plywood, single piece, full-length and width, insulated Rear

bumper: Tread plate with center flip-up aggressive step section

Rear upper windows: Standard, tint fixed

Reflectors: Six total, four rear and two front

Roll-up flooring: 3" recessed

Skirt rails: Diamond plate

Body Striping: Single belt (Optional)

Undercoat: Per QVM Industry guidelines

Upholstery: Choice of optional colors

Urea Full: Aluminum housing (diesel engine and where applicable)

Doors

Door hold opens: Grabbers on rear doors

Handles: Handicap style on all entry doors

Seating

Attendant seat: Captain's chair on storage box with Per4Max Seatbelt Cot

mount: Stryker or Ferno

CPR seat: Street-side with Per4Max Seatbelt and telemetry area

Compartments

Backboard storage: Right rear compartment, vertical

License plate holder: Recessed in rear kick plate with LED Light

Lining: Diamond plate

Oxygen cylinder rack: Aluminum rack, LF compartment

Shelves: One total aluminum in exterior compartment

Spare tire: Shipped loose

Straps: One total in right rear compartment for backboards

Cabinets/countertops

Action area cabinet: Laminated

Laminate: With choice of optional colors

Polycarbonate: Gray tinted or clear with full handles

RF cabinet: Wood doors with inside/outside access

Electrical system

TraumaHawk Telematics AVI System

12vdc outlets: Two cigar outlets

125vac outlets: Two total, one curbside, one RF-ALS

Batteries: Two under hood

Battery switch: Cole Hersee 2484-16

Coax cable: One tagged at both ends

Console: Wood between cab seats covered with EZ-Grip

Electrical cabinet: Behind attendant's seat

Electrical system: Printed circuit boards with LED diagnostics

Oxygen outlets: Two total, Ohio style

Shoreline: inlet located on street-side behind M1 compartment

Wiring: Color, name and number coded with as built schematics on USB drive

Emergency alert

Backup alarm: With auto reset switch

Siren: Whelen WS-295

Siren speaker: Dual 100 watt

Lighting

Action area light: 12vdc LED

Clearance lights: LED on front and rear with recessed corner lights

Dome Lights: LED for both streetside and curbside

Indicator lights: Door, compartment ajar, low voltage and battery on cab console

Load lights: Two Whelen on rear

Scene lights: Two Whelen on each side

Side marker lights: On sides of body

Tail lights: Triple light cluster on rear

Third brake lights: Mounted over rear doors

Warning package lights: Whelen perimeter lighting

Environmental

Heat-A/C: Ceiling ducted

Insulation: Reflectix circumferential package

Product #2

EMS Stair Chair Aluminum Light Weight Ambulance Medical Lift

https://www.amazon.ca/Stair-Aluminum-Weight-Ambulance-Medical/dp/B004FRSUO2

Promotional Piece *(Highlight the Benefit)*

This Aluminum EMS Stair Chair is designed to help EMTs transport patients through tight spaces and up or down stairs, safely and efficiently. The sturdy aluminum frame is strong enough to hold up to 400 pounds, yet surprisingly lightweight. Three adjustable straps with quick-release buckles ensure the patient's comfort and safety. Non-slip grips on the rear and front handles help rescuers maneuver the Aluminum EMS Stair Chair easily. Compact folding allows you to stow the stair chair in the ambulance without taking up a lot of space. Dimensions: Height: 36" (91cm) Width: 20" (51cm) Depth:

Open: 27" (69cm) - Folded: 7 7/8" (22cm) Weight: 21 lbs. (9.53kg) Load Capacity: 400 lbs. (159kg)

Features *(Highlight the Features)*

- Sturdy aluminum frame / hold up to 400 pounds
- Three adjustable straps with quick-release buckles
- Non-slip grips on the rear and front handles
- Compact folding allows it to store easily
- Light Weight Increased Durability

Product #4

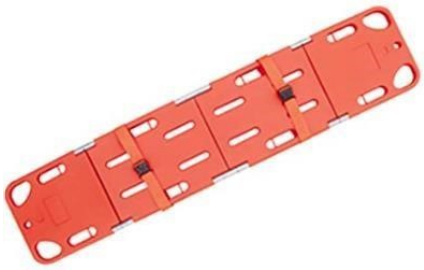
Urban Performance

https://www.amazon.ca/Portable-Stainless-Stretcher-Protective-

Treatment/dp/B08DG2HVD1/ref=sr_1_44?dchild=1&keywords=Paramedic+Stretcher&qid=1605581292&sr=8-44

Promotional Piece *(Highlight the Benefit)*

Description- High quality Durable plastic material ,,- 4 fold easy portable- Small volume and light weightProduct parametersDimension: 183×45×6cmPacking size: 185x46x7cBearing weight: 159KG(350lb)9Net weight: 9 KGGross weight: 11kgPackage package1 x Rescue stretcherTips: The product size will vary by 1-3cm due to different measurement methods, please forgive me! **Features** *(Highlight the Features)*



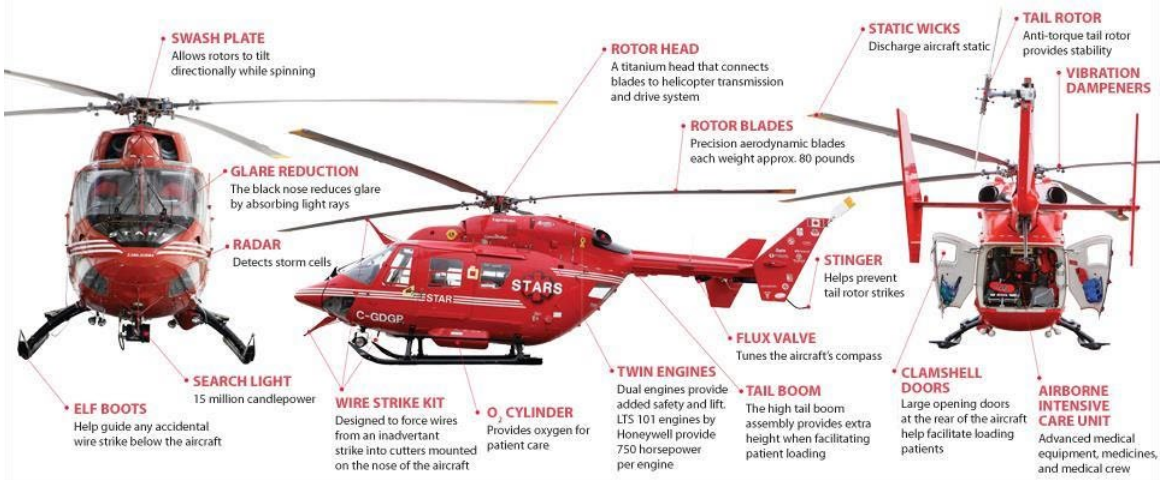
PE stretcher is made of PE material without release pollution, which is sturdy and durable, and can be used for Xray.

- ★ Keep the patient's spine aligned to avoid secondary damage.
- ★ The stretcher can be used in combination with the head restraint.
- ★ The stretcher is equipped with a seat belt for safer transportation.life-saving stretcher is easy to fold into 4 fold, easy to carry
- ★ This easy to use foam filled board is excellent for water rescue as it is waterproof.

AirCARE1

https://stars.ca/helicopter-air-ambulance/our-helicopter-fleet/ Promotional Piece

currently operates a fleet of Airbus H145 and BK117 helicopters, which have been specially outfitted for helicopter EMS operations. At any given time, one helicopter is the primary, inservice aircraft at each of our bases and is available to respond to missions.



Benefits of Product Benchmarks

BENEFITS	Sort #1	Sort #2
From Promotional Material	DATA [On Menu Bar] →	Groups like categories
Large Opening Doors	Comfort Easily Portable	*comfort* 11
Advanced Medical Equipment	Comfort Celing Deducted	Comfort Easily Portable
Extra Height	Circumfernential Package	Comfort Celing Deducted
Provides Oxygen	Comfort Advanced Medical Equipment	Circumfernential Package
Wire Cut Prevention	Comfort Durable	Comfort Advanced Medical Equipment
15 Million Candlepower	Comfort Easily Storable	Comfort Durable
Detects Storm Cells	Comfort Easy Storage	Comfort Easily Storable
Discharge Aircraft Static	Comfort Quick Releases	Comfort Easy Storage
Anti Torque Tail Rotor	Function Discharge Aircraft Static	Comfort Quick Releases
Black Nose Reduces Glare	Function Allows Rotor To Tilt	
Allows Rotor To Tilt	Function Anti Torque Tail Rotor	
Easy Storage	Function Enhanced Lightning	
Durable	Function Light Clusters	*Function* 9
Holds up 400 Pounds	Function Precision	Function Discharge Aircraft Static
Quick Releases	Function Reduces Glare	Function Allows Rotor To Tilt
Easily Storable	Function Visual Black Nose Reduces Glare	Function Anti Torque Tail Rotor
Celing Deducted	Function: Detects Storm Cells	Function Enhanced Lightning
Circumfernential Package	Necessity Provides Oxygen	Function Light Clusters
Light Clusters	Nuance elegant retro	Function Precision
Titankum Head	Power 15 Million Candlepower	Function Reduces Glare
Precision	Power Holds up 400 Pounds	Function Visual Black Nose Reduces Glare
Reduces Glare	SecurityWire Cut Prevention	Function: Detects Storm Cells
elegant retro	Siren Noise	*Power* 6
Siren Noise	Style Large Opening Doors	Power 15 Million Candlepower
Enhanced Lightning	Style Titanium Head	Power Holds up 400 Pounds
Easily Portable	StyleExtra Height	
		Style 7
		Style Large Opening Doors
		Style Titanium Head
		StyleExtra Height
		Necessity 4
		Necessity Provides Oxygen

Features of Product Benchmarks

FEATURES		Sort #1		Sort #2
From Promotional Material	Re-order: NOUN first	DATA [On Menu Bar] →		Group like categories
Aluminum Frame	Body: Alumium Frame	Body: Action Area Light	Hang: 75mm suspension fork 7	Body Unisex design
Adjustable Straps	Body: Adjustable Straps	Body: Adjustable Straps	Hang: Elf Boots	Body: Action Area Light
Non Slip Grips	Hang: Non Slip Grips	Body: Aluminum Flares	Hang: Non Slip Grips	Body: Adjustable Straps
Compact Folding	Body: Compact Folding	Body: Alumium Frame	Hang: Reflectors	Body: Aluminum Flares
Light Weight	body: Light Weight	Body: AVK NutSerts Doors	Hang: Rotor Blades	Body: Alumium Frame
PE material	Body: PE material	Body: Clamshell Doors	Hang: Rotor Head	Body: AVK NutSerts Doors
Spine Algning Design	Body: Spine Algning Design	Body: Compact Folding	Hang: Seat Belt	Body: Clamshell Doors
Seat Belt	Hang: Seat Belt	Body: Diamond Plated Lining	Hang: Static Wicks	Body: Compact Folding
4 Folding	Other: 4 Folding	Body: Drip Rails	Hang: Swash Plate	Body: Diamond Plated Lining
Foam Filled	Body: Foam Filled	Body: Flux Valve	Hang: Tail Rotor	Body: Drip Rails
Drip Rails	Body: Drip Rails	Body: Foam Filled	Hang: Vibration Dampeners	Body: Flux Valve
AVK NutSerts Doors	Body: AVK NutSerts Doors	body: Light Weight		Body: Foam Filled
Aluminum Flares	Body: Aluminum Flares	Body: O Cylinder		body: Light Weight
Cout Mount Stryker	Extras: Cout Mount Stryker	Body: PE material		Body: O Cylinder
Reflectors	Hang: Reflectors	Body: Spine Algning Design		Body: PE material
Diamond Plated Lining	Body: Diamond Plated Lining	Body: Tail Boom		Body: Spine Algning Design
Swash Plate	Hang: Swash Plate	Body: Twin Engines		Body: Tail Boom
Elf Boots	Hang: Elf Boots	Extra: Airborne Intensive Care	Other: Kenda road tires	
Radar	Iother: Radar	Extra: Backup Alarm	Other: 4 Folding	
Glare Rexcduction	Shield Glare Rexcduction	Extra: Clearance Lights	Other: Shield Glare Rexcduction	
Rotor Head	Hang: Rotor Head	Extra: Siren		Extras
Flux Valve	Body: Flux Valve	Extra: Siren Speaker		Extra: Airborne Intensive Care
O Cylinder	Body: O Cylinder	Extras: Cout Mount Stryker	Hang	Extra: Backup Alarm
Twin Engines	Body: Twin Engines	Hang: Elf Boots	Hang: Elf Boots	Extra: Clearance Lights
Tail Boom	Body: Tail Boom	Hang: Non Slip Grips	Hang: Non Slip Grips	Extra: Siren
Clamshell Doors	Body: Clamshell Doors	Hang: Reflectors	Hang: Reflectors	Extra: Siren Speaker
Airborne Intensive Care	Extra: Airborne Intensive Care	Hang: Rotor Blades	Hang: Rotor Blades	Extras: Cout Mount Stryker
Vibratio Dampeners	Hang: Vibration Dampeners	Hang: Rotor Head	Hang: Rotor Head	
Tail Rotor	Hang: Tail Rotor	Hang: Seat Belt	Hang: Seat Belt	
Static Wicks	Hang: Static Wicks	Hang: Static Wicks	Hang: Static Wicks	
Rotor Blades	Hang: Rotor Blades	Hang: Swash Plate	Hang: Swash Plate	
Backup Alarm	Extra: Backup Alarm	Hang: Tail Rotor	Hang: Tail Rotor	
Siren Speaker	Extra: Siren Speaker	Hang: Vibration Dampeners	Hang: Vibration Dampeners	
Siren Speaker	Extra: Siren	Iother: Radar		
Action Area Light	Body: Action Area Light	Other: 4 Folding		
Clearance Lights	Extra: Clearance Lights	Other: Shield Glare Rexcduction		

CHAPTER 3: ANALYSIS

Image acquired from (https://learn.g2.com/hubfs/data-analysis-process.jpg)

3.1 Analysis – Needs

The difference between working in a rural area as a paramedic, and working in a more urban filled area as a paramedic may seem very similar to the untrained eye. But in the eyes of a paramedic who is seasoned in both fields offers different perspective. This thesis consists of user interviews regarding both urban and rural circumstances, struggles, and tribulations from the rural area paramedic perspective. The needs of a paramedic whoa re working in a rural area in the harsh winter conditions need a more precise solution for their issues regarding their environment and equipment

available to them. The purpose of these needs from a research perspective, is to find the needs and necessities that aren't provided by the current equipment used in the rural areas that paramedics serve

in.

3.1.1 Needs/Benefits Not Met by Current Products

The needs not met by current products are a lack of temperature control and a proper vehicle needed to ride the rough terrain of a harsh winter environment. There is an issue regarding patients who require proper warmth when being serviced. Heart arrythmia is a common problem that paramedics deal with when servicing patients in the cold environments. Heart arrythmia an arrhythmia is a problem with the rate or rhythm of the heartbeat. During an arrhythmia, the heart can beat too fast, too slowly, or with an irregular rhythm. When a heart beats too fast, the condition is called tachycardia Arrhythmia is caused by changes in heart tissue and activity or in the electrical signals that control your heartbeat. These changes can be caused by damage from disease, injury, or genetics. Often there are no symptoms, but some people feel an irregular heartbeat. You may feel faint or dizzy or have difficulty breathing.

3.1.2 Latent Needs

Comfort	Comfort is the root of the problem for passengers and paramedics alike that need to
	be transported form location of call to hospital in order to provide a safe journey for the patient.

Storage	Proper storage for all the equipment needed in an ambulance for a paramedic. There requires a dignified amount of space for all the pharmaceuticals and hardware needed to treat patients.
Efficiency	Efficiency requires their equipment to work in extreme harsh winter conditions. This includes a vehicle that can pass through harsh snowfalls with ease. Traffic will always be a factor when traveling from point A to point B But the availability to smoothly travel through all terrain is a positive worth designing for.
Ease of Use	In order to cause an ease of use scenario with each paramedic who utilizes this product and or vehicle is to prioritize good work flow. This involves preparation and planning as well as travel to be intuitive

3.1.3 Categorization of Needs

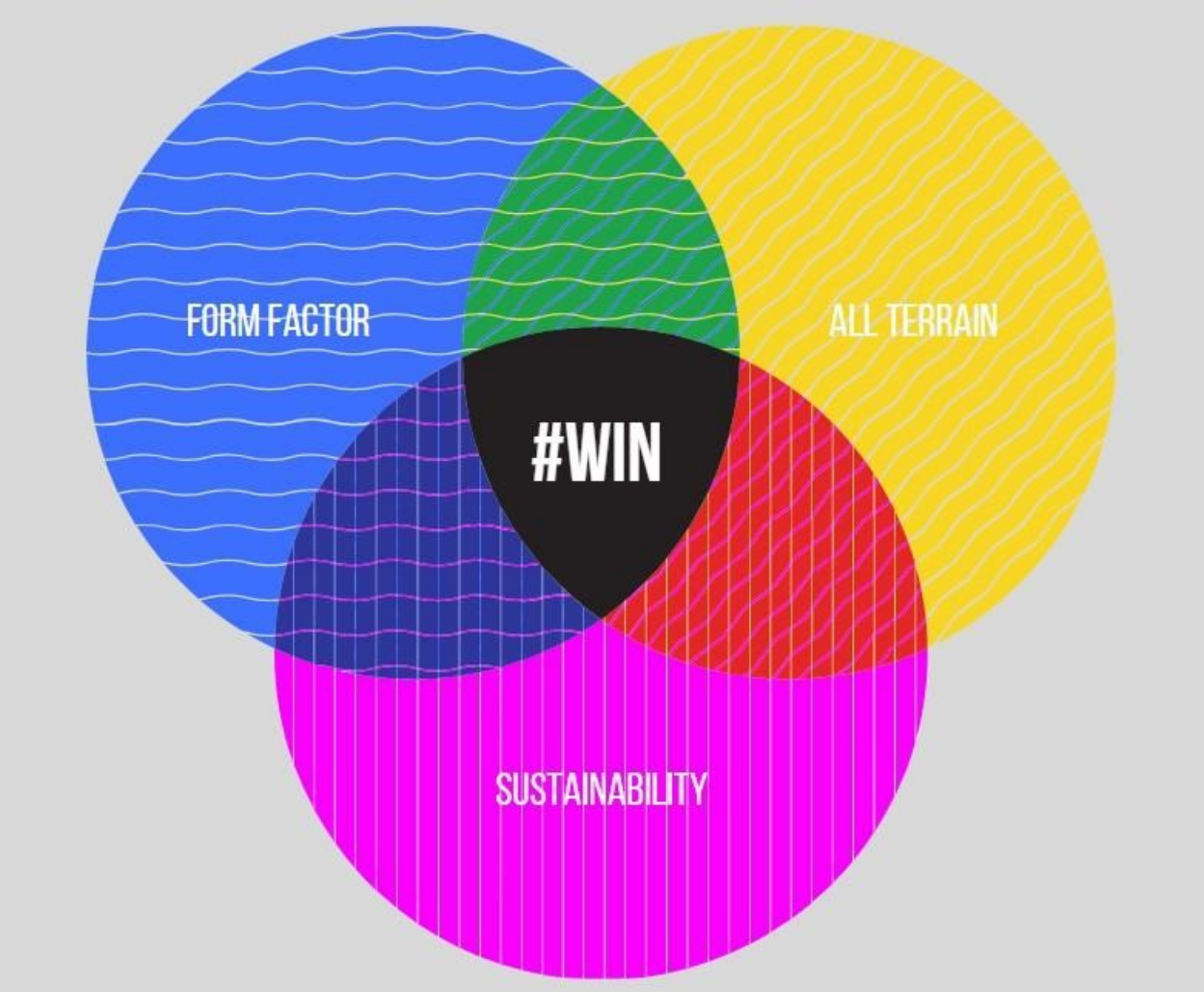
Need	Benefit Statement	Relationship with Benefit
Long Distance Travel	Even though rural area is the focus with this product, it needs to be able to travel far for long lasting trips. The design requires endurance.	**Moderate**
All Terrain Capability	The matter of harsh winter environment creates an uncontrollable terrain	**Strong**
Form Factor	The form factor is important for the nimbleness of the design. The form factor has to be able to service within harsh winter conditions and still move freely.	**Strong**
Nimble Design	The nimble design is to provide the vehicle with a weight feasible enough to travel through snow but also having enough traction to plow through the weather.	**Small**

Comfort	Comfort in the interior of an ambulance is a quality of life that is difficult to design around. The comfort for the paramedics is important for their bodily health and an area for the patient to rest in the stretcher uninterrupted is paramount.	**Moderate**
Durability	Strong material to protect the chassis from the elements as well as the people inside is important due to it being a safety product.	**Moderate**

Sustainability	For semi or mass production this product needs to be sustainable and environmentally friendly.	**Moderate**
Cost Effective	Semi mass production may make this product more affordable for manufacturing as it isn't mass production but still needs to be sustainable material and environmentally friendly.	**Strong**

Feasibility	The feasibility of this product will service a lot of rural areas if it were to be successful. The importance of this feasibility is to be able to service semi mass production	**Strong**
Functionality.	It has to function as an ambulance but also as an Allterrain Vehicle. The synonymous factor of these two will create a product	Stong
	best suited for harsh winter conditions.	

3.1.4 Needs Analysis Diagram



3.2 Analysis – Usability

3.2.1 Activity – Workflow Mapping + Experience Mapping

3.3 Human Factors

The current state of harsh winter emergency services is the use of normal type 1,2 and type 3 ambulances. These ambulances do not accommodate the struggles of EMS workers in harsh winter environments very well. They're the same designs that are used in warmer areas of the Northern American continent. The current problem with ambulances is they're not designed and engineered to efficiently service those who live in the harsh winter environment. The large snow falls prohibit ease of work flow and traffic flow, causing EMS services to take more time to get to their destinations. The sooner medical personnel can service those in need the better chances they have at survival. Designing an electric small and nimble ambulance meant for 2-3 personnel and a patient can be designed to combat this. Ergonomically this needs to be designed properly to fit the form factor but also not be too heavy for the environment. The findings in the ergonomic study are that: The takeaways and contributions are that:

Literature Review:

In relevance to Henry Dreyfus "The Measure of Man" The 95 percentile man measurements are referred to when designing the dimensions of the seats. 33" inches high as well as 21.5 inches deep and 20.5 inches wide. These measurements are adequate to fit the figure of a 95-percentile man. In order to properly measure distances of dashboards and foot room to person values as well as seats. Measurements were taken from manufacturing blueprints for cars, ambulances and ergonomic percentiles. Law and resource measures dimensions for a regular motor vehicle from wheel base to dash board to seat dimensions. PL customs also measure ambulances dimensions and ergonomics for typical dimensions

Objective:

The objective with this mock up model to made to 1:1 scale is the accuracy being made in an efficient small form factor and nimble electric ambulance that is able to service properly and more efficiently I a harsh winter environment. Electric components are heavier than a combustion engine vehicle, therefor the small form factor has to be adjusted accordingly to counteract this material choice. In order to properly measure the ergonomic capability of this small form factor all terrain ambulance, the interior needs to be measured properly to obtain the correct ratio of space allocated to equipment, and space a person can move through.

Decisions to be made:

1. Storage information of equipment in relation to wear the patient as well as the paramedics rest their bodies in seats and when reaching for equipment.
2. The location and tracking of the Passenger seat rotating to intersect with the back of the Ambulance to further help with patients.
3. Interaction with instrument panels as well as steering for the vehicle itself.
4. Managing patients efficiently in travel circumstances.

Description of users targeted by product:

The targeted demographic for this product is paramedics ages 20-45 who enter the field in a harsh rural environment. Mixed Gender. Located in Northern Canada. Paramedics in the GTA as well as Northern Ontario are monitored for this study.

Evaluation Process:

The evaluation process consists of designing a full scale 1:1 model of the cabin as well as the rear unit of the ambulance where paramedics, workers, and essential items would be kept. This allowed for the analysis of.

1. Position for integrated stretcher to attach to main unit.
2. Passenger seat from front interior rotation and seating path for rear assistance
3. Electric component locations
4. Stair chair location
5. Storage locations for equipment and pharmaceuticals
6. Loading and unloading area

Description of User Observation Environment Used in this Study

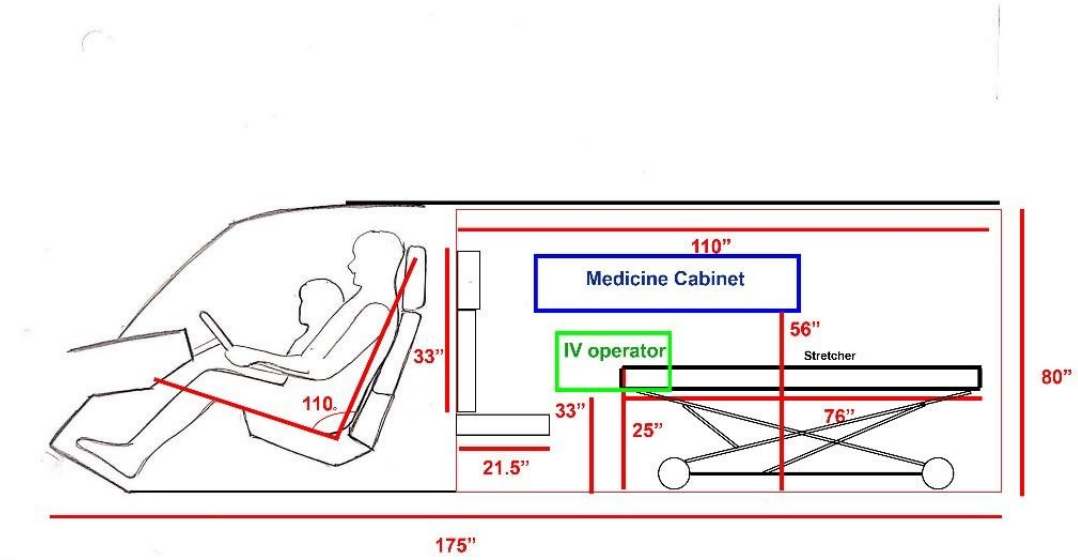
For this study, a user would normally be accustomed to a work station in a paramedical facility. The operation carried out for this model was taken in a parking lot

Location and Time

Date of observation: 29/12/20

Location of Observation: Humber College

Results:



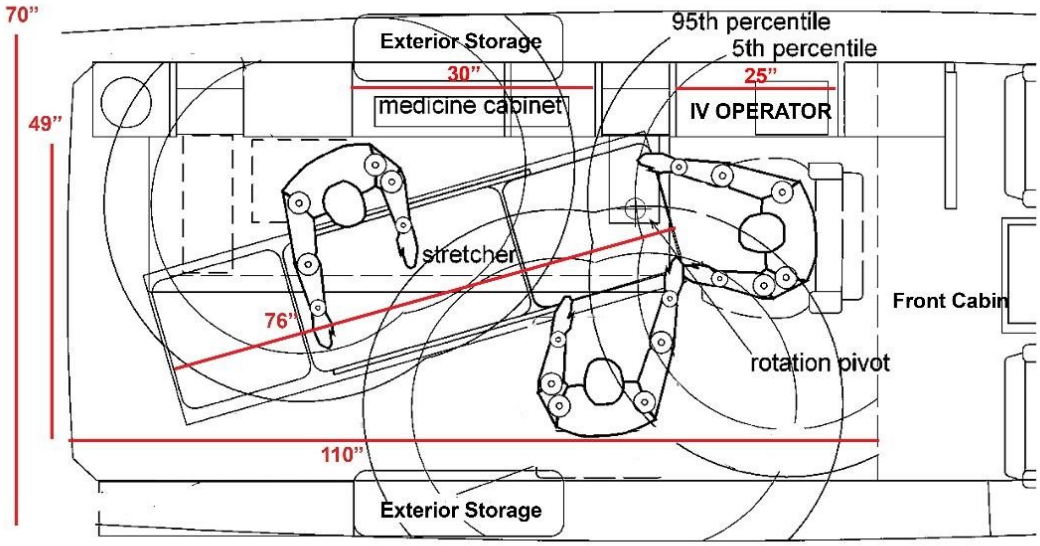
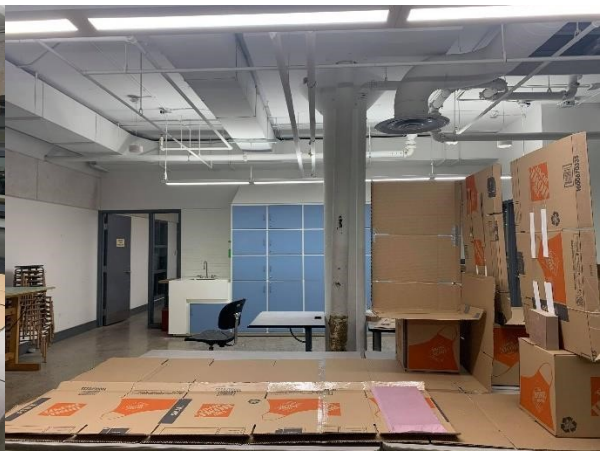
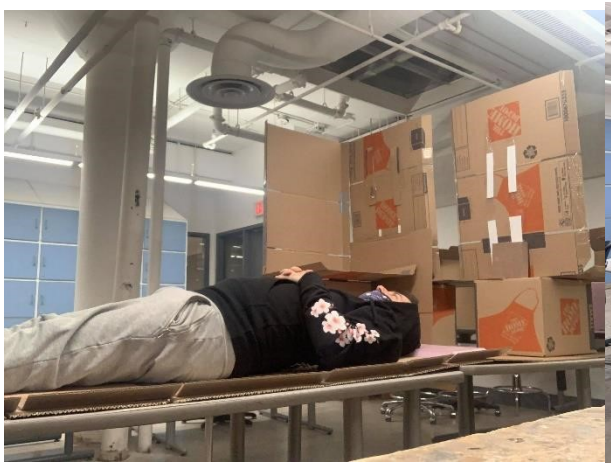
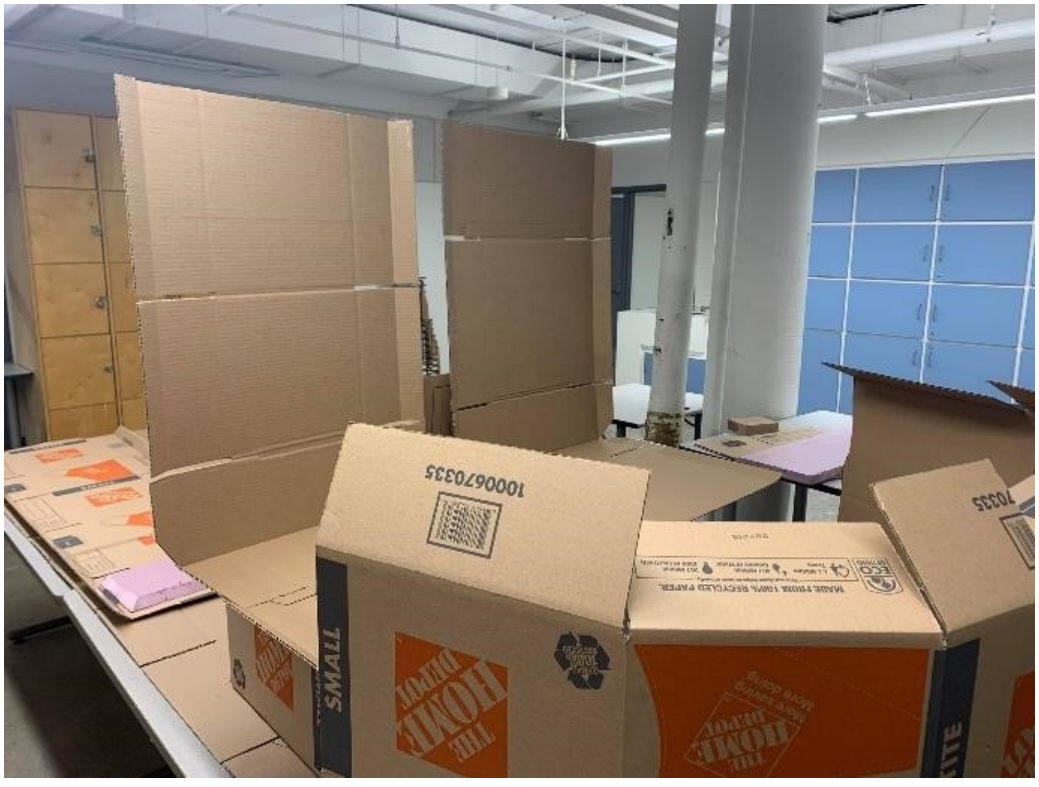


Diagram of usable space with human interaction and measurements. Vehicle designed for 2-4 person interaction. 95th percentile male in consideration for measurement.


PETITE






SMALL
THE HOME DEPOT

Analysis

Type 1 ambulances have a history of being very large due to being conventional vehicles and non electric. Some Type 1 ambulances are 300” inches in length. The ergonomic study is going to provide a small form factor for this all-terrain winter friendly EMS vehicle, but the problem arises with compromises. Originally the goal was to have the passenger seat of the driving interior able to be turned around and face the back to provide extra support to the patient in need if the EMS team has a personnel level of 2 or more. However, the compromise being with a smaller form factor but an effective EMS vehicle and being electric with the weight sacrifices, it may not be possible. In order for the passenger seat to be able to rotate, the vehicle would have to maintain the same dimensions, to combat this, a one seat behind the driver side is implemented. The dimensions for the stretcher stretch out to 76 inches.

The seats of the vehicle are 21.5 inches deep by 20.5 inches wide and the back rest is 33 inches tall. This fits the 95-percentile male body dimensions. With an almost half sized interior compared to a regular type 1 ambulance when regarding the back interior, a compromise needs to be made. A ¾ size comparison may be the ideal measurements. The seats located in the front interior as well as the seat in the back are close together due to keeping a small form factor in the vehicle. This may have caused issues with the overall sizing. There may need to be more space divided from the seat in retrospect to the stretcher. The back cabin for the ergonomic buck was 90 inches, this is too small after installing the 76-inch stretcher. 90 inches presumes to be too small for the back interior as there is no room for storage equipment and not enough room for the paramedic located back there to continue servicing the patient. A more traditional size can be considered for testing.

The distance of the dash board in relevance to the seat is 53 inches this provides the standard ergonomic distance between the driver and passenger with the dash. The interactive portions and

instrument panel would be located at a distance of 21 inches this would allow for complete comfort, with screens being the focus of an electronic EMS vehicle, there needs to be minimal travel time between tech. There needs to be access from the passenger side as well to all the electronics so they can monitor the patients needs necessary the distance to the dash will remain the same, as well as the space for foot room. The ability to turn around so that the passenger paramedic could help service should be explored further as the space confinement and restrictions may not permit them if the goal is to keep the vehicle light weight and nimble.

Limitations and Conclusion

1. Size restrictions with compromises in functionality and form factor achievements.
2. Width of back interior interfering with paramedic to patient relationship
3. Back seat interferes with placement of stretcher.

Ergonomic Issues Still not yet resolved

The transition from back to the front of the interior needs more development. The back doors interacting with the back interior. Its possible that when the cockpit opens up at the front the back door can be the only entry way into the vehicle. The space strategizing in regards to all the equipment drawers need to be thought out for a smaller form factor.

Alternative possibilities for the future

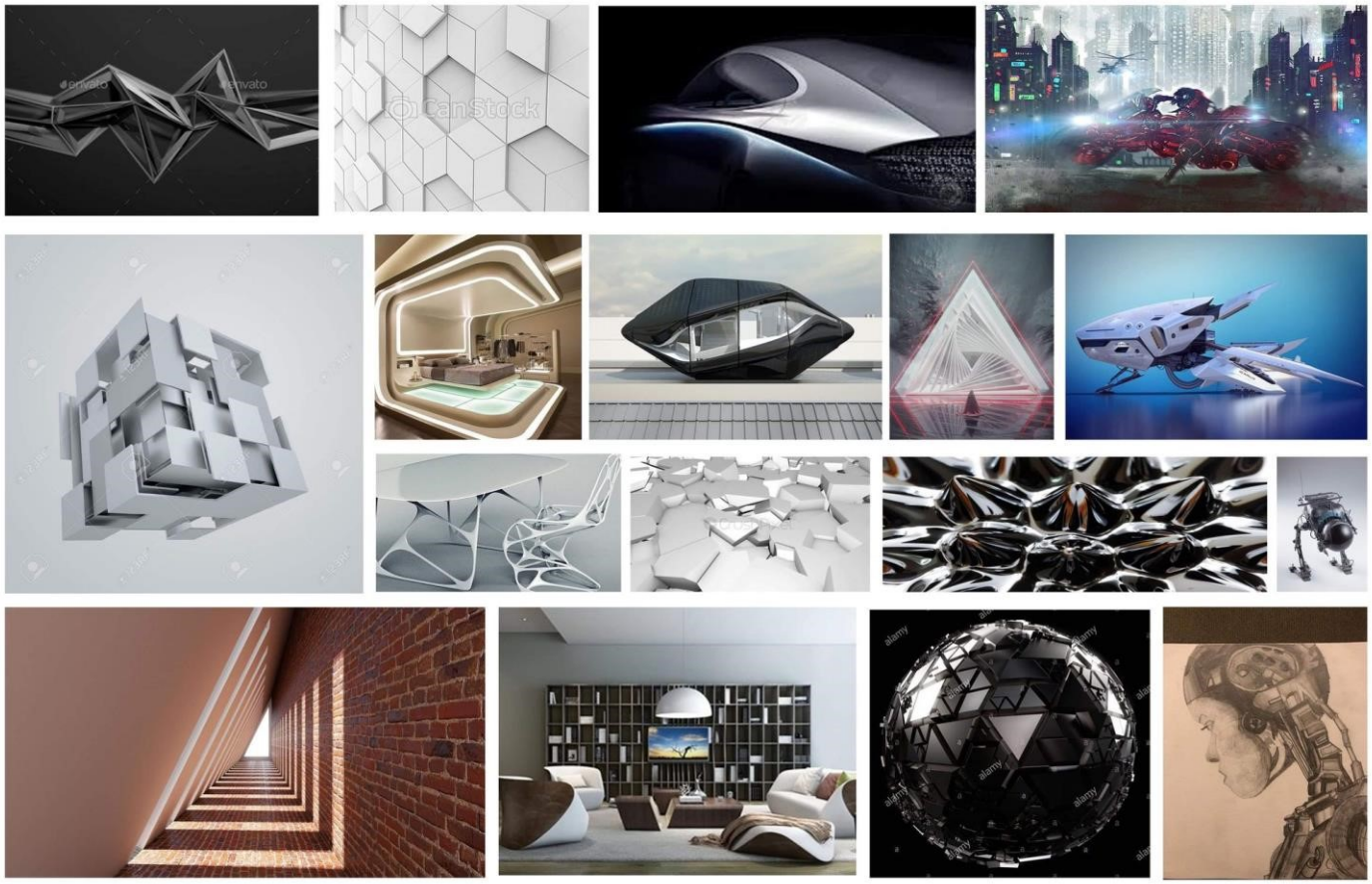
1. Indented features, chairs being indented into the walls, while this would preserve space, it would sacrifice durability in the material. Unsure if this would be affected
2. Extra 20 inches added for drawer space.
3. Stairs located to enter the vehicle opens into a door for Stair chair location.

4. Mounting cameras for replacement of mirrors

The challenge with this cabin design is designing a space small enough to manage a light enough vehicle, being electric, to manage 3-4 people in a small form factor with manageable equipment.

3.4 Aesthetics & Semantic Profile

Inspirational images and form used in consideration for final design.



3.5 Sustainability – Safety, Health and Environment

The purpose of this technical report is to discuss the importance of sustainability in electric vehicles, and how the production of EV's will eventually be the most common vehicle in production in the coming years. Following this technological revolution will be the use of electric EMS vehicles for paramedics to

routinely use. By benchmarking and analyzing current EV's on the market, the design can be formed around the structure of a more sustainable solution. This report will cover the materials needed as well to explain how electric vehicles handle their materials and manufacturing process. The steps on how those materials will be sustainable and help the environment will also be included.

Sustainability

The sustainability factors involving an Electric vehicle progress to less Co2 emissions that vehicles make. According to Andre Goncalves, the editor and head of English Market, there is a space for repurposing lithium-ion batteries and having them be reused for a second life. Some are used in the electric grid of buildings and storing energy from wind and solar sources. This would change the overall impact of batteries' effect on the environment, since lithium-ion batteries are a financial write off. Fossil Fuels accumulated to approximately 62% of the US's energy production alone. 38% of Canadian Energy is Petroleum, 35% is natural gas, Hydro and nuclear cover 22.3%. Electric cars emissions are up to 70% lower than their gasoline counterparts.

Emissions associated with battery production are taken from the Most recent (2019) estimate from the IVL Swedish Environmental Research Institute. The Nissan Leaf was analyzed with a 40-kilowatt hour battery while the tesla model 3 has both 50- and 75-Kilowatt hour options. Their findings provided that Tesla model 3 would have higher life cycle greenhouse has emissions compared to a conventional car, even in other countries a model 3 would lower emissions compared to any petrol vehicle.

Approximately 50% of the battery lifecycle emissions come from the electricity located in the battery manufacture and assembly. This concludes that batteries in a plant that are produced are renewable energy.

There's a record of ambulance companies already taking steps to reduce the carbon footprint paramedics make on a daily basis. Yorkshire Ambulance Service was the first ambulance service in the UK to conduct a project on sustainable solutions and environmental change. Emissions have been gradually decreasing through the introduction of new technology that would include lighting and boiler upgrades. This however is only a temporary solution due to the fact that they are still combustion engine vehicles. All the more reason why an electric solution to EMS vehicles should be implemented.

Safety, Health and Environment.

Ev's are responsible for considerably lower emissions over their consumer timeline than their combustion engine counterparts. In countries with coal dominant electricity generation, the benefits of EV's aren't as large as they can have just as much impact on the environment as other vehicles. As countries resort to decarbonizing electricity to meet benchmarks

Manufacturing emissions as well as driving emissions will continue to fall for new EV's Comparisons between the two vehicle types are depending on size, fuel economy and how electronic emissions are calculated. Driving patterns are also a factor as well as weather. There isn't a very distinct number estimate that applies to every country or city.

Biological Cycles.

The biggest jump in emissions that an EV provides spikes upon creation due to assembly. EV's start out large due to their high demand for materials. But it is in fact their life cycle that provides a lower average use of emissions. A vehicle like the Nissan Leaf would pay back the carbon debt after just a few years. As more EV's are starting to be produced. they would take under 4 years to pay back the carbon debt they've left on the emissions by being produced.

Ultimately the inclusion of EV's on the market will slowly cycle out the combustion engine typical vehicles that are on the road today. Eventually more electric cars will not be a premium and will be a more affordable option to the public. More countries will continue to push towards an all eco friendly road vision. The materials needed for an EV will have a high initiation cost on emissions but will have a three times lower average emission usage over its life cycle. Ultimately this is because of more material use in the construction process of an EV Certain companies like Yorkshire Ambulance Service are working towards a greener solution to tackle the upcoming challenges of sustainability and environmental change. More ambulance companies should adopt an electric solution as they can reduce the carbon footprint, they contribute to the overall cause of climate change.

3.6 Feasibility & Viability

Materials and Manufacturing

Battery Packs Require: Housings, Thermal Management, Insulation, Fire Retardant Materials

Electric Motors Require: Magnets, Windings, Housings, High Voltage Cables

With manufacturers improving their battery designs, the mass of materials being used around the cells is steadily being reduced allowing for a lighter battery pack or more cells to be used for the same mass.

The thermal management method to be used will have a significant impact on the fast-charging method. Thermal throttling prevention as well as non fire susceptible materials will be used. More effective thermal management is required for fast charging as well as a smaller and lighter packaging which in turn will lead to lower battery packs per vehicle. Traction batteries and motors in electric vehicles are different than in a combustion engine vehicle. While the combustion engine relies on aluminum and steel alloys, , Lithium ion batteries rely on Nickel, Cobalt, Lithium and Copper. IDTechEx forecasts a use of 28 materials in the construction of electric vehicles.

EV motor materials alongside the batteries will increase in demand over the next 10 years. EV motors are predominantly using magnet-based rotors. Neodymium and Dysprosium elements located in the earth, Unfortunate volatile price history. Manufacturers like Renault do not use magnets in their EV's but Tesla does as this may provide future innovation to efficiency as well as reduce requirements for other battery elements.

3.7 Design Brief.

The design brief will explain all the necessary key factors necessary for the design process to move forward., This design brief will consider key elements that have to be considered for the design to be successful in handling the problem definition in an efficient manner. These design guidelines will be the pillars that create the concept strategy.

Safety:

Safety being the number one priority when managing a vehicle for paramedics. The vehicle not only needs to be safe for the paramedics themselves, but also for the patients they are servicing. Safety of a vehicle is important naturally, there are laws and regulations regarding the construction of a vehicle that have to be legally implemented. But even more safety precautions need to be obliged when dealing with harsh winter conditions. 6 **Storage:**

Storage is important when considering a design for an ambulance due to the fact that the ambulance carries so much equipment. It is paramount to recognize the essential components that need storage when an ambulance is in use. These can include pharmaceuticals, Oxygen tanks, Electrical equipment, stretchers and stair chairs.

Comfort:

Comfort needs to be addressed in the sense of the rescuing of the patient who is being serviced. It is important to ensure comfort by having seamless equipment transferring from outside of the vehicle into the vehicle. The patient needs to be transported safely while being serviced potentially. In the event of an emergency travel, the patient and the paramedics need to be comfortable, to be continuing their service effectively.

Form Factor:

Form factor will be considered to the design of the vehicle because it needs to be able to remain

lightweight, while also maintaining density. The reason for this is to be able to be an all terrain vehicle. The functionality will be seamless the more fluid the form factor can be integrated into routine use by paramedics who service rural area harsh winter environments.

Intuitiveness:

Intuitiveness comes into fruition when thinking about the transferring of equipment. Ambulance servicers as well as the paramedics who drive them are well equipped with the training of memorization for the current vehicle they are using. This means that there must be a seamless transition of use when moving from one design to the other

Versatility:

In order for the design to be versatile, what must be considered is the terrain. This vehicle is meant to be an all-terrain solution to the harsh winter development of the northern climate. This vehicle must be able to go on all land mass with ease while maintaining a center of gravity and efficient functionality.

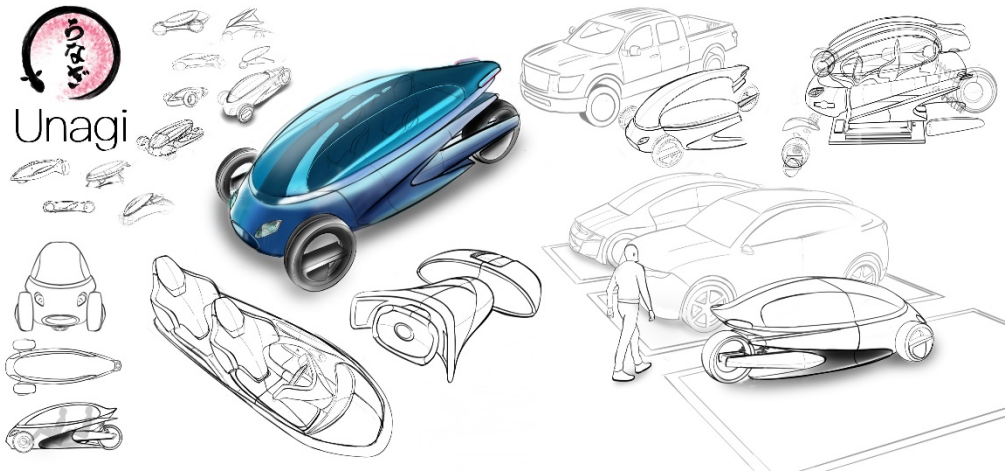
Sustainable:

As the world moves forward with autonomous and electric vehicles, the EMS industry should oblige. Electricity is more sustainable than combustion and more efficient when dealing with power of a vehicle. As the world moves forward with this technology, EMS workers shouldn't be ignored when designing a new efficient piece of equipment to service them as well.

Ease of Use:

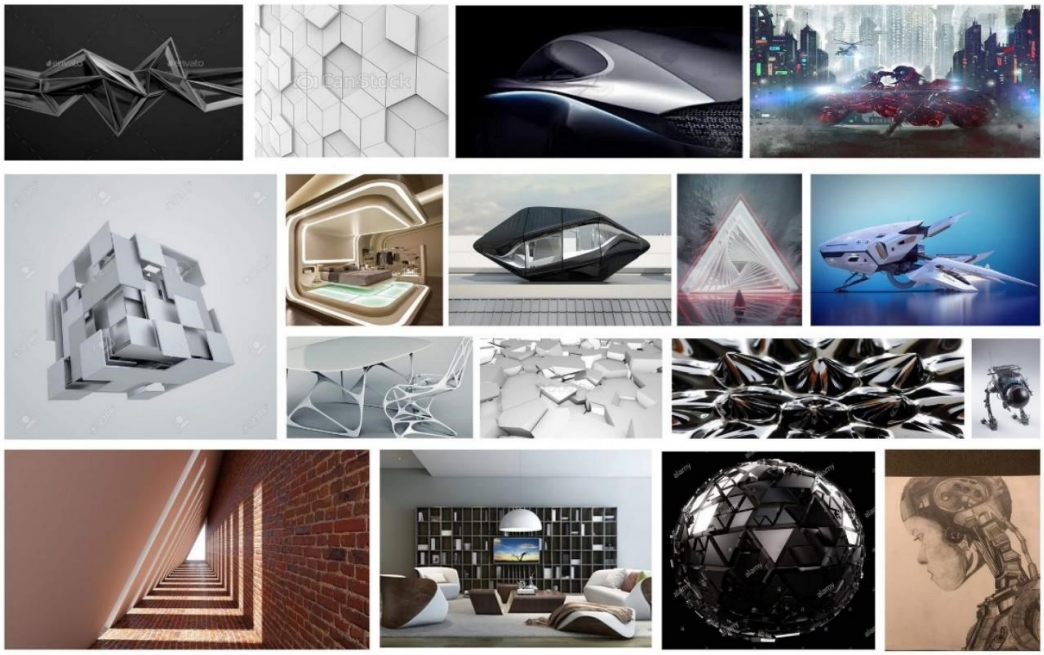
With Technology always on the rise, efficiency in use of equipment is paramount in evolving the way people use products. It is important that EMS workers are able to travel through cities easily, as well as start up the vehicle and enter an environment of harsh winter climate seem un threatening.

CHAPTER 4. IDEA GENERATION

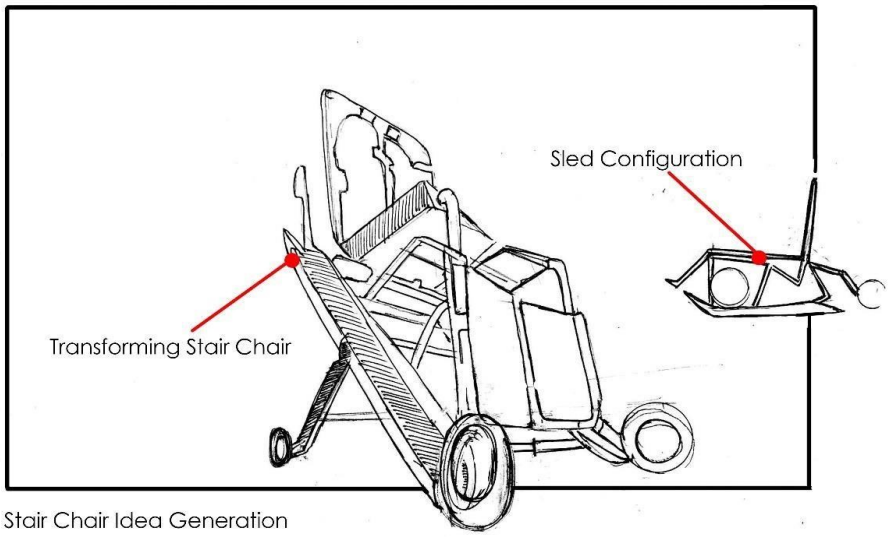


4.1 - Idea Generation

4.1 - Idea Generation Inspiration

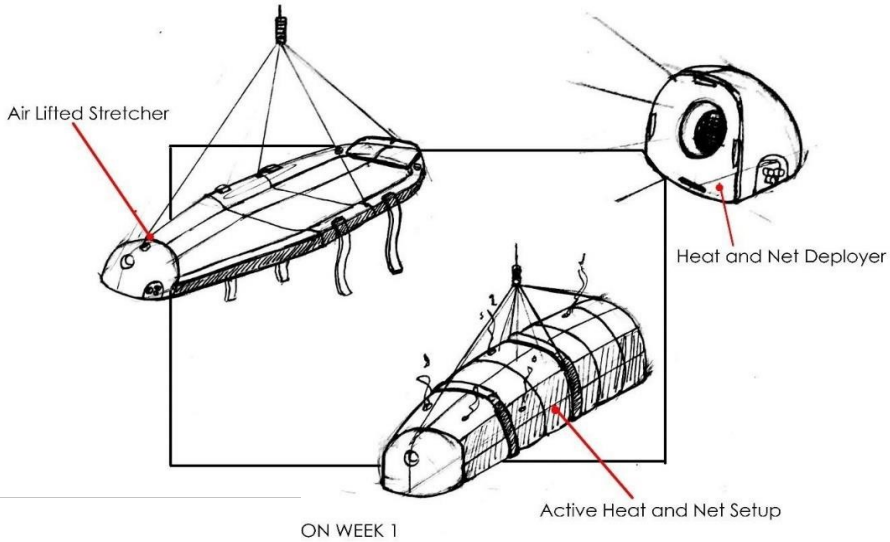


4.1.3 - Ideation Sketches. Initial concepts for dealing with EMS workers in Harsh Winter



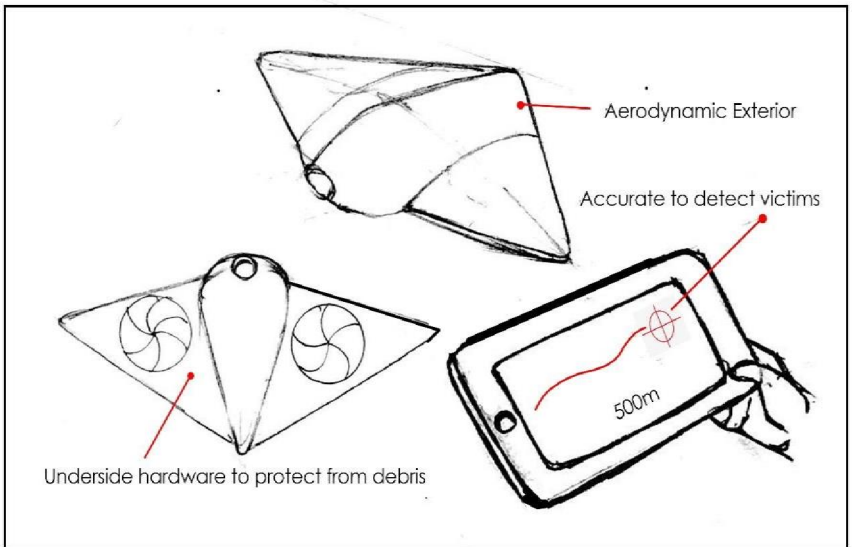
Stair Chair Idea Generation

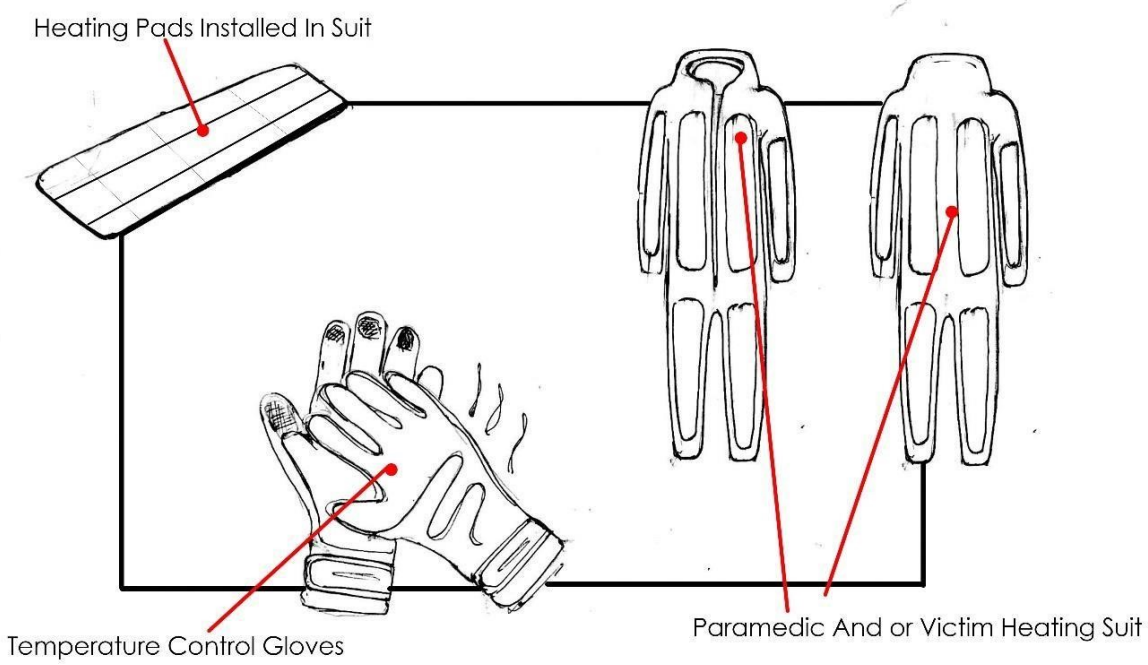
THESIS 2020-2021 IDEA GENERATION WEEK 1



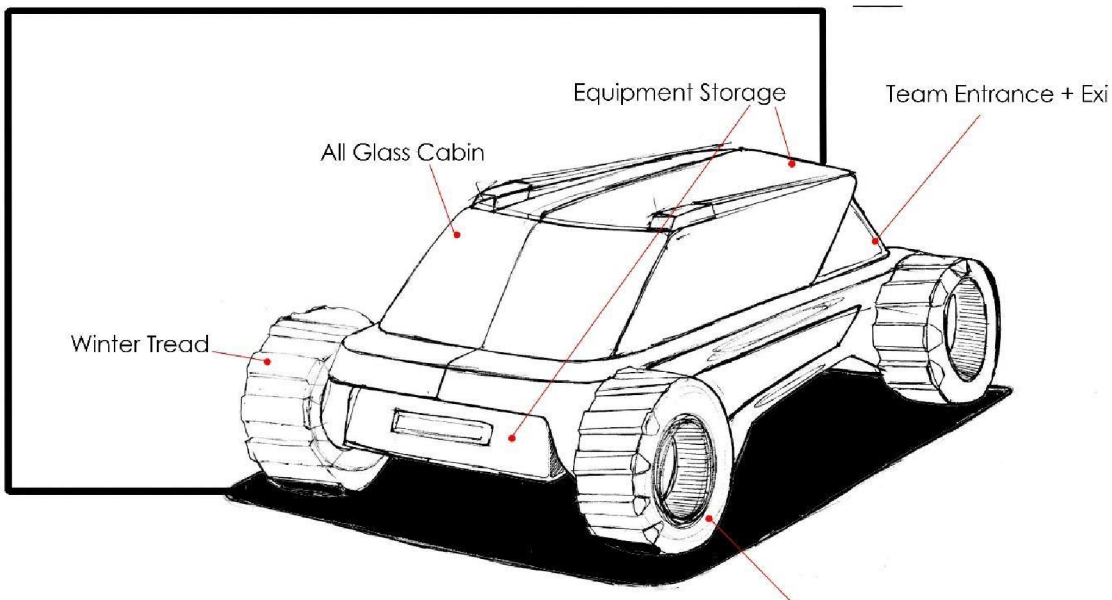
ON WEEK 1

Recon Drone

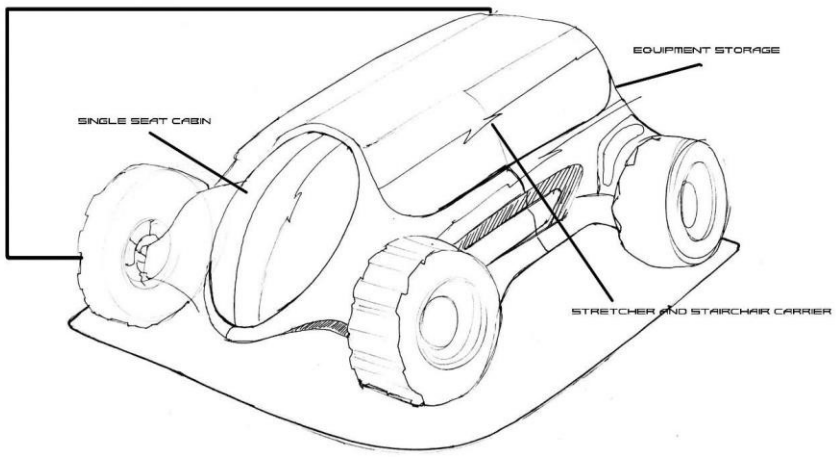




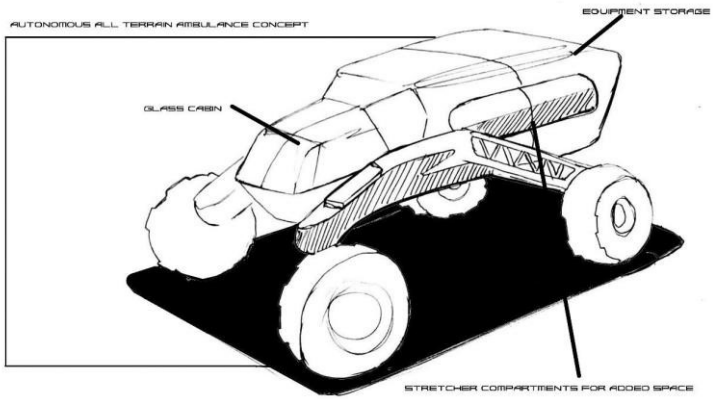
THESIS 2020-2021 IDEA GENERATION WEEK 1



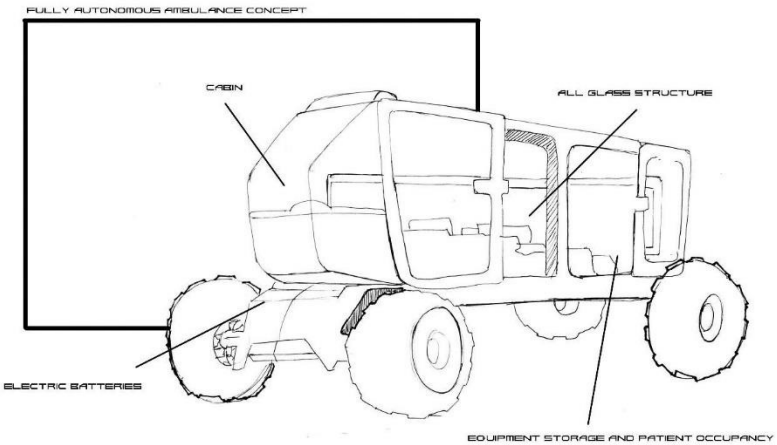
4.2 - Preliminary Concept Explorations



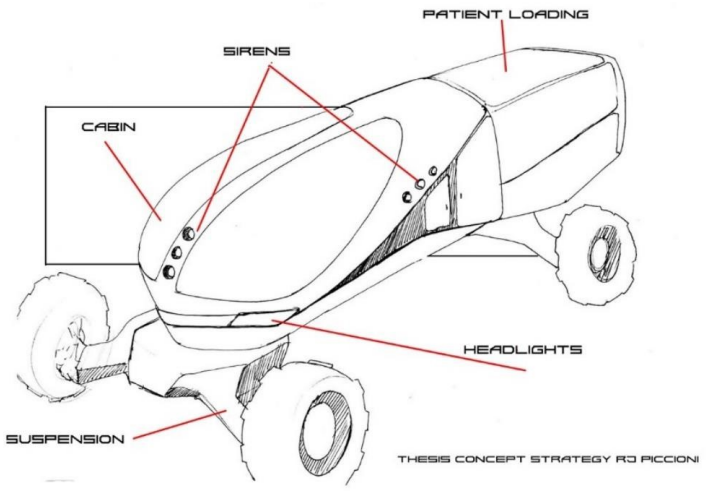
RJ PICCIONI CONCEPT EXPLORATION

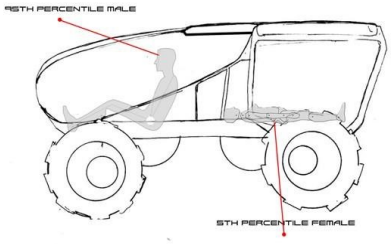


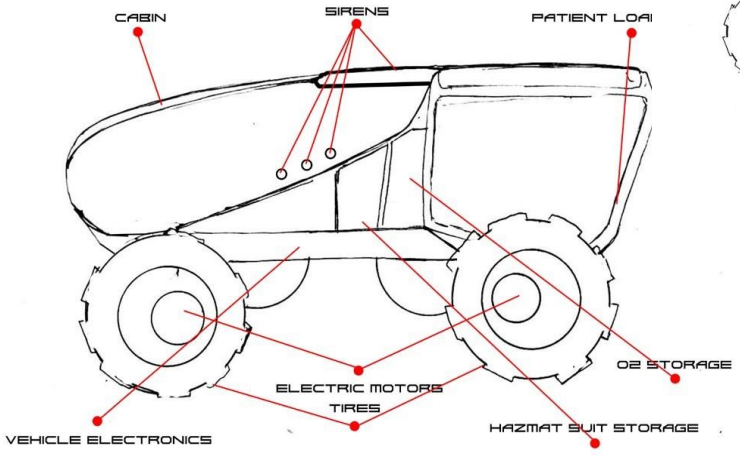
RJ PICCIONI CONCEPT EXPLORATION

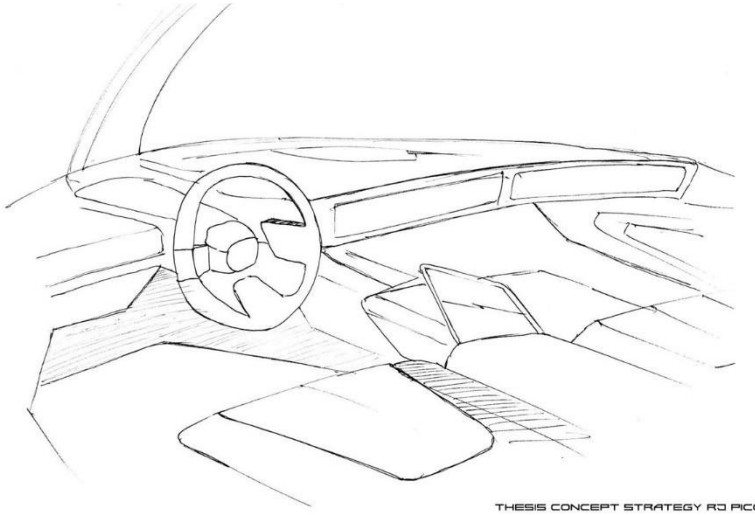


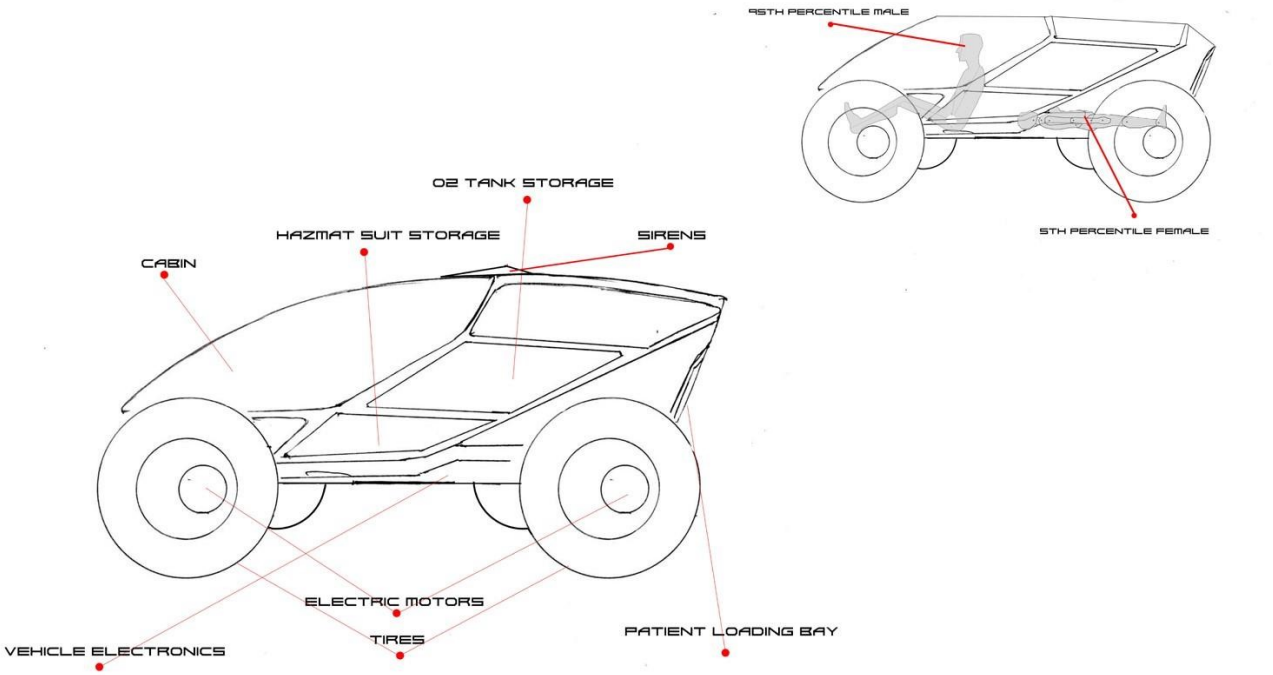
RJ PICCIONI CONCEPT EXPLORATION

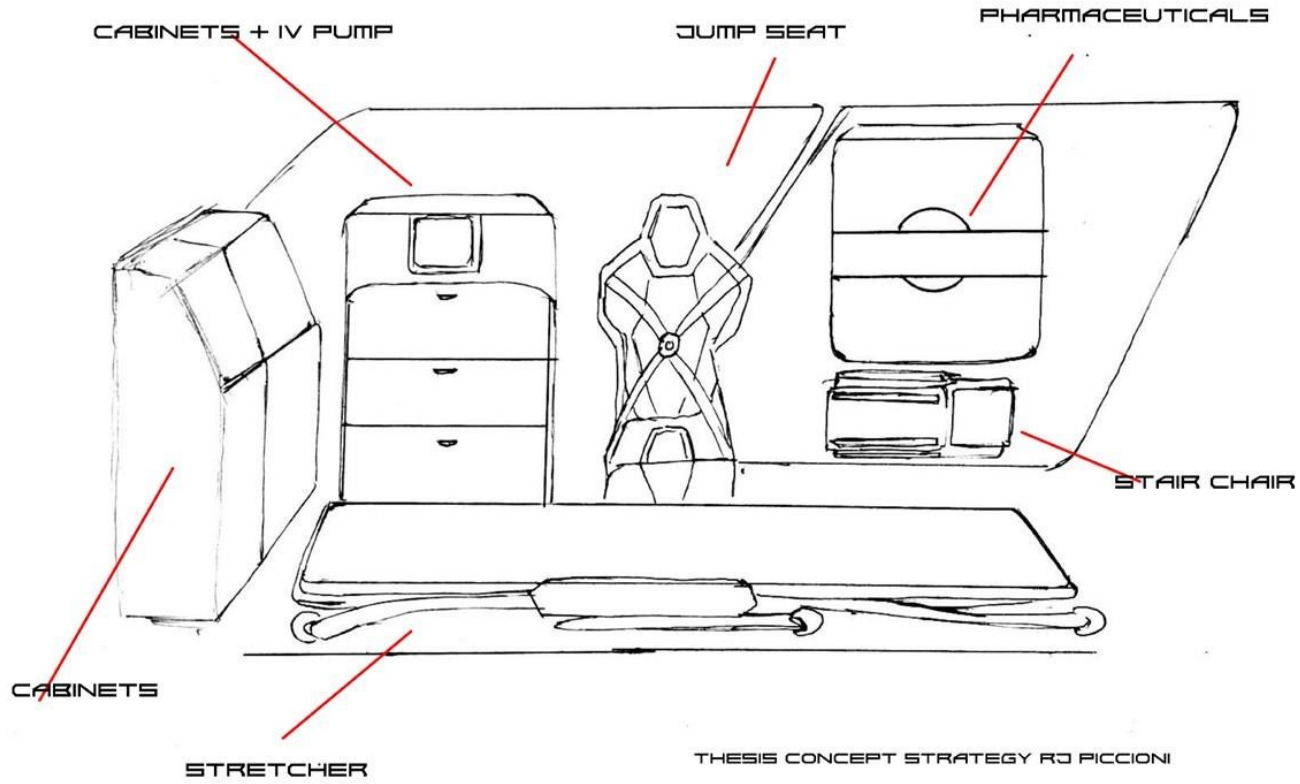

PATIENT LOADING
SIRENS
CABIN
HEADLIGHTS
SUSPENSION
THESIS CONCEPT STRATEGY RJ PICCIONI


95TH PERCENTILE MALE
5TH PERCENTILE FEMALE


CABIN
SIRENS
PATIENT LOAI
O2 STORAGE
ELECTRIC MOTORS
TIRES
VEHICLE ELECTRONICS
HAZMAT SUIT STORAGE

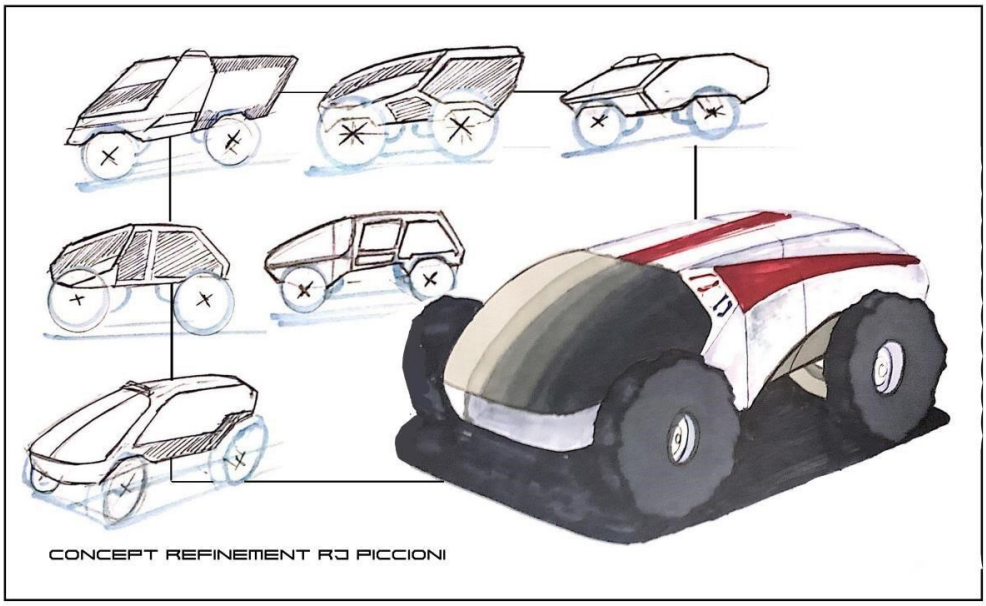

THESIS CONCEPT STRATEGY RJ PICCIONI

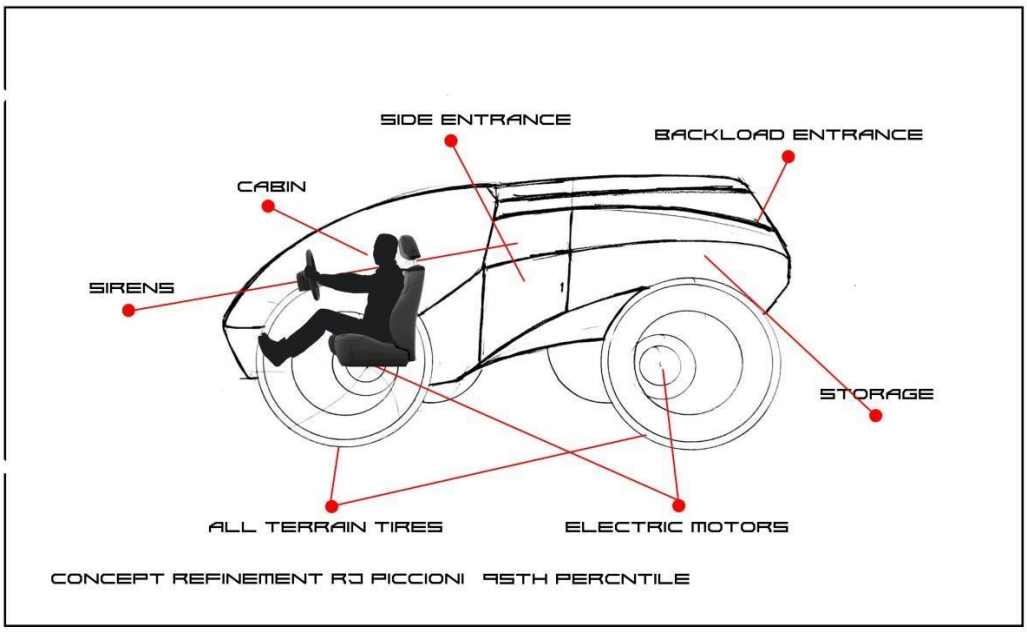


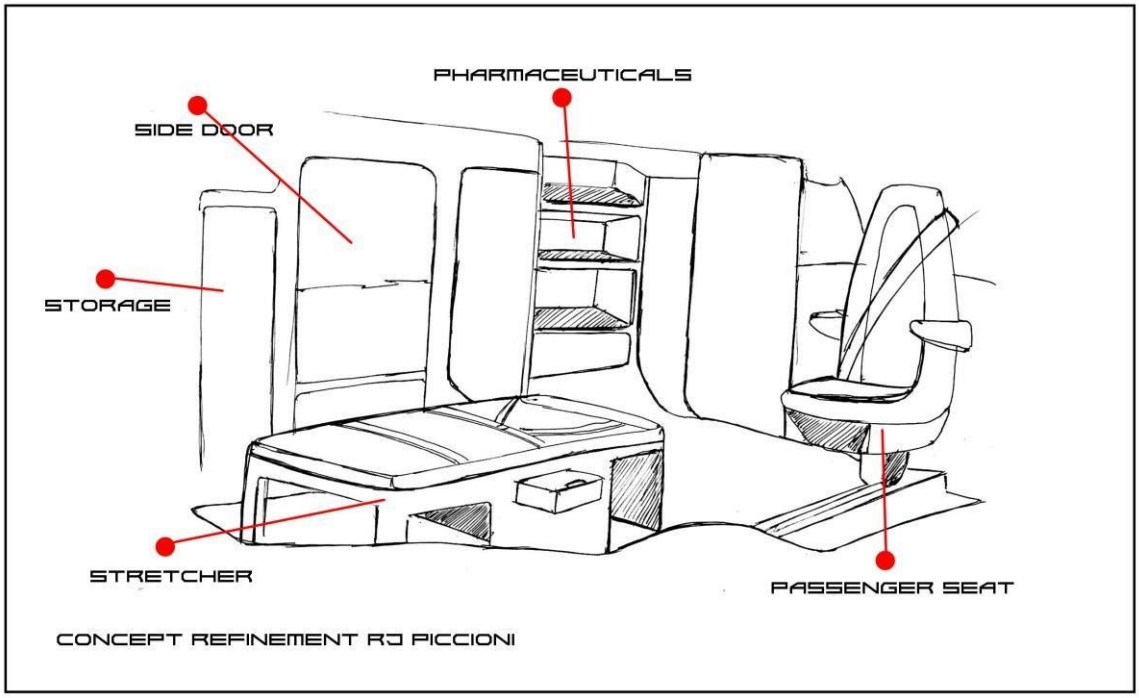


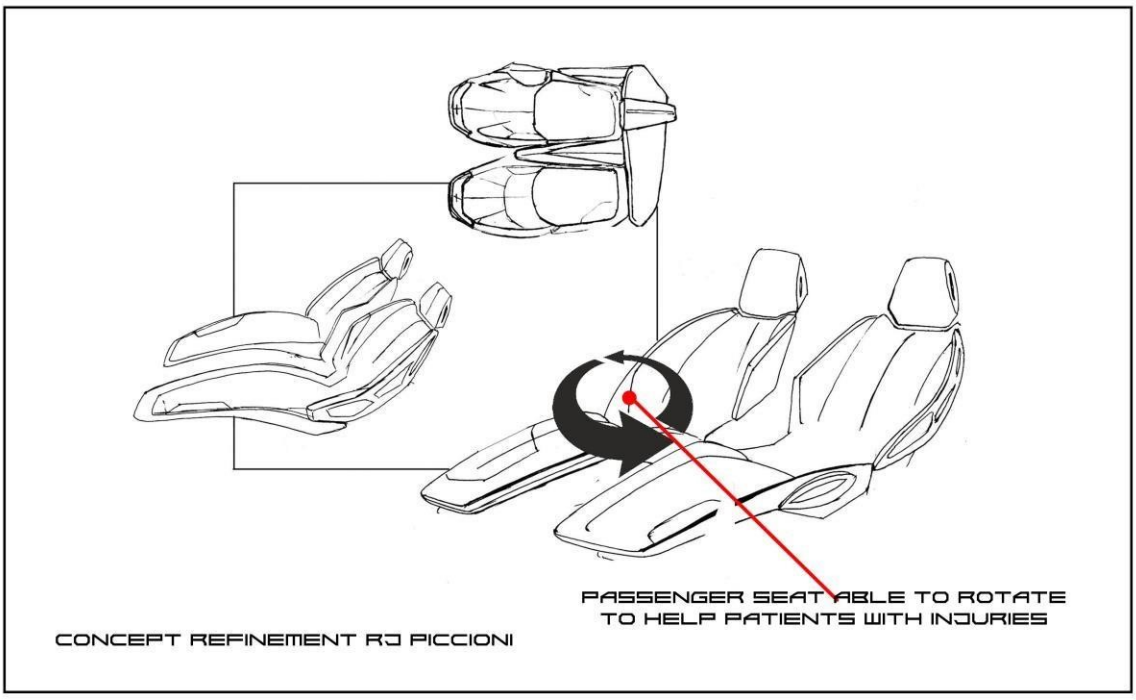
THESIS CONCEPT STRATEGY RJ PICCIONI

4.4, - Concept Refinement






PHARMACEUTICALS
SIDE DOOR
STORAGE
STRETCHER
PASSENGER SEAT
CONCEPT REFINEMENT RJ PICCIONI

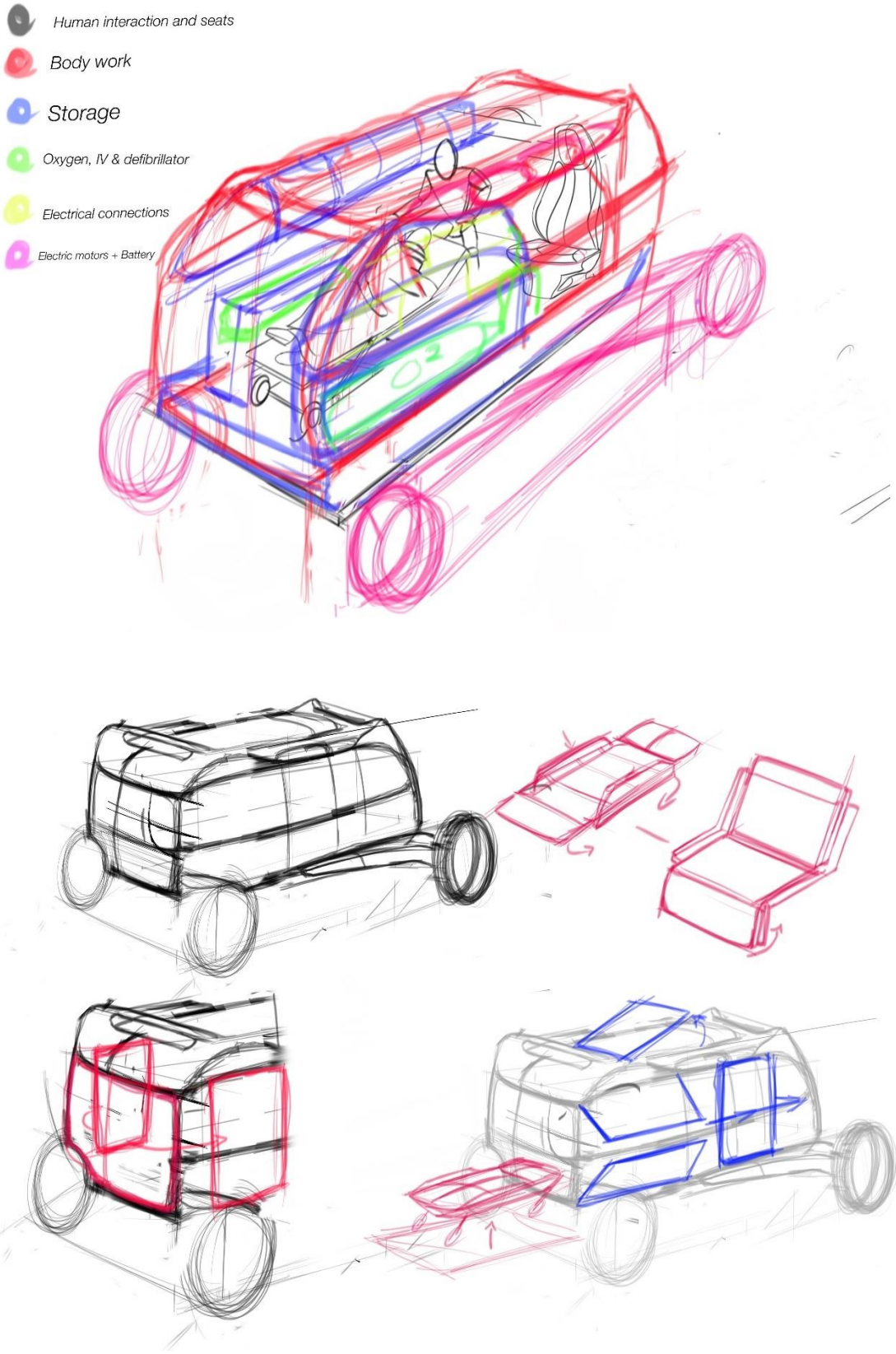

PASSENGER SEAT ABLE TO ROTATE
TO HELP PATIENTS WITH INJURIES
CONCEPT REFINEMENT RJ PICCIONI

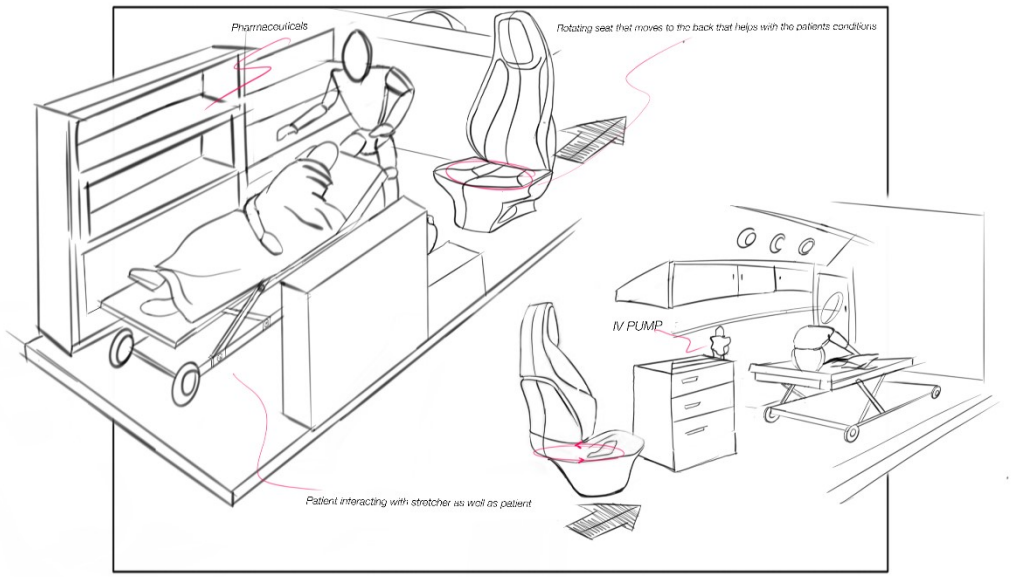
4.5 - Design Realization

4.5.1 - Physical Study Models, Sketch Model Mock Up

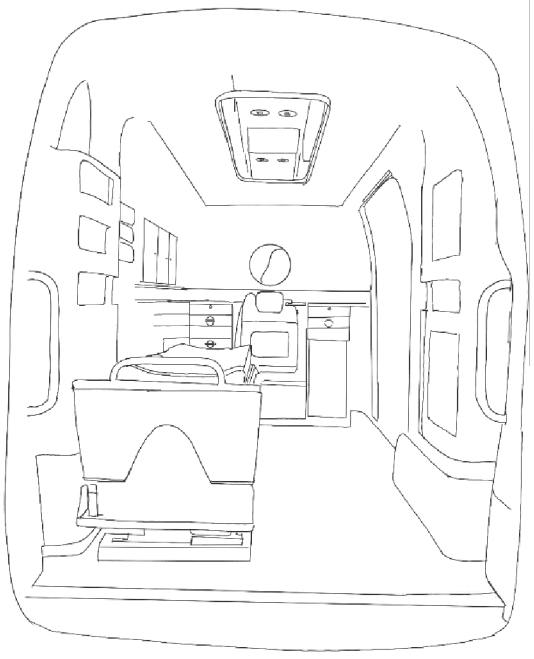

;

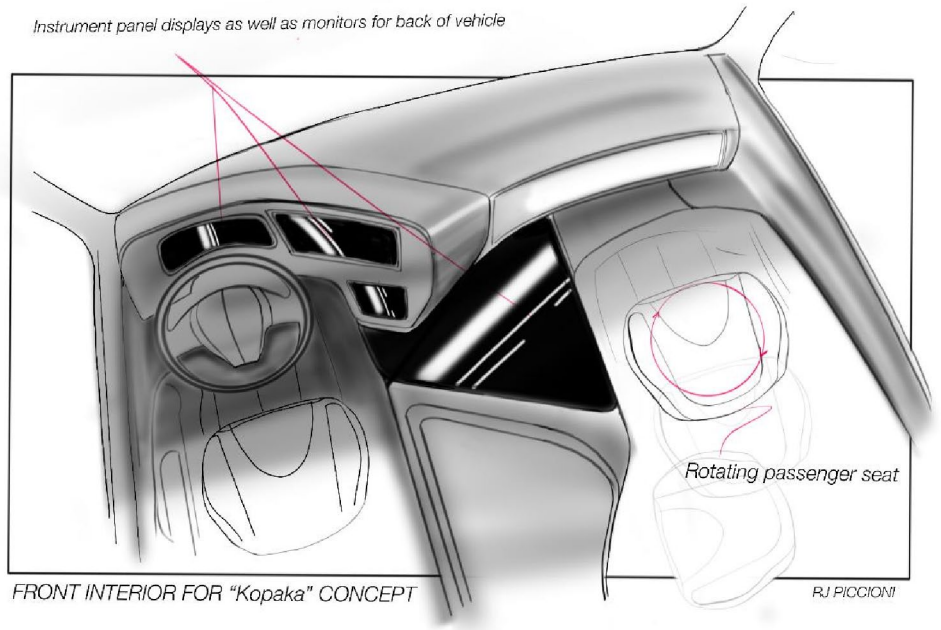
- 4.5.3 Production Schematic





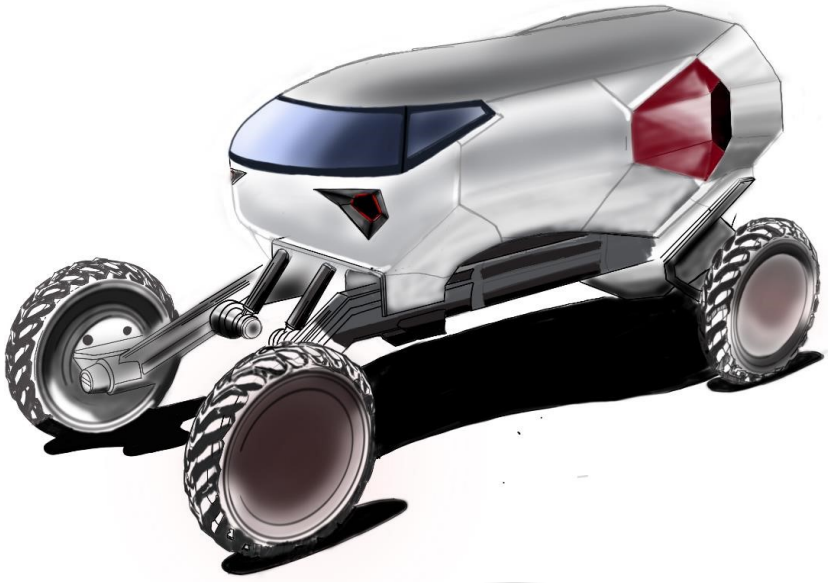
INNER INTERIOR OF ALL TERRAIN CONCEPT ''Kopaka" - RJ PICCIONI

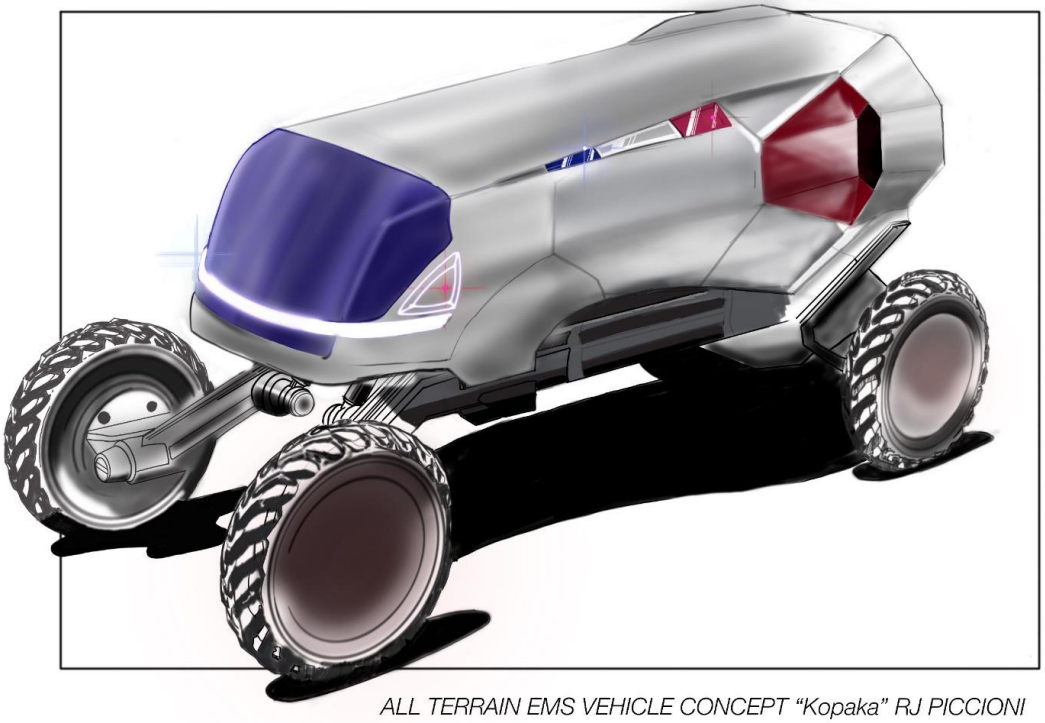




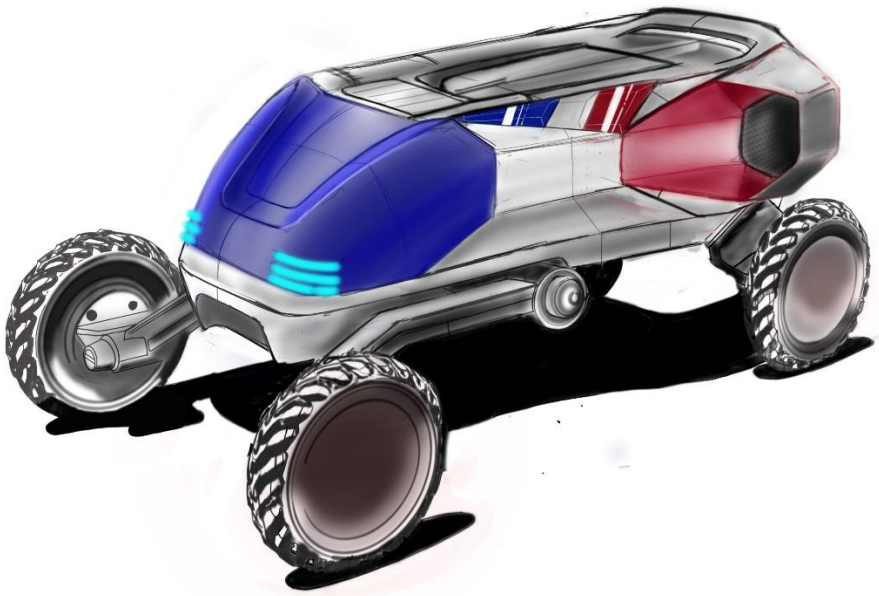
FRONT INTERIOR FOR "Kopaka" CONCEPT

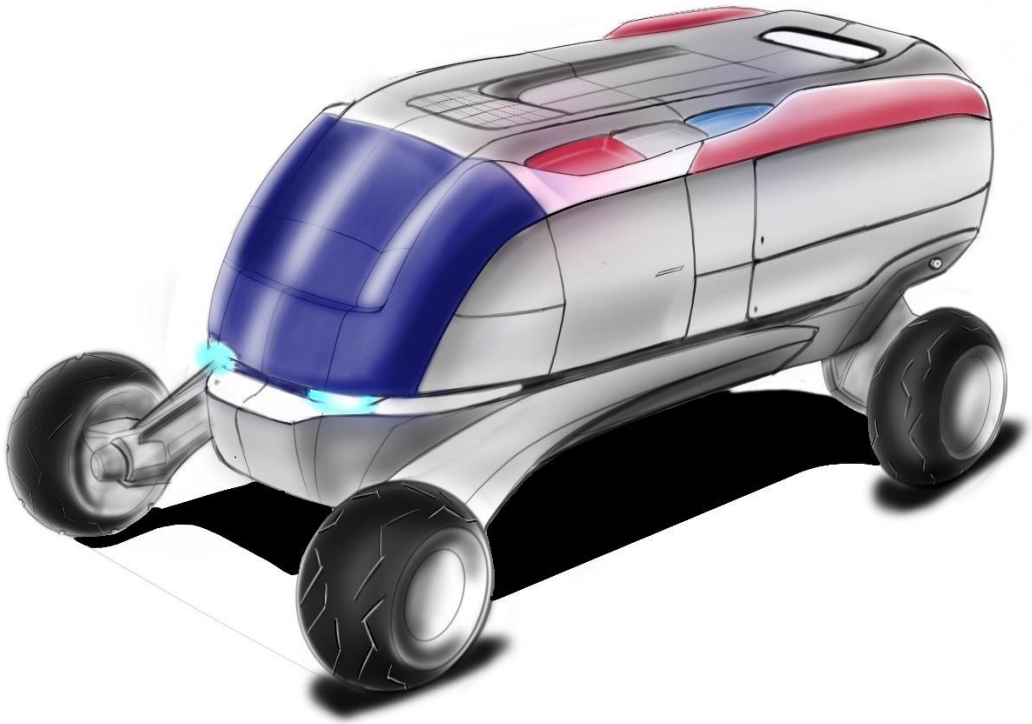
- 4.5 Design Resolution

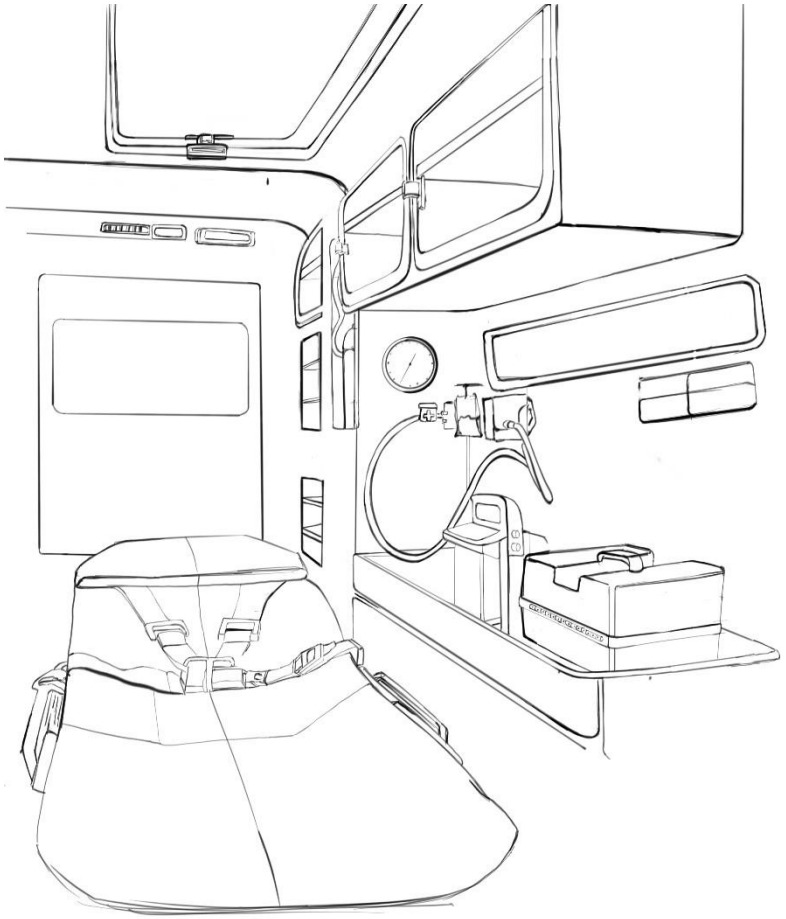


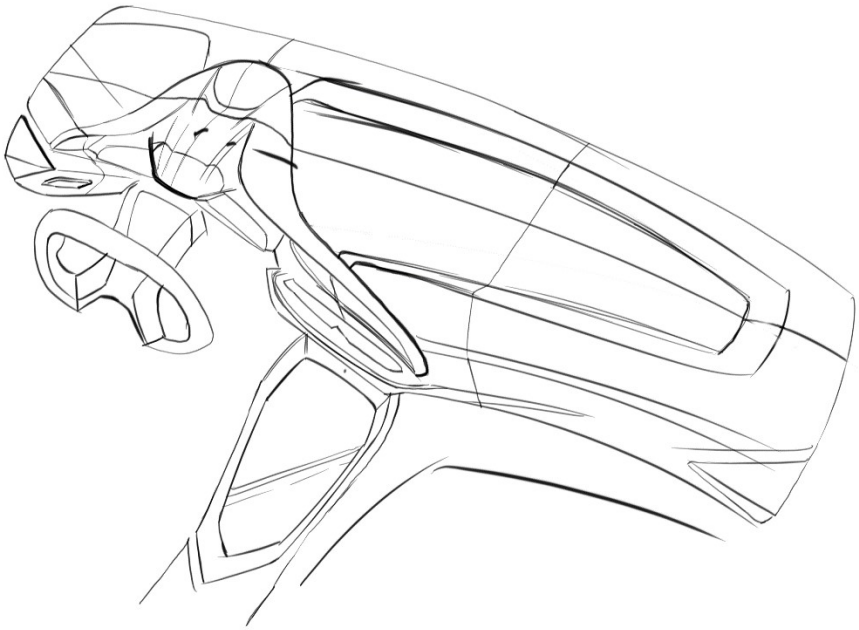


ALL TERRAIN EMS VEHICLE CONCEPT "Kopaka" RJ PICCIONI

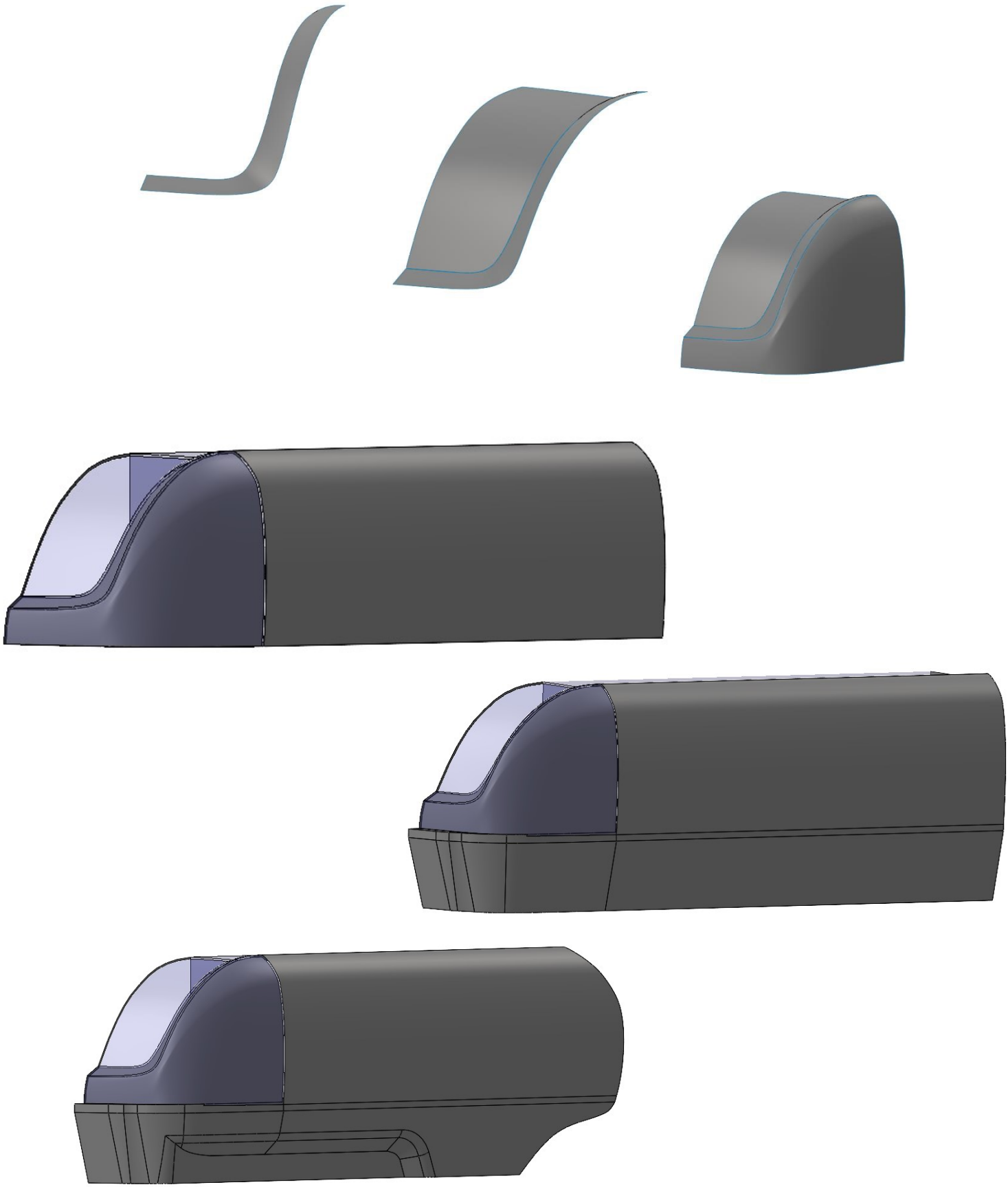


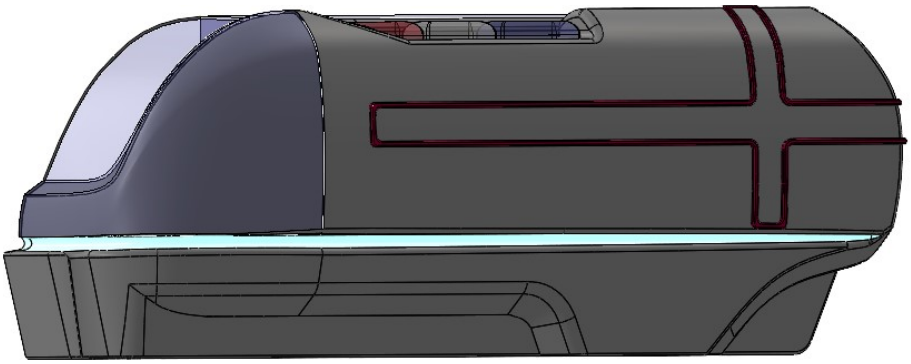


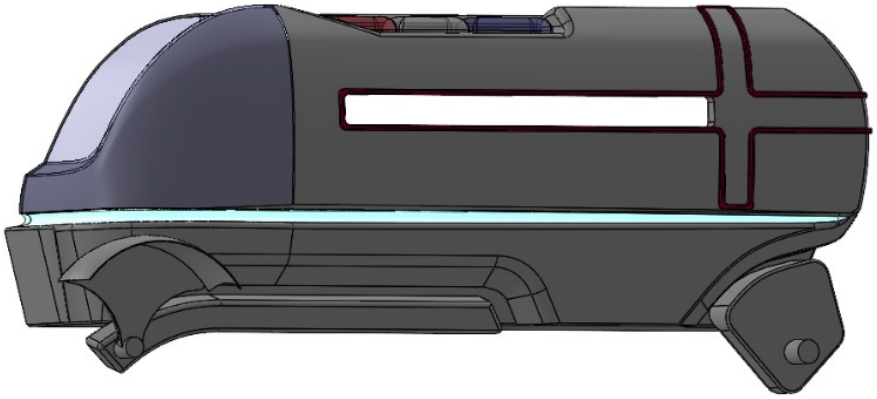


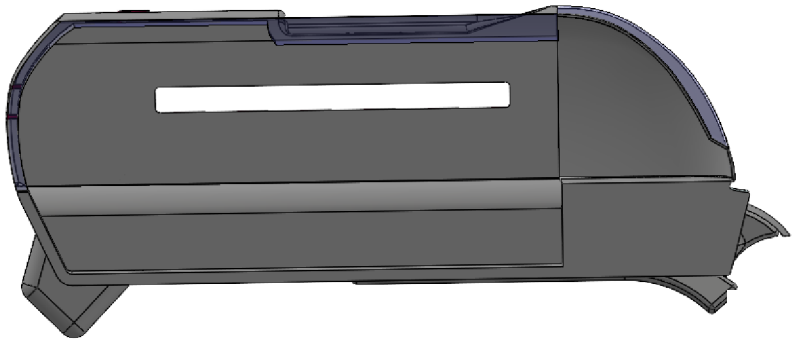


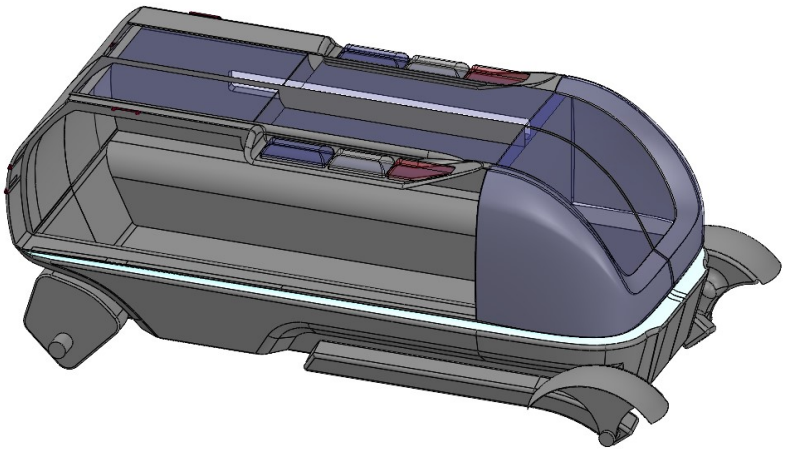
4.7 - CAD Development

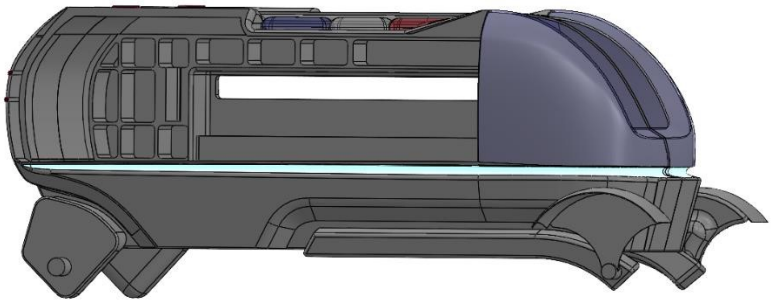


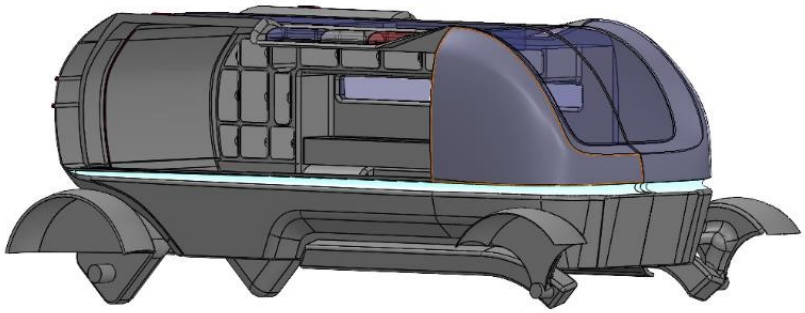


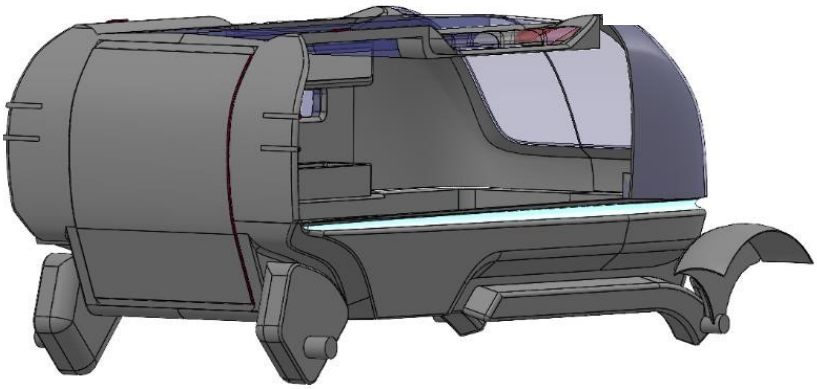


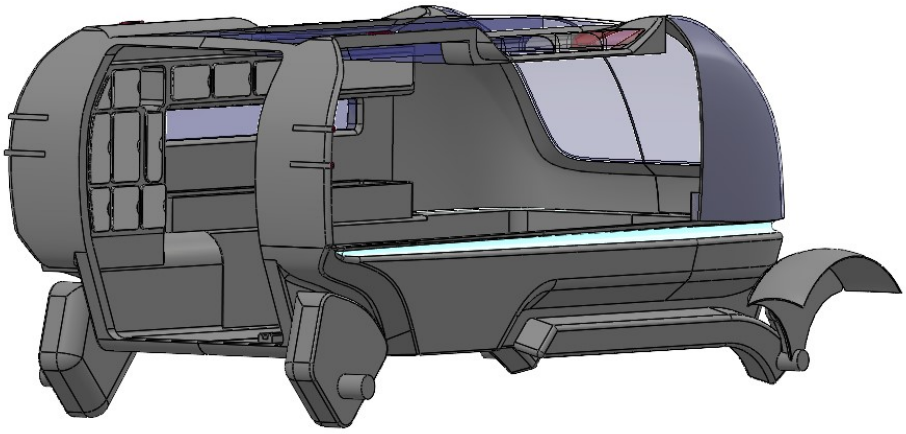


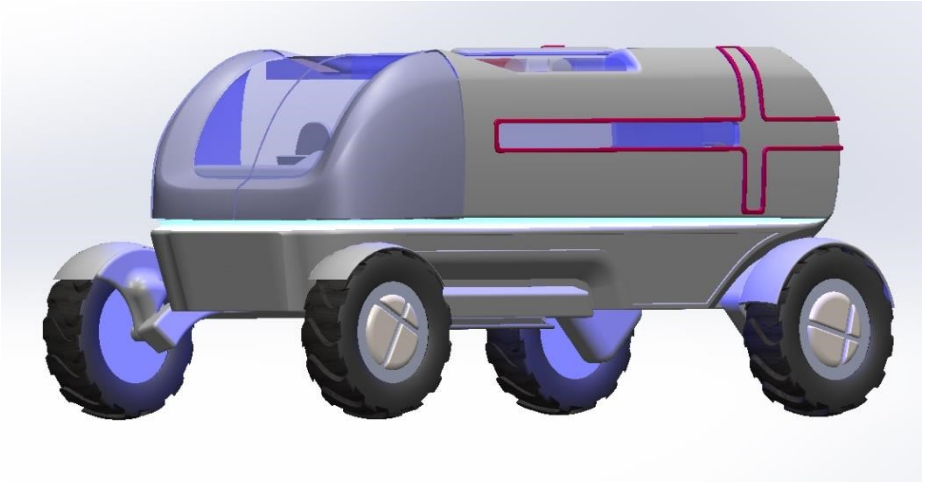


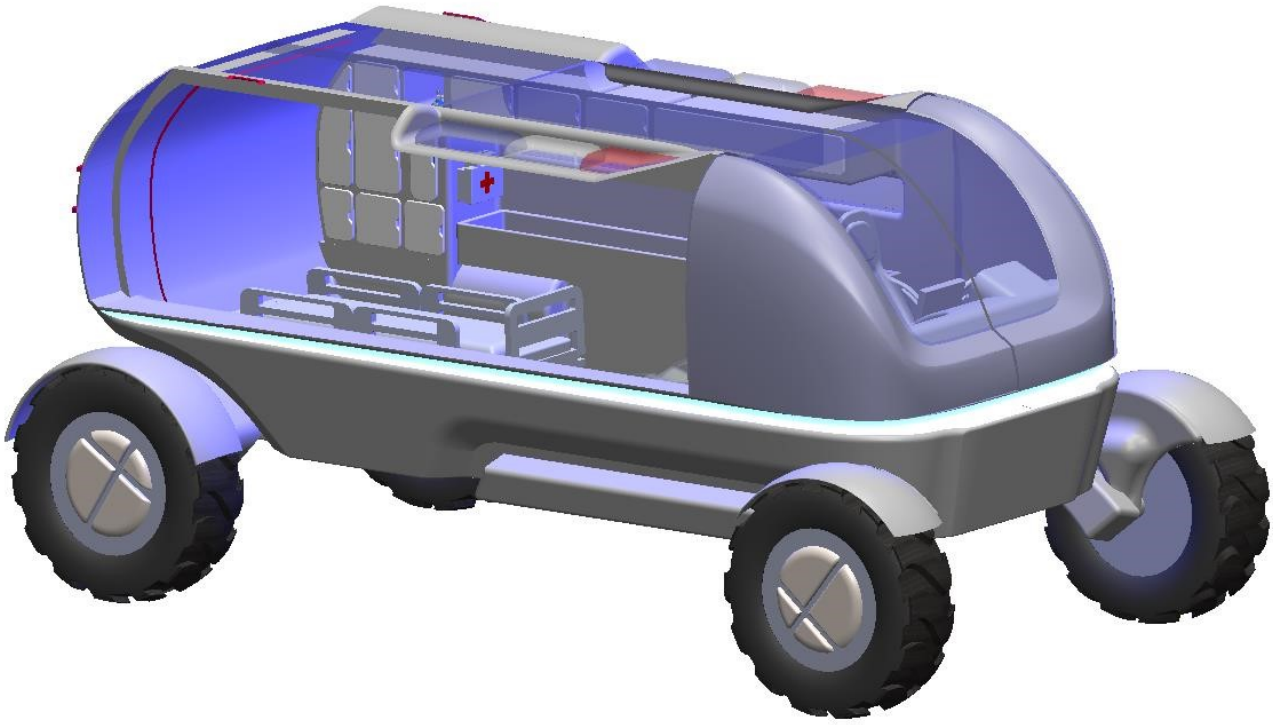












4.8 - Physical Model Fabrication

Chapter 5 – Final Design

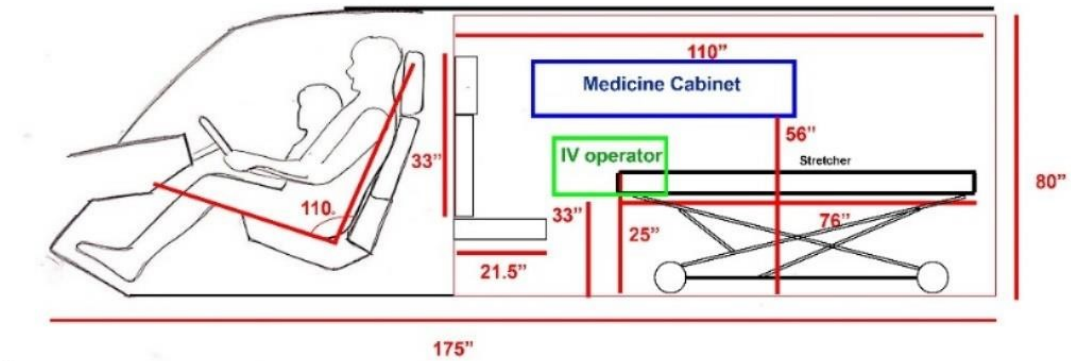
5.1 Summary,

Design exterior designed with a belt line LED headlight that angles down on either side of the vehicle and angles straight with peripherals at the front. Windshield and roof designed with clear blue glass as the roof doors will open. Creating an area for the patient on the inside needing to be air lifted. Cabinet doors installed in the interior due to storage needs. All terrain tires added to suspension. Sirens added to the top separately. Added passenger seat rotates to provide comfort to the patient in rear. Track added for mounting Stretcher to the vehicle itself, provided passenger seat is located on the same track.

-

5.2 Design Criteria Met

5.2.1 - Full Bodied Interaction Design (Located in Chapter 3 Ergonomic study)



5.2.3 - Implementation Feasibility and Viability

Bill of Materials			Material Cost		
Number	Part	Material	Qty	Estimated Cost	Total Cost
1	Electric Motors	Various	4	9000	
2	Lithium-Ion cells	Lithium Ion	7100	9.39/kg	
3	Lithium-Ion Battery Modules	Lithium Ion	18		$6000
4	Dashboard		1	2000	
5	Oxygen Tank		2	2000	
6	OLED Display	Various	1		
7	Medical stretcher	Stainless Steel, Memory Foam	1(2)	10,000	
8	Seats	Pinatax Leather		600	
9	Defibrillator	Various	1	1700	
10	Syringe pump	Polymer various	1	4000	
11	Solar Panels	Various	24	6000	
12	Cabinets	Stainrless	16	3000	
13	Body	Aluminum	N/A	10,000	
					$150,000

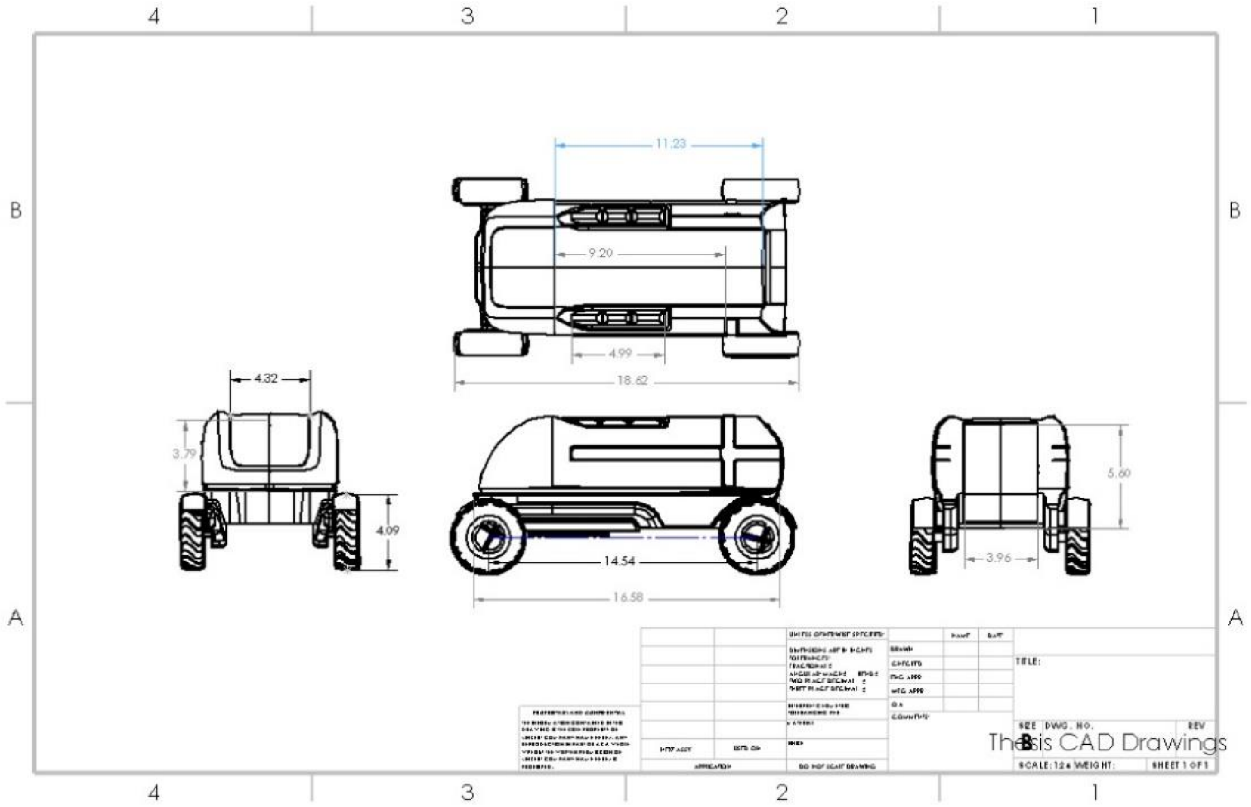
-

5.3 Final CAD rendering

-

5.4 Physical Model

5.5 - Technical Drawings



References

. Oneida Nation Paramedic Services. (n.d.). Retrieved October 16, 2020, from https://oneida.on.ca/oneida-nation-paramedic-services-2/

Average Salary 2020. (n.d.). Retrieved October 16, 2020, from http://www.salaryexplorer.com/salarysurvey.php?loc=38

Toronto Paramedic Services. (n.d.). Retrieved October 16, 2020, from https://www.toronto.ca/legdocs/mmis/2019/ec/bgrd/backgroundfile-133014.pdf

Hamilton Paramedic Service 2016 Annual Report (N.d) Retrieved October 16 2020, From https://pubhamilton.escribemeetings.com/filestream.ashx?DocumentId=125527

Data USA. (n.d.). Retrieved October 16, 2020, from https://datausa.io/profile/soc/emergencymedicaltechnicians-

Vacon, C., & Follow. (n.d.). How many paramedics? Retrieved October 16, 2020, from https://www.linkedin.com/pulse/how-many-paramedics-charlene-vacon-ph-d-pcp

View of Using a sociological approach to answering questions about paramedic professionalism and identity: Australasian Journal of Paramedicine. (n.d.). Retrieved October 16, 2020, from https://ajp.paramedics.org/index.php/ajp/article/view/301/541

Types of energy in Canada: Canada's energy resources. (2020, November 09). Retrieved February 15, 2021, from https://www.capp.ca/energy/canadas-energy-mix/

André Gonçalves - Editor & Head Of English Market After studying and working in HR, André Gonçalves - Editor & Head Of English Market, After studying and working in HR, & All, S. (2020, March 09). Are electric cars really ecofriendly? Maybe not as such much as you think. Retrieved February 15, 2021, from https://youmatter.world/en/are-electric-cars-eco-friendly-and-zero-emission-vehicles -26440/

Harrabin, R. (2020, March 23). Electric car emissions myth 'busted'. Retrieved February 15, 2021, from https://www.bbc.com/news/science-environment-51977625

Materials for electric VEHICLES: Electric Motors, battery cells & PACKS, HV Cabling 2020-2030. (2020, August 24). Retrieved February 15, 2021, from https://www.idtechex.com/en/researchreport/materials-for-electric-vehicles-electric -motors-battery-cells-and-packs-hv-cabling-2020-2030/770 Hb. (2016, January 07). Ambulance services unite in carbon reduction.

Retrieved February 15, 2021, from https://healthbusinessuk.net/features/ambulance-services-unite-carbon-reduction

Factcheck: How electric vehicles help to tackle climate change. (2020, February 11). Retrieved February 15, 2021, from https://www.carbonbrief.org/factcheck-how-electric-vehicles-help-to-tackle-climatechange

https://www.demers-ambulances.com/model-comparison-chart/

http://design.data.free.fr/RUCHE/documents/Ergonomie%20Henry%20DREYFUS.pdf

https://plcustom.com/vehicle-showroom/type-lll-medallion-ambulance/

https://law.resource.org/pub/us/cfr/ibr/005/sae.j1100.2001.html

Appendix

Discovery

SURVEY QUESTIONS FOR ADVISORS

1. What are the steps in becoming a Paramedic?

To become a paramedic, one has to go to college and enrol in a paramedic program. If you have previous healthcare experience or have had previously educated in health and sciences, you have hgher chance of being accepted into the program. Majority of the programs are 2 years long. Courses include Med math, Paramedic theory in class and in lab, fitness, pharmacology, biology, pathology.

After graduating paramedic school, you have to get your certification as a paramedic for Ontario, this is called the Advance Emergency Medical Care Assistant (AEMCA) certification. The test consists of scenario based multiple choice questions that are based on controlled acts and standards that paramedics across Ontario go by.

Once one has an AEMCA certification you can start applying for jobs. Most job-hiring test consists of written testing, interview testing, scenario testing, and driving testing. Once one is hired with a service, one has to get testing and certified by that services base hospital. A base hospital is the what gives permission for paramedics to do the controlled acts.

2. What is the standard equipment you use everyday?

With my service we use pagers, radios, electric stretcher, LifePak (LP)15[cardiac monitor], suction, oxygen tanks, response bag, stair chair, #9 stretcher, blankets, sheets, and pizza blankets.

3. What would you say is the biggest struggle paramedics face in a colder environment?

I believe that the biggest struggle that paramedics face in a colder environment would be extrication of the patient and heat management.

4. In terms of efficiency, do you feel the industry needs an equipment upgrade, or an upgrade in another area particularly?

   I do believe that the industry needs an equipment upgrade in many places to make pt care as efficient as possible. It if the little things that would make a world of a difference,

5. Where do you think efficiency could be improved in the occupation or industry?

Efficiency could be improved response times to calls and response time for back up crews.

6. What are the more typical injuries people face on the job?

Back injury, shoulder injury, knee injury, and mental injury

7. What are the more typical injuries paramedics face on the job? What about victims?

   Back injuries, shoulder injury, knee, wrist, neck, ankle, mental injury

8. What are the main issues when dealing with incidents in a harsh winter environment?

Accessibility to the pt, visibility, warmth of the pt, equipment being able to function properly. An example of this would be like a stretcher wheeling digging into the snow, stair chairing and a foot falling into the snow, brings up increase chances of dropping a pt, snow drifts and bringing pt out onto the road where equipment is left due to accessibility issues.

9. What incidents do you feel could've been handled better had there been a product made for that specific situation?

   If there was a product that was like a sled type device that was like a scoop or a spinal board that was collapsible and would allow the crew to be able to slide the pt ontop of snow to make it to the stretcher. I believe a device like this would have greatly impacted the way a call would go, it would also benefit the amount of scene time a crew could have, decrease the risk of injury to pt and to paramedics, hopefully reduces the need for allied

agencies (in my service to call for back up may take from 10-20 minutes as there is one base per community and only one crew working days and one crew working nights).

10. Which equipment items do you wish worked a little more efficiently?

    I wish the stretcher would work more efficiently with snow, like the wheels don't sink into the snow. When this occurs it can cause the stretcher to tip over causing injury to pt and crew. Battery like of the stryker stretcher does not do well with cold environments as the battery gets drained faster. One time I was working on a refusal in the winter time probably around 11 pm (around -26 degrees C) and stretcher was outside of the house for 10-15 minutes and the battery was almost drained.

11. What is your opinion on the current vehicles used for paramedical services?

    I believe that the vehicle that my service uses can be better fitted for the winter weather. I believe that if we had trucks with higher clearance, fitted with AWD or 4WD options (as the trucks we use are RWD), winter tires for the front pair.

12. Have you ever had equipment malfunction or a break during a time of need? Which was it?

    I have never had a item break in a time of need however I have had the stryker loader malfunction on a call where we were offloading the pt to ORNG helicopter crew. The loaders prongs were not able to lower itself and disconnect the stretcher. This caused the stretcher to be held in the air with the pt on it. It was quite embarrassing as the ORGN crew was waiting for the pt and staring at us. However, we found a way to override the system and manually lower the loading prongs and offload the pt.

13. What is a piece of equipment you couldn't operate without? Stretcher

14. What is one weather condition you never operate on and why?

    We operate in all conditions. The most challenging weather to operate in would be slush or when the snow

melts and refreezes. This makes it very challenging for us to manuver the trucks as our roads are gravel roads and there is a big hill that is right before the hospital. It also increases the chances of us getting stuck going to a call and leaving the residence.

15. Which piece of equipment is the hardest for a paramedic to use with a patient?

I believe that the hardest equipment to use is the stair chair. But not by any design flaw, mostly pt condition and environment factors.

16. What are the similarities and differences between rural area operations versus urban area operations?

The biggest difference my service and a service down south is that we have to deal with longer wait times for back up. As there is only one working crew on days and one working crew on nights at each base. If we require another crew, we have to request an up staff from the supervisor. In the wintertime an ice road connects all 5 communities. Therefore, times for waiting on scene for an upstaff could go from 5-30 minutes. This is a seasonal road that is built in the wintertime the runs the length of James Bay. During the summer and winter time there are no roads connecting the communities.

We have to deal with longer winters due to the snow not melting as quick as down south.

NEEDS		DESCRIPTION
Category of Fundamental Human Needs (Max-Need)	Category of Psychological Needs (Maslow)	Interpretation of possible relevance to design problem space
Basic Needs		
Subsistence		
Protection		Protection from the elements. Protection from further physical and mental injury
Affection		Physical health and first aid
	Physical (the need for air, water, food, rest, health)	
	Security (the need for safety, shelter, stability)	-control over one's environment -value, in terms of fulfilling a need at lower price and enhancing access, reliability
Social Belonging (Effort/ resources to belong to a 'tribe')		
Understanding		
Participation		-convenience, in terms of speed (fast, uses less time) -optimization of limited resources
Leisure		N/A

Social (the need for being loved, belonging, inclusion)	-fear of abandonment -fear of the enemy -Tribal identity (belonging to the winning team) -Peer Pressure (direct and indirect 'Everybody else has it') -could also consider ease of use that permits participation where participation had been limited

Ego (the need for self-esteem, power, recognition, prestige)	-social expectation -social status (the elite has it.. I want to be like them) -social recognition -convenience and ease of use that enhances social recognition -gift giving: reciprocal social covenant
Personal Accomplishment	
Creation	-could consider the convenience aspect of a product (tool) that amplifies human abilities ease of use
Identity	-could relate to the next generation and be longer term / less immediate. Examples: sexual attractiveness; the health/care/education of children -environmental sustainability
Freedom	-convenience in terms of availability (is it easy to buy)

Self-Actualization (the need for development, creativity)	-includes sensual pleasure, such as: visual, acoustic, tactile, haptic, taste, olfactory includes aspects of emotional response, such as: empathy, excitement, fun, nostalgia, memory, etc. -could also include compulsive behaviours, such as: buying, gaming, smoking, drinking, sex, adrenaline rush, etc. -aesthetically pleasing -intrinsic pleasure -the ability to prepare for the future in terms of insurance (house, car, medical), pension, investments

COMMENTS BASED ON EVIDENCE & EMPATHY			
Comments about Needs discovered in topic/problem space (include source from discovery search, if possible)	Level of Relative Importance to design of new product		
	Slight	Moderate	High
At the basic minimal level, this product needs to be able to contribute to saving lives.			x
In the need of paramedical staff, protection for the patients.			x
N/A	x		
Paramedical staff need to be in good physical condition in order to be professional and provide adequate care.			x
This would allow paramedical staff to turn a unfavourable climate into one that is manageable.			x

		x	
A product or a vehicle built to deal with harsh winter environments in a paramedical field, needs to be able to get to its destination quickly, as well as scale harsh terrain.			x
Not meant for leisure. Strictly productive function.	x		
The fear of the enemy that paramedical staff deal with is the loss of a patient or the fear of being too late to do their job. Unable to complete what they commit to everyday		x	
The social expectation of any medical product is the understanding that the product needs to physically work. The more successful the product is, the more the public would have an understanding of how "easy " a premedical staff's job is. Which can be detrimental	x		

This product will amplify human’s success rate to save lives. Speed as well as strength			x
If this product is successful, future generations could use it or improve it as well., environmental sustainability will increase as well as efficiency in health care			x
Not meant for public purchase. Only meant for industry use	x		
Emotional response includes reassurance that the job will get done. Insurance to keep product up to date to perform job at hand. Small repairs or iterations to stay relevant is important.		x	

User Research

Bonus Survey Questions

5. Where do you think efficiency could be improved in the occupation or industry?

Equipment delegation, workload management, Volume of calls.

6. What are the more typical injuries people face on the job?

7. What are the more typical injuries paramedics face on the job?

8. What are the main issues when dealing with incidents in a harsh winter environment?

9. What incidents do you feel could've been handled better had there been a product made for that specific situation?

10. Which equipment items do you wish worked a little more efficient?

11. What is your opinion on the current vehicles used for paramedical services?

12. Have you ever had equipment malfunction or break during a time of need? Which was it?

13. What is a piece of equipment you couldn't operate without?

14. What is one weather condition you never operate on and why?

15. Which piece of equipment is the hardest for clients to use?

6. elderly falls, typically hip (from falling on their side) and wrist (from trying to brace their fall)

7. lower back, knees (acl tears, dislocations, etc.)

8. Time spent outside should be limited to prevent medic frostbite/injury as well as patients

9. Tough terrain/snow terrain tires for stretchers/stair chairs

11. current vehicles are best suited for city/suburb terrain, could be better equipped to handle off roading (tires, suspension system, etc.)

12. Equipment that runs on batteries (stretcher, suction unit) become extremely cumbersome once they run out of battery and make the job harder rather than easier

13. Cardiac monitor

15. CPAP (Continuous Positive Airway Pressure) machine, many patients have trouble letting the machine breathe for them and can often make their anxiety/breathing worse

ADVISOR MEETINS AND AGREEMENTS

Humber ITAL / Faculty of Applied Sciences & Technology

IDSN 4502

Bachelor of Industrial Design / WINTER 2021

SENIOR LEVEL THESIS TWO

Catherine Chong / Sandro Zaccolo

CRITICAL MILESTONES: APPROVAL FOR CAD DEVELOPMENT & MODEL FABRICATION

Student Name:	**RJ PICCIONI**
Topic / Thesis Title:	**Sustainable EMS Vehicle For Winter Environments**

THESIS DESIGN APPROVAL FORM

☐ X

Thesis design is approved to proceed for the following: **CAD Design and Development Phase**

Comment: Initial CAD progress reasonably as of week #12 / April 12th, continue with detailing and refinement. CAD must complete before model fabrication.

Model Fabrication Including Rapid Prototyping

☐ X

Thesis design is approved to proceed for the following: **and Model Building Phase**

Comment: Design development progress reasonably as of week #12 / April 12th, once CAD is completed, can move forward to model fabrication from week #12 onward.

IDSN 4002

Humber ITAL / Faculty of Applied Sciences & Applied Technology

Bachelor of Industrial Design / FALL 2020 SENIOR LEVEL THESIS ONE Catherine Chong / Sandro Zaccolo

FTA-4 THESIS TOPIC APPROVAL (TEMPLATE)

This project/assignment constitutes 5% of total mark for the course

Start: Week #4 / Sep-28
Due: Week #5 / Oct-05

Student Name:	RJ Piccioni
Topic Title:	How may we improve efficiency for first responders in harsh winter condition?

THESIS TOPIC APPROVAL:

Abstract

Harsh winter climates provide a difficult environment for first responders to work efficiently. Places in the Nordic have access to emergency care and services but those products and vehicles are inefficiently equipped to deal harsh climate. One of the biggest obstacles first responders face is the roads that are unforgiving to current vehicles. are a great number of deaths per year due to winter roads being in an undrivable state? How can the product design mitigate these fatal injuries as well as save lives with new and improved innovations to our EMS workers? This provides an in -depth study of conditioning factors that make up the products used in rescues today for paramedic and first responder occupations that live in harsh winter climates. Data collection is used to provide information on the injuries related to harsh winter climate conditions su ch as, harsh roads, fires, lack of time. Feedback from active in the industry will be present to bring awareness of the current setbacks of the equipment that paramedics use Data collection on where in Nordic environments are there an increase or a decline, proportionately, to the well as how many successful versus unsuccessful operations are listed. Why do current solutions not work? What current setbacks that the product industry faces to help? Ergonomic detail will be provided in a full body interaction and a solution can be made to provide successful operations within the EMS work force in the harsh winter

Chong, Kappen, Thomson, Zaccolo

Student Signature(s): RJ PICCIONI	**Instructor Signature(s):** Catherine Chong Sandro Zaccolo
Date: OCT 5 2020	**Date:** 03 / 11 / 2020

Conditions of Participation

- ☐ I understand that I am free to withdraw from the study at any time without any consequences.
- ☐ I understand that my participation in this study is confidential. (i.e. the researcher will know but will not disclose my identity)
- ☐ My identity will be masked.

☐ I understand that the data from this study may be published.

☒ **I have read the information presented above and I understand this agreement. I voluntarily agree to take part in this study.**

Zack Cattapan	Zack Cattapan	**11/09/2020**
Participant's Name	Participant's Signature	Date

Project Information

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more about this Senior Level Thesis project, please contact me at the followings:

Phone: (647) 625-5233

Email: caseyho@live.ca
My supervisors are:

Prof. Catherine Chong, **catherine.chong@humber.ca**

Prof. Sandro Zaccolo, **sandro.zaccolo@humber.ca**

PARTICIPANT INFORMED CONSENT FORM

Research Study Topic: How may we make prosthetics more accessible for those in developing countries?

Investigator: RJ PICCIONI (905 699 8532) rjpiccioni@hotmail.com

Courses: IDSN 4002 & IDSN 4502

I, Zack Cattapan have carefully read the Information Letter for the project “How may we help EMS workers perform efficiently in Winter Environments” ,led by RJ Piccioni A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact RJ Piccioni at any time during the project.

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

Consent for Publication: Add a (X) mark in one of the columns for each activity

ACTIVITY		YES	NO
Publication	I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public	☒	☐
Review	I give consent for review by the Professor	☒	☐

Privacy

All data gathered is stored anonymously and kept confidential. Only the principal investigator /researcher RJ Piccioni and Prof. Catherine Chong or Prof. Sandro Zaccolo may access and analyze the data. All published data will be coded, so that visual data is not identifiable. Pseudonyms will be used to quote a participant (subject) and data would be aggregated.

I also understand that I may decline or withdraw from participation at any time, without negative consequences.

I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, **Lydia.Boyko@humber.ca** or

Casey Ho, (647) 625-5233, caseyho@live.ca

Verification of having read the Informed Consent Form:

☒ I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

Zack Cattapan	Zack Cattapan	**11/09/2020**
Participant's Name	Participant's Signature	Date