Appendix I: Comments gathered from Kickstarter

Hello, Backer#821 here, wanted to ask about the traveling case add-on. What brand will the case be from, size, and materials used? Also will the case have space for all the add-on items that we can get, as well as the Meticulous Milk foamer device?

For $200 I expect the case to be top notch. I can get a decent hard guitar case for that kind of money. I made the mistake of buying the $50 dollar lagom mini case from option-o that was a total piece of crap. Warranted or not my opinion of option-o dropped considerably after that

Well, $200 buys you a decent mid-sized Pelican case (when not on sale), so that's why I'm asking. My biggest concern is it will only hold the Meticulous Espresso maker and not the Milk device. If that's the case I'd rather just buy my own hard case with foam and configure it myself

Hi Matt! We're still sourcing that but you'll have all the details at the moment you order your case :) However, the options we're looking at do not have room for the Meticulous Milk, so the case will be just for Meticulous Espresso + its accessories

@Eric, it will be excellent quality for sure! We want to make sure you machine stays safe!

Thank you for the size information. Because I've ordered both the espresso and milk machines, I'll probably just find a larger case on my own to fit everything. Thanks!

Wishlist want: be able to use met milk to instant heat water for espresso

You mean use it as a kettle?

Yeah, fill the milk pitcher with hot water

Why if you can do that directly in MET Espresso, unless you are only planning to buy MET Milk

I could be wrong but it seems in general it's very difficult to have both fast thermal transfer and accurate thermal stability. You see flair users still using a kettle even though they have electronically heated brew chambers. I envision using met milk for quick, inaccurate heating and then met espresso for slow, accurate heating

I honestly don't think that this idea makes much sense. The Meticulous espresso machine will be able heat up water (from cold) in less time then you can prepare a portafilter with coffee. I'd also say that the Meticulous Milk is not really suitable as a kettle. While the water volume is probably big enough (I think I read 250ml somewhere), it's a milk steamer, producing steam. That's at or above 100 degrees Celsius (at sea level), meaning the espresso machine will have to cool it down most likely. It can't do that with its heating element. Apart from all that, have you ever tried to fill a pitcher with water from a steam wand? Not ideal to say the least. All in all, even if possible, your idea just introduces extra steps without any benefit whatsoever. No offence, that's just how I see it

The video I saw it still took a couple minutes for meticulous to heat the water, and that was from a kettle. Doubt it’s going to be quick enough to heat from cold when it only takes a minute or so to prep a portafilter

With the final version it will take probably 3 minutes or less to heat up the water. It only takes you a minute to weigh out the beans, grind the beans, distribute and tamp for a properly prepared portafilter? Respect, I’m nowhere near that fast

I pre weigh into vials, mostly because I like having time to go through a bag and pick out the cruddy beans. Not a big deal if I have to wait I just have trouble standing idle

Feedback/opinion about the Meticulous Milk: I think that the motorized inverted lever concept in the Meticulous Espresso is a genius idea. It's a brand new idea that might have a real positive impact on the current home-espresso market if properly implemented. The app shot mirror (one of the stretch goals) is another innovative and brilliant idea. However, I am far from having the same positive impression about the Meticulous Milk concept. The reason is because I don't see any new idea in the Meticulous Milk, either in concept or in the implementation. Sorry to be so blunt. For that reason, I don't see how the Met Milk could bring anything superior to existing equipment.

As described by Meticulous, there are two ways to use the Met Milk: 1. automatic or 2. manual modes. 1. The automatic mode in the Met Milk is no different than how Italian or Swiss super automatic expresso machines operate by injecting air for bubbles and steam for mixing. We know that none of these machines (even the most expensive ones) produce milk froth quality anywhere close to milk froth quality produced manually by any good barista. In my opinion, the probability that Met Milk will produce any better milk froth quality automatically than these existing machines based on the same concept is very low. 2. The manual mode in the Met Milk is no different in concept than the milk module in the Decent, which is also based on a boiler-less technology. The main difference is that Meticulous is proposing a milk unit separate from the machine, which is an interesting offer in itself. But, I think they should just have focused on a manual-only milk unit for home use and try to partner with Decent (who has already a working technology). Here, by trying to have both an automatic mode and a manual mode, they need to have a much thicker steam wand (to incorporate temperature sensors), which will make the manual mode harder and, likely, lower quality. In the end, my guess is that none of the automatic or manual modes will be worth it.

It seems that Meticulous is trying to become a design company proposing simple, modern and functional designs of espresso equipment re-imagined from the ground-up. That's what they could achieve with the Met Espresso (if the implementation is successful), but not with the Met Milk (not as it is currently presented). If the goal is to provide high quality milk froth automatically for home use and at a reasonable price point, I think the NanoFoamer PRO (https://subminimal.com/pages/nanofoamer-pro) has a much higher probability of achieving this goal than the current Met Milk. Another interesting steam-less concept for milk frothing is the one proposed by Heylo in their Milk Module (https://heylo.coffee/en-us/pages/milk-module). It is supposedly based on a Venturi effect to inject air in the milk.

I will not back the Met Milk because I don't think it's bringing anything new and I am afraid it will be a disappointing piece of equipment (that's my guess).

I think Meticulous should get away from steam-based concepts for the Met Milk and take the time to re-think from the ground-up a new concept, maybe similar to the Heylo Milk but for home use.

Anyway, that was my humble opinion about the Met Milk. Happy to hear any differing or agreeing viewpoints from others

RESPONSE: Hey guys, first of all, thank you for all the feedback. We are paying close attention to your comments and considering all of this while we continue to develop the product. I truly believe you'l be surprised with the milk quality it will be capable of producing. Of course, this might not suit some very specific needs, but we are making sure it is an excellent product in both auto AND manual mode. And yes! You'll get to hear external pro opinions before you need make up your mind. Remember you will be able to add or remove Milk from your order through the pledge manager we'll send soon, so you will have the chance to see real world performance before making your decision.

RE/RESPONSE: @Meticulous, thank you for your comments and for re-stating that the Met Milk will be put to the test by external experts. I also admire your confidence about what you and your team will be able to do with this machine.

It does not change my thoughts that this machine would have been better off as a stand alone manual steamer only or as an automatic frother only but based on a non-steam principle, because steaming is just too hard to automate at this price point. In the end, it really depends on what people means by high quality milk foam, since there is no objective metric for milk foam. But if we try to quantify this, and imagine a scale from 0 to 10 where 10 would be the best milk foam that an expert human can create with a commercial steam wand. 0 would be no foam at all and 1 would be the worse foam possible with massive and rigid bubbles. In this scale, 8, 9 and 10 would be what I call latter-art quality milk froth. Then my guess is that Met Milk will be able to produce a 6 consistently, may be a 7 at best. It's a guess based on what we know about the current principles of this machine, and what others were able to do based on the same principles (at a variety of price points). But I would be very happy (and surprised!) to be proven wrong

Then my guess is that Met Milk will be able to produce a 6 consistently, may be a 7 at best." By that, I meant in the automatic mode, of course. Met Milk will probably be able to achieve a 8 in manual mode (maybe a 9)

New thread: Does anyone know if met milk will be programmable or be able to receive software updates?

RE: Hi Eric, yes! Meticulous Milk will be able to receive software updates as well. The on board controls should be all you need to achieve great results without the need for programming.

RERE: Thanks, specifically I was thinking about having an auto purge option after removing the pitcher. If that's not planned it would be useful to allow someone to enable it

RERERE: It does have an auto-purge function from what I remember. Check out the video in their update!

New thread: @Carlos, I know that at least a variation of this question has been already asked.... It would be nice if we can at least power the milk steamer through the Espresso machine to save on power outlets and ugly cables all over the place! Just the shared power, not even shared intelligence/ info between devices would make a big difference.

Good idea. It would be nice to have a C19 power out socket next to its power in socket or somewhere appropriate

Wanting only the met, I am not a fan of adding a power outlet to a machine that handles water. Additionally it does not reduce the total amount of required cables so I see no benefit in this. I take your point on the exposed outlet close to a potential wet environment. I forgot that I was under on the assumption that the Milk will come with a kettle lead which may not be the case. If not, the wish list will not useful. It doesn't reduce the number of cables but it will give an easier access to the power for the Milk.

@Awry, the extra power socket on the Espresso machine could be concealed and even covered when unused, don't kill the dream of those that do want it!. It could provide, through a completely separate circuit current to the Milk Steamer without affecting the Espresso Machine in any way!. Maybe offering a retractive cable that pulls in when not used, a small one to keep the Milk Steamer close by?

I don’t want a power outlet on the Meticulous machine either. I would also like to get my machine rather sooner than later, so no pointless design changes please.

Hi there, we considered this feature but there is no room in the back to fit the required components

Hi @Carlos, thank you for your response, no space sounds like the end of this idea!. @Gert, pointless to you, if would be great to respect other's opinions, from your comment I take you will not be buying the steamer... It is funny how you will disqualify something that if implemented would not affect you at all... "Pointless Design Changes"... hahahaha, you are funny to say the least

Actually I do plan to get the milk steamer. And yes, “pointless to me”, no offence, I’m all for respecting other’s opinion. And this happens to be mine :)

Hi all, I did request for the same thing previously. I think one solution we could handle ourselves is to get a cable with 2 C13 sockets

I got all my gear hooked up to a Surge protecting power bar underneath my coffee cart. I know that won't work so well for people with their coffee gear on their counters though.

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NEW THREAD: What are the dimensions of the Meticulous Milk

Hi Andrew, the current prototype is 12 cm/4.7 inches diameter x 28 cm/11 inches tall. Since we're still in the last design review, these dimensions might vary slightly from the final production version.

NEW THREAD: The Meticulous Milk should be build in a rectangular body that matches the design aesthetic of the espresso machine. Also, the stainless steel part at the end of the steaming wand should be longer so that the black part is the wand is not submerged in pitchers that are more full. We like wiping clean stainless steel, not anodized or powder-coated parts

I like that idea more. I wished the Meticulous Milk was modular and can be connected to the Meticulous and utilize same power supply for cleaner/simpler look

Hi Joshua and Ali, thanks for the feedback :) We though about the shape a lot and drafted and prototyped many versions but we ended up going with the cylindrical version for both aesthetic and functional reasons. We think they look beautiful together and we're sure you will love them once you have them in your home :) Thank you!

NEW THREAD: Wouldn't it have been possible to integrate the milk device into the main machine? Would save space, the footprint might need to grow only by a little and the dripping milk issue would be solved (milk would just go into the tray). Also, the looks might still be super clean and overall price impact limited. With all these machines build around a computer I see one main challenge - what about the reliability of the IT parts? CPUs age and get slow over time and may be difficult to replace. Software, once no longer supported, might not be running any more on tablets/phones etc. So, how do you tackle and rate the lifetime of these components? Thanks and hope this has not been answered many times before...

RE: I say no! Don’t include the “milker” into the design (that would be too late anyways, I guess). I love the clean design that focus on espresso and only that but with a million options.

NEW THREAD: Does the milk jug for the milk frother have internal measure markings?

Was a jug mentioned somewhere that I missed? I wouldn't expect it to include one

Please take a look at the FAQs.

Yes, it will have markings, and YES, the jug is included :)

NEW THREAD: What is the capacity of the drip tray? How easy is it to remove, empty, and replace?

Hi Joshua, we designed the drip tray to be super easy to take out and empty. It attaches magnetically so you can pull it out whenever you need to and easily place it back. It holds about 400-500 ml of liquid, so you can purge about 20 times before you need to empty it. Although it's better to do it more often to keep it clean

Hopefully a good strength magnetic, not too high strength otherwise pulling a drip tray full of water and fighting magnets is likely not going to be a fun experience :D But You are Meticulous I'm sure you've designed it beautifully.

NEW THREAD: Hello Meticulous team, another question: Do you guys have the power/intensity (watts & amp) draw amount for 120v and 220v? Thank you

Hi Caleb, yes! Meticulous is 110/220v compatible. Thanks!

NEW THREAD: I am sure this has been considered but can you add milk profiles to the frother? Like Whole, Almond, or Oat maybe even by brand? And then drink type cappuccino, latte, etc. think this would really make this product interesting and you already have the UI with the iPad solution from the espresso machine.

Hi Elias, it currently doesn't have profiles, but you will be able to adjust temperature and air injection level, and we will design settings specifically for plant-based milk so you know how to set it up to get the texture always right :)

NEW THREAD: As I suspected, they do not have a proper working version of Meticulous Milk, and it seems awful. It creates a cup full of coarse bubbles without any vortex formation. That makes it just a no-go at this moment. They might fix it, but I think there should be a total redesign and a significant amount of time invested. It will be another Kickstarter challenge with high risk.

The current version is already capable of producing great texture in manual mode and with the right settings, very good texture in auto mode. As stated in the campaign, the design still needs some work but this is factored in in the plan and timeline already

Check their youtube shorts, they make a latte and it looks perfectly fine

NEW THREAD: Thanks for the update! As a prior ZPM Espresso backer who was jilted, the zero-risk pledge guarantee is reassuring. Just a quick question about meticulous milk - In manual mode, I noticed it shut off by itself in the video. Does the probe still read the temperature of the milk and shut off when it hits the right temperature, or is that strictly for automatic mode?

I think that’s just because the prototype doesn’t have the working button. Manual mode will require tapping on/off button

Hi Rafayet, David is right, in manual mode you will turn it off yourself. Thanks!

It would be very helpful to have an optional temperature target to automatically turn off the steamer in manual mode. Call it “semi-manual mode” perhaps. But the point is that we almost certainly will be steaming to a desired temperature, and since you’ve got that temp sensor in the tip, let’s put it to use

That would be cool having it auto-stop at your set temperature even in manual mode (if desired), if it's not too hard to implement in the software or settings

NEW THREAD: Hello Meticulous team, in the milk steamer update video, it seems that every time the wand in lifted away after streaming (for either mode), there is a lot of milk dripping that happens from the tip. It looks like maybe the wand is too long, the do tray is too small or there's a lot of milk build up on/inside the wand. Just an observation.

Thanks for the feedback, I think the reason is that the large diameter tends to grab more milk than a normal think wand. But we will pay more attention to this, thanks for pointing it out.

Yeah I noticed that, larger wand, more drippage when removed, not sure they can really do much about it, besides make it thinner, or don't put it in so deeeeeeep. Something to be aware of in use, to prevent a mess.

NEW THREAD: Hmmm, the milk steamer seems to deviate alot from current designs, and I'm not sure it's for the better. The single position for manual steaming doesn't give full control of the tip to allow a proper vortex. I'm not sure where the holes are located, but from the video it seems you can't properly submerge them at the surface, again cause it's very thick and the tip is flat, I assume that's why it's screaching and blowing bubbles. Without instant on steam it's difficult to properly purge, I think a design similar to the BDB might have been better, since it has instant on and off with a valve, and only takes about 3 or 4min to heat. Sadly I think it's too late for a redesign, and I don't think there are any nice alternatives on the market, which leaves the Meticulous as a machine for non milk drinks. I'll cross my fingers and wait for some professional reviews first and hope for the best

Hi Majed, we've listened to a lot of feedback and we are integrating many changes to make it better. The holes are at the center of the cap, so it's not hard to submerge them. We've tested Meticulous Milk with many professional baristas and they are happy even with the current state of performance. We are confident that the final version will produce some of the best milk texture of any machine at home :)

+1 on met milk.For its price tag, it needs to be excellent.

NEW THREAD: I love milk based drinks so this so hinges on the Meticulous milk. There's sadly no alternative as for some reason it's just not something any other manufacturer has developed

NEW THREAD: Regarding the steam wand “device”, what’s the specs? How long for it to be ready to steam? How many cups of 5-6oz milk can it steam continuous until the machine needs to stop for reheating again? Would like to add this but there isn’t much information

I don't it has any sort of boiler that needs heating. My guess is it's using some sort of thermocoil, in such case it will heat pretty much instantly, and will just keep steaming

until it runs out of water. The issue is more how much steam power you can get out of it, it's likely to be fairly slow to steam milk...

15 seconds according to the campaign update

Both answers are spot on :) we will make sure to post more in depth-videos showing how it works so you can make your decision before the campaign ends. The Meticulous Milk does have a water reservoir that should be good for about 5-10 uses depending on milk amount.

NEW THREAD: Are there any other gaskets, o-rings or anything else on either the espresso or milk machine that would need periodic changing? How does the piston seal against the cylinder? Will that part need to be changed regularly? Is so, how hard will that be ? So what will be the maintenance schedule, what to be done and when?

Also wondering this. I'm planning to replace my La Pavoni with this, which needs gaskets replaced every year or two, but it's relatively simple and easy to maintain. Maintenance is my biggest concern with a modern electronic machine.

MET RE:The gasket is a consumable, we have not tested the Decent one so I can't tell you. The Cafelat E61 gasket works, if that helps. The O-rings in the plunger could require replacement especially if the machine is not cleaned regularly. Other than that there are no consumables. They don't need to be changed regularly, but after a lot of use they can start degrading. We will need to do more testing to determine that, but likely more than a year. We will publish a final maintenance schedule once we do final testing on the production version. Spares will be available for super cheap though, probably ~10 for a full set of replacement O-rings

Based on my experience this replacement set won't be easily available outside the US, and shipping costs would be a killer. Is that possible to add that as a post campaign add-on? :)

NEW THREAD: Will the milk steamer on automatic mode support alternative milks?

Seems so, see my question and their answer below.

Hi Sam, yes, it has different settings and some are specifically designed to texture plant-based milk.

NEW THREAD: Does the milk frother have different settings for fake kinds of milk like Oat or almond? (if they are even needed, of course

Yes! it has different settings and some are specifically designed to texture plant-based milk.

NEW THREAD: What pressure is the steamer equivalent to? I can't see any videos up about it but I've had a quick flick through on the comments and couldn't find anything.

NEW THREAD: I hope they improve the steam power. Personally I don't need all the smarts they seem to want to put in the stream wand. I'd be very happy with a more powerful, narrower, "dumb" wand, steaming milk really isn't that hard.

Hi Kevin, we will post some videos with detailed information about Meticulous Milk before the campaign ends so everyone has enough time to decide :) But if you want to

know a little more about it now, take a look at this update where we posted answers to some of the most common questions we got about it: https://www.kickstarter.com/projects/meticulous/meticulous-espresso/posts/3770579

NEW THREAD: would you consider piggy-back-ing the power cord of meticulous milk from the main meticulous machine? This way we'd use only 1 wall socket and/or avoid ugly multiple sockets? Cheers

I second this!

That’s a cool idea. It doesn’t look like there is room internally for something like that though, it would require us to change a lot of how the machine is structured inside. Thanks for the suggestion

Searching google for "C13 piggyback", another way to see it is a supply cord with 2 C13 sockets. Maybe angled C13 connectors and different length for meticulous + milk could be a solution to that idea... Keep it in mind, maybe it's technically/commercially viable!

NEW THREAD: Suggestion for Meticulous Milk: While I understand you have designed the tip with 4 holes, I can only urge to make the tip (and O ring seals etc.) compatible with some big name brands out there. Often times, the amount of holes is personal preference and changes steaming characteristics quite dramatically. E.g. on my elektra, I changed from a 4 hole tip in the steam wand to a 2 hole design. Easily possible, as both the tip as well as the O rings are common size and available off-brand in the aftermarket. So would be nice to have at least the thread diameter in the meticulous milk compatible with e.g. Gaggia, La marzocco or some other big name brand with widespread aftermarket parts. I don't know how this will work with the sensor placement etc, but a machine like the breville oracle also has sensors in the steam tip for auto mode and already has aftermarket parts available.

NEW THREAD: Suggestion: Please consider a second milk SKU that is manual only. Simper design and inherently higher reliability without the sensors and extras for those of us who don't need or want the auto functionality.

NEW THREAD: Questions I would like to be answered before deciding to add the Meticulous Milk as an add-on: 1. How many steam holes does it have (1, 2, 3, 4?)? 2. I know there is no steam boiler, but what would be the equivalent steam pressure that this device can produce. 3. How long does it take to steam 250mL of cold milk (4C) up to 60C? 4. The steam wand looks pretty thick. I was wondering if the thickness of the steam wand could interfere with the circulation of the whirlpool when using a small pitcher (or even a medium size pitcher). 5. What type of steam power and milk frothing quality does it compare to: a Breville Bambino, a Gaggia Classic, a Breville Barista Express, a Lelit Bianca, a Decent, a GS3? A dedicated video demonstrating the milk frothing workflow, and the quality of milk frothing to expect, would be nice

NEW THREAD: Posted this question on Reddit.. Interested in thoughts from fellow backers: https://www.reddit.com/r/espresso/comments/125zka2/meticulous_milk_backers_are_you_canceling_your/

NEW THREAD: Meticulous Milk being an add-on is already behind the price increase of the main machine. I think the value behind the milk steamer right now is to complement

the main espresso machine and not the main selling point, hence hard to justify a price increase given little is known about the standalone steamer

That makes sense to me, I'm just conflicted at the moment between it and the nanofoamer pro which has a week left on pledges haha I only need 1 steamer

I'm in the same boat. I have them both on order, but am considering canceling the NanoFoamer Pro now

Yes I have the same dilemma as you. :) Hopefully, we'll get more info within 8 days to make a more informed decision

Hi Roshan. I also was contributing to the NanoFoamer Pro but I cancelled my contribution. First, because I think the Meticulous is a better design and these guys appear really responsive to feedback. Second, I supported the original NanoFoamer and had problems with it that were never resolved. I was told numerous times I'd receive a replacement (they were working on some issues). They never sent me a replacement, even after I contacted them numerous times. So, for me, clearly the way to go is with the Meticulous Milk foamer

Hey Robert! Thanks for the input, I thought about it overnight and I think I'll switch to Meticulous Milk as well.

NEW THREAD: How do i add meticulous milk to my pledge? This is exactly the product (milk) i was looking for to accompany my flair!

NEW THREAD: Just an idea: for the Milk wouldn't a color matching jug be possible (even as an add-on)? That would make it quite a whole set

Hi Zoltan, that would be pretty cool! We have considered this and if we are able to offer it as an add-on we'll let you know!

NEW THREAD: I am thinking of canceling the pledge for the Nanofoamer Pro and getting the Meticulous Milk. What I like about it is the fact it obviously works like a regular steam wand, meaning you can use any pitcher you like to foam milk and just wipe down the wand when you finish. With the Nanofoamer Pro (like the Aeroccino 4 and similar devices) you need to thoroughly clean the included electric "pitcher" after use. This in turn means you can make back to back milk drinks much faster with the Meticulous Milk. But we need more, please give us more info on the technology behind it!

NEW THREAD: Honestly would love to know as much info as you can provide on the Meticulous Milk! How long can it steam? Does it have temperature sensors? The top seems safe to touch

Definitely more info about the Meticulous Milk is needed. Still excited for it though

I second that. Thx | I third it!

NEW THREAD: Meticulous Milk was an awesome (and unexpected) surprise! Not sure what to do with my NanoFoamer Pro now. 😉

Me too.. Early back for NanoFoamer PRO to go with this machine.. Not sure what I'm going to do now. I *think* I'm going to stick with Nanofoamer, but this is tempting.

Appendix II - User group identification research

Quantitative study

What do we want to learn from this questionnaire?

The goal of this questionnaire is to validate the previously stated problem definition. Furthermore, this questionnaire aims to provide insights into the user profile of possible SteamUp customers. This is necessary, to build the List of Requirements for the development of the product solution.

According to the Delft Design Guide, a questionnaire should be developed in 7 steps.

1. Determine topics you want to address

2. Choose the form response per question (closed, open, categorical)

3. Formulate questions

4. Determine order

5. Pre-test and improve the Questionnaire

6. Invite the right respondents depending on the topic.

7. Precent results by reporting percentages for each answer option or use statistics to report mean results. Test relationships between questions.

STEP 1 | Topic determination

- Preferred coffee drink:
    - At home
    - In cafe
    - If difference, why?
    - What type of milk?
- The problems people experience when making coffee at home
    - Do people have problems making coffee at home (are they self aware?)
    - What problems do they experience?
    - How often does the problem occur?
    - Explain MVP - do they recognise of the problem now?
- User group
    - Who experiences the problem?
    - How do they make coffee at home?
    - How big is this group?
- Solving the problem

  - Have people tried to solve their problems?
  - Why did they stop looking? (either solved or no solution yet?)
  - What are they looking for in a solution?
- General survey questions
  - Age
  - Gender
  - Continent

STEP 2 | Response form

Preferences

1. How many drinks at each location (Home - Cafe - Work) - **SCALE**
2. Which type of drinks most often at what location - **MULTIPLE CHOICE (2 options)**
3. Explain difference between locations - **OPEN**
4. Which type of drink is preferred in general - **MULTIPLE CHOICE**
5. If difference with what they make at home, why - **OPEN**

Home habits

1. What machine for making coffee - **IMAGES MULTIPLE CHOICE**
2. How often and when do you make coffee during the day? ********OPEN********
3. How do you make coffee - walk through - **OPEN**
4. How satisfied with coffee that you can make at home - **SCALE**
5. Do you experience problems with preparation - **YES/NO partly open**
6. Did you try to solve your problems (before) - **YES/NO partly open**

Milk focus

Do you like to add milk (foam) to your coffee? - **YES/NO**

Why? - **OPEN**

Wat type of milk? **CATEGORICAL**

What does your milk look like - **CATEGORICAL IMAGES**

How satisfied are you with the milk you make at home - **SCALE**

How would you like it to look like - **CATEGORICAL IMAGES (SAME AS ABOVE)**

5. Is there something that bothers you when preparing milk - **YES/NO partly open**

6. Have you tried to solve it? **YES/NO both with because....**

7. What is important to you during preparation of milk foam? - **OPEN**

General questions

1. Age - **CATEGORICAL**

2. Gender - **********CATEGORICAL**********

3. Continent - **********CATEGORICAL**********

4. Can I reach out for short interview - **Yes/No with addition of email**

After review of customer-problem fit graph, goals are; defining user group - how do they make coffee and how do they prepare milk? What does their milk look like? Do you wish you could prepare your milk differently? Have they tried to solve the problem? What were/are they looking for? Why were/are they looking for this? Did they find what they were looking for? Why did they stop looking?/ What isn't ideal of the current solution? *End with general questions*.

Drink preferences

1. How many cups of coffee at different locations in general weekly (Home - Cafe - work) **CATEGORICAL**
2. Which type of drinks do you consume most at each location? **CATEGORICAL**
3. What is your overall favourite type of drink? **CATEGORICAL**
4. If different at home from office or cafe - why? OPEN

Home setup

1. How do you prepare your coffee at home? **CATEGORICAL**
2. Do you add milk to your coffee at home? **CATEGORICAL**
    a. YES
        i. How do you prepare your milk at home? **CATEGORICAL**
        ii. What type of milk do you generally add to your coffee at home? **CATEGORICAL**
        iii. What does your milk generally look like at home? **CATEGORICAL**
        iv. How satisfied are you with the milk (foam) you prepare at home?
        v. Is there anything you would like to change about your milk (foam)? / Wat zou je fijn vinden?
        vi. Have you tried to find make these changes at home?
        vii. What were you looking for?
        viii. Is there still something
    b. NO
        i. Have you prepared milk foam at home in the past?
            1. NO - Have you considered adding milk (foam) to your coffee at home?
            2. YES - How did you prepare your milk (foam) at home?
                a. Why did you stop preparing milk (foam) that way?

General questions

1. Age - **CATEGORICAL**
2. Gender - **CATEGORICAL**
3. Continent - **CATEGORICAL**
4. Can I reach out for short interview - **Yes/No with addition of email**

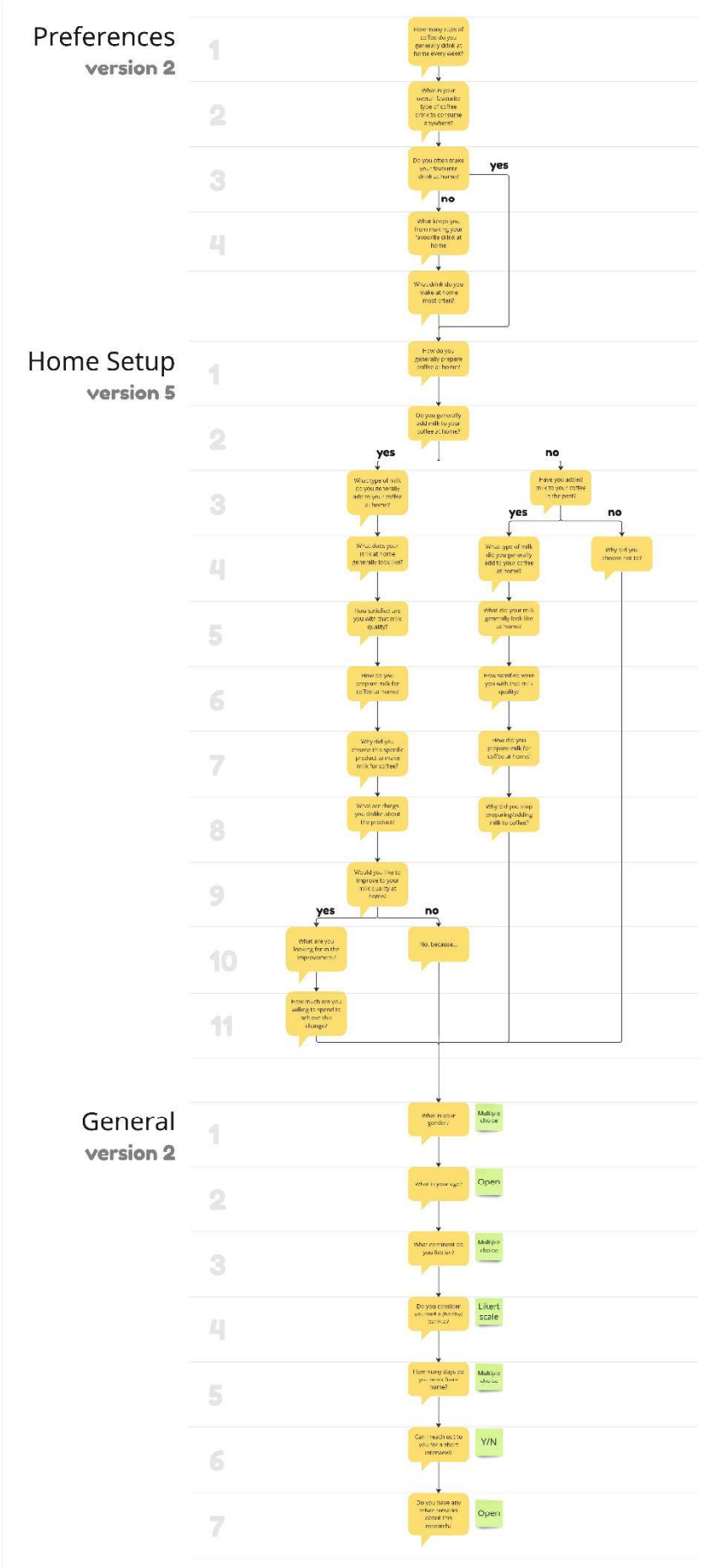
STEP 3 | Question formulation

Home page

Explaination page

Questionnaire is to compare coffee drinking habbits out of house with in house, to identify areas of improvement of coffee preparation at home.

To verify whether the goals of the research can be achieved with the intended research, the research is evaluated by Impact Studio. Impact Studio is a pre-incubator of the TU Delft, with the mission of guiding TU Delft students with starting their own company. They work extensively in determining the user group and implementation areas of new technologies. This is very helpful in determining the setup of the research.


Preferences
version 2
1
How many cups of coffee do you generally drink at home every week?
2
What is your most favourite type of coffee drink to consume anywhere?
3
Do you often make your favourite drink at home?
yes
no
4
What keeps you from making your favourite drink at home
What drink do you make at home most often?
Home Setup
version 5
1
How do you generally prepare coffee at home?
2
Do you generally add milk to your coffee at home?
yes
no
3
What type of milk do you generally add to your coffee at home?
Have you added milk to your coffee in the past?
yes
no
4
What does your milk at home generally look like?
What type of milk did you generally add to your coffee at home?
Why did you choose not to?
5
How satisfied are you with that milk quality?
What did your milk generally look like at home?
6
How do you prepare milk for coffee at home?
How satisfied were you with that milk quality?
7
Why did you choose this specific product at make milk for coffee?
How did you prepare milk for coffee at home?
8
What are things you dislike about the products?
Why did you stop preparing/adding milk to coffee?
9
Would you like to improve to your milk coffee at home?
yes
no
10
What are you looking for in the improvement?
No, because...
11
How much are you willing to spend to achieve the change?
General
version 2
1
What is your gender
Multiple choice
2
What is your age?
Open
3
What continent do you live on?
Multiple choice
4
Do you consider yourself a coffee lover?
Likert scale
5
How many days do you work from home?
Multiple choice
6
Can I reach out to you for a short interview?
Y/N
7
Do you have any other remarks about this research?
Open

Appendix III: Expert interviews

Semi-structured interview with the goal of finding out what makes great milk foam, how it is achieved. Next to this, the goal is to find out the influence of characteristics of different frothing technologies on milk foam quality and foaming experience. These were the questions that were prepared for the interviewees:

1. Wat is perfect milk foam?
    a. Do participants of latte art workshops agree with this definition?
    b. What is necessary to achieve this quality of milk foam?
    c. Can participants of the workshops achieve this type of quality at home?
    d. Do the participants actually want to achieve this quality?
2. What are the reasons for people to follow a latte art workshop?
    a. Do most participants have experience with steaming milk before the workshop?
    b. What kind of foaming device do they have at home?
        i. What would you recommend them to get?
3. Is it possible for people to learn this technique without attending a latte-art workshop?
3. Which machine is used in the workshop?
    a. Why is this machine used?
    b. Are settings changed on the machine to make foaming 'easier'?
4. Have you made changes to the espresso machine(s) in your cafe to improve performance?
    a. Are there suggestions to improve performance?
5. What should I take into consideration while designing our milk frother?

XX - Capriole Cafe

Great milk foam

1. Microfoam, wet foam - no visible bubbles, soft texture
2. Full foam (approximately 50% increase in volume for cappuccino)
3. Sweet flavour
4. Glossy surface

This is achieved by

1. Proper technique
2. Highlighted that especially the swirling is important to do, also when using mechanical agitation
3. Experience
4. Using fresh - full-fat milk (UHT pasteurized milk gets too thick too quickly and has poor flavour)
5. Making coffee first, making the milk foam on demand afterwards

Reasons to attend a latte art workshop

1. They own an espresso machine (sometimes for years), but cannot figure out how to make proper foam (and therefore art)
2. People are on the brink of buying an espresso machine and want to gain knowledge and experience before doing so.

3. People want to learn to pour latte art (other machines, such as automatic mechanical agitation)
4. People are starting to work in a cafe and are attending to gain the skills needed to serve customers proper milk foam and latte art.
5. They really want to learn how to handle a steam wand, to make nice proper milk foam. (They want to do it themselves, without automation).

NOTE: All in all, getting the right consistency of milk foam is very difficult for many people. Some even get rid of their machines, because they cannot get the hang of it.

Foaming capabilities of attendees at home

1. People are quite happy with their thick, dry foam at home. Although they acknowledge that they would like it better.
2. People dislike having to turn on the frothing apparatus for every cup of coffee they make. This increases preparation time significantly (in the case of a mechanical frother).
3. It is difficult to learn to make proper milk foam with a steam wand at home without guidance.

Makes milk foam at home with a cafetiere or handheld mechanical foamer (notes that this takes a long time and is quite tricky to get right, however, it is possible to make latte art)

Higher pressure makes it easier to make great foam. It is much quicker and it is easier to correct mistakes because of the aggressive swirl produced by the high pressure.

General remarks on the performance of a professional machine (Sanremo Opera)

1. Is always on - always ready
2. High pressure
3. 4 hole nozzle (The more holes, the better)
4. Boiler material is very important (heat capacity, resistance to limestone buildup)

Remarks for development of foaming apparatus

1. People want no automation
2. Should be at full pressure straight away after turning on (after a bit of a discussion this changed to: must be at full pressure just before the coffee is ready)
3. Should have a 4-hole nozzle
4. Steam must be on instantly

XX - Cupp

Great milk foam

1. Microfoam - invisible bubbles
2. Smooth texture
3. Not too thick, 50% increase in volume (Although not dry)
4. Glossy texture
5. Should be sweet

This is achieved by

1. Just about any device, as long as you know how to use it.
2. Right temperature
3. Right technique

They use a very *high-end espresso machine in their training because it is very reliable* (what is reliable?) Later in the conversation, Peter added that the machine in the workshop area has a reduced steam boiler pressure than the cafe, to grant the participants a bit more time.

They are testing with a Sage machine for a latte art workshop, but the capacity is very different. It also takes a lot longer when using a Sage.

Higher pressure makes it easier to create a vortex in the pitcher.

People do not know the base rules of making milk foam, which requires a workshop and is difficult to achieve with videos.

If hot milk/coffee runs underneath the milk foam, the foam is too dry.

Most automatic mechanical frothers are designed to heat the milk too much.

Remarks for development of foaming apparatus

NOTE: From what I could tell of the conversation, Peter had the impression that the SteamUp is or should be automatic.

1. Users can set the desired temperature
2. Users can set the foam thickness
3. Should make as much milk foam as you need for the number of cups of coffee you can make at once (this is most likely 2 at best)

NOTE: Temperature and foam thickness are end products, those are important. Pressure is just a mean to achieve a foam thickness.

XX - Single Estate Coffee Roasters

Great milk foam

1. Invisible bubbles (microfoam)
2. Thin, to achieve very contrasty latte art
3. Creamy (flavour / sensory)
4. Glossy surface

This is achieved by

1. Proper understanding and application of base rules.
2. Making sure to swirl the milk after foaming for uniform texture
3. Using the right type of milk. Milk is a big determining factor in the taste and gloss of the foam.

How milk is selected at SECR

1. The flavour it produces
2. Reactivity with coffee (some kinds of milk react to compounds in the coffee, resulting in big bubbles)

3. The amount of gloss (some kinds of milk do not make the milk glossy)

Making great foam is the hardest part of making a cup of coffee.

Using an automatic mechanical milk frother (that allows you to set the foam thickness), allows you to make latte art (as long as you scoop away the top 'thick, dry' foam), then you need to transfer it to a pitcher and swirl!

It is more difficult to steam at higher pressures, if you do something wrong you have a big chance to get a milk shower *(might be dangerous if milk is hot).*

They would not use our device in training facilities because it requires more plugs than traditional espresso machines *(is this also the case at home? Should we provide a plug that snaps under another plug? Is that even possible?)*

Interesting remarks for development - and sales

To make sure people can use your product properly (and therefore achieve what you tell them they can achieve), you need to provide them with instructions (written, video, possibly audio)

A great sales tool would be an add-on (training wheels) that somehow attaches to your milk jug or steam wand, to help you position the wand perfectly during the process.

Marten thinks that the market we see now (manual lever) is rather small. REMARK: *Customer identification is key*

If a fully automated version is possible, this would increase the market size dramatically

If you can pair it with a Nespresso, the market is huge!

Sales through ES Repair in Ridderkerk or Kookpunt (high end, specialty stores)

Remarks for development of foaming apparatus

To improve usablility

1. Make sure heating time is very low
2. Provide high temperature
3. Provide high pressure
4. Have a switch to fully open the steam wand at an instance
5. Provide the option to switch steam wand tips

Interview takeaways

The characteristics of perfect milk foam are compliant with the literature. Therefore we can conclude that the perfect milk foam can be described as followed:

Must include

1. Small microfoam (specified by a paper in bubble size) - which means bubbles are nearly invisible by the naked eye.
2. Smooth, homogeneous texture
3. Wet foam
4. Sweet flavour
5. Glossy surface finish

Spinning (in Dutch ‘walsen’) the milk in a pitcher counteracts drainage. It at allows milk to be trapped in between the bubbles of the foam again. Spinning your milk jug around or transferring your milk into a new jug will restore the liquid around the bubbles and will take your foam further from the yield point, to ensure your bubbles can slide past each other again. The term in surfactant science for how readily bubbles can slide past each other is their sliding friction. This process is not strictly necessary if you steam and pour immediately, but if there is a delay in your workflow, such spinning can help to restore milk back into a usable condition.

Next to this, it is important for users to know how to achieve this quality of milk foam

1. Users need to be guided/taught by means of training or a add-on (training wheels) in order to use the device properly.
2. Users need to swirl the pitcher to make a homogeneous emulsion.

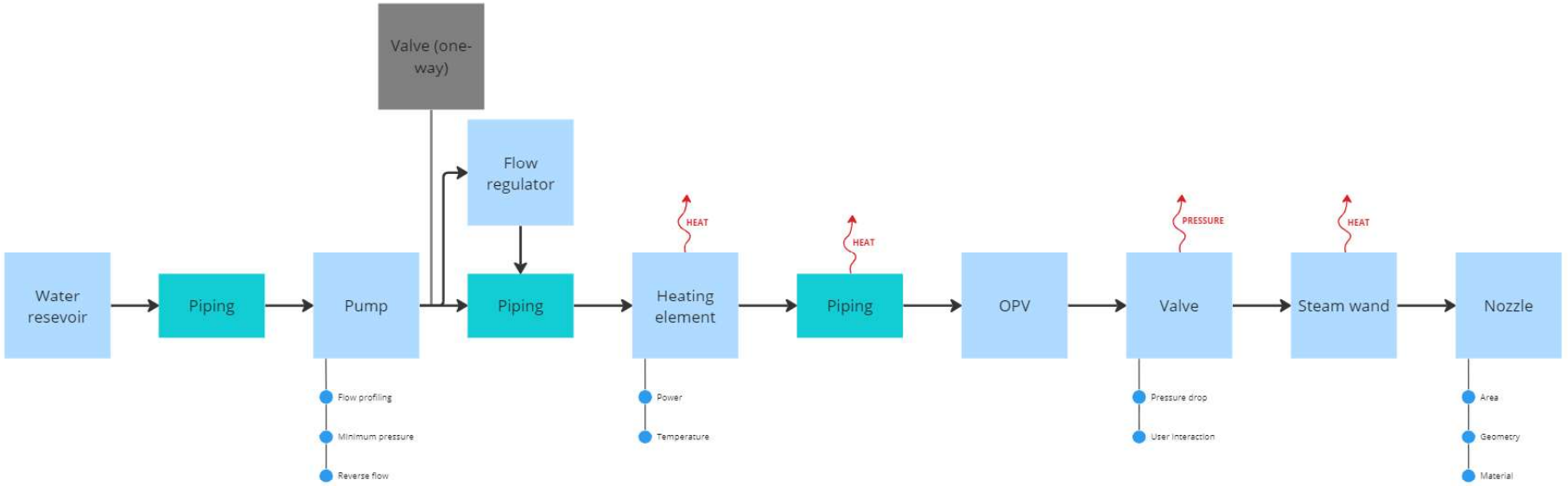
While designing the SteamUp milk foamer, the following requirements must be met

1. Heating time (start-up time) must be very short (the shorter, the better)
2. The output must be consistent - reliable.
3. Output must be instant - not more than one movement
4. Temperature must be high (if making use of steam)
5. Pressure must be higher than espresso machine for home use, yet lower than commercial machines (lower than Kees van der Westen)
6. Provide adjustability (temperature and pressure)
7. Allow modification (steam tip design)
8. Create milk foam for 2 espresso-based milk drinks at once.

What is still unclear in the problem space after the interviews

1. Who is the intended user, and how big is this market?
    a. Is there a need for automation?

Appendix IV: Theoretical system model



Doel van het model is:

1. Bepalen welke onderdelen de grootst invloed hebben op de werking van het product.
2. Een indicatie geven van range voor de experimentele systeem (control) waardes van deze onderdelen.

Hierbij weten we dat:

1. De maximale bubbelgrootte voor microfoam 160 µm is
2. Het is wenselijk om de bubbel size distributie zo klein mogelijk te houden voor stabiliteit.

Het volgende moet uitgezocht worden:

1. Wat de voorwaardes zijn om een maximale bubbelgrootte van 160 µm te krijgen in een schuim, gebruik makende van stoom.
2. Welke systeem parameters hebben hierop invloed en hoeveel invloed?
3. Randvoorwaarden opstellen voor specifieke onderdelen.

System modelling

The basis of the system rests on the energy that is required to heat the milk in the pitcher from fridge temperature to 60 °C. The energy required for this process can be calculated using the following equation:

$$Q_{fluid} = Q_{vaporization} + Q_{water} \quad (1.0)$$

$$m_{fluid} * c_{p,fluid} * \Delta T_{fluid} = m_{water} * C_{vaporization} + m_{water} * C_{p,water} * \Delta T_{water} \quad (1.1)$$

To determine the mass flow rate through a round orifice one must first calculate the following:

$$\frac{(p_1 - p_2)}{p_1} = F_y * x_T \quad (2.0)$$

The ratio of specific heats for steam ranges from 1.3 to 3.0 at different pressures and temperatures. Steam is a very non-ideal gas and the Cp/Cv ratio should not be used. The actual isentropic exponent varies only slightly from 1.3 (Buzzard, 2001).

Therefore we can use k=1.33 as given on many websites. Fy = constant =1.33/1.4 = 0.95. So to determine which formula should, one should identify the value of:

$$\frac{(p_1 - p_2)}{p_1} = 0.684 \; where \; p_2 = \; 101.325 \; kPa \; (atmospheric \; pressure)$$

$$p_1 = \frac{101325}{316} \approx 320.65 \; kPa$$

If pressure in the system is below 3.2 bar abs, 2.2 barG (which is around 135.883 C) the following formula can be used to calculate the mass flow rate through a round orifice

$$m_s = 2.73 * C * \left(\frac{d_o}{4.654}\right)^2 * \left(1 - \frac{\frac{(p_1 - p_2)}{p_1}}{3 * F_y * x_T}\right) * \sqrt{(p_1 - p_2) * \rho} \quad (2.1a)$$

Density is for primary pressure

When pressures higher than 2.4 barG are required, the following equation should be used:

$$m_s\,[\tfrac{kg}{h}] = 0.66 * 2.73 * C * \left(\frac{d_o}{4.654}\right)^2 * \sqrt{F_y * x_T * p_1 * \rho} \text{ (2.1 b)}$$

Since the equation for mass flow rate is time dependent, the initial equation (1.1) must be adapted to be time dependent too:

$$\frac{m_{fluid} * c_{p,fluid} * \Delta T_{fluid}}{t_{steaming}} = \frac{m_s}{3600} * C_{vaporization} + \frac{m_s}{3600} * C_{p,water} * \Delta T_{water} \text{ (1.2)}$$

Affandi et al. (2012) have proven that pressure (P), Entropy of vaporization ($C_{vaporization}$), Entropy of water ($C_{p,water}$), specific volume (V) can be approached in equations based on temperature:

$$P = e^{9.56756 + 5.39806 * \ln(T_r) - 6.16183 * (\ln(T_r))^2 + 1.49572 (\ln(T_r))^4 + 0.43300 * T_r^5}$$

$$T_r[K] = \frac{T}{T_{cr}}, where\ T_{cr} = 647.096\ K$$

$$C_{vaporization} = e^{\sqrt{-4.38230 + 77.88524\left(\ln\left(\frac{1}{T_r}\right)\right)^{0.1} + -\frac{9.76781}{(T_r)^2} + \frac{5.34311}{(T_r)^3} - \frac{0.86975}{(T_r)^4}}}$$

$$\mathrm{V} = e^{\sqrt{-7.75883 + 3.23753 * \left(\ln\left(\frac{1}{T_r}\right)\right)^{0.4} + \frac{2.05755}{(T_r)^2} - \frac{0.06052}{(T_r)^4} + \frac{0.00529}{(T_r)^5}}}$$

$$\rho = \frac{1}{V}$$

$$\rho = \frac{1}{e^{\sqrt{-7.75883 + 3.23753 * \left(\ln\left(\frac{1}{T_r}\right)\right)^{0.4} + \frac{2.05755}{(T_r)^2} - \frac{0.06052}{(T_r)^4} + \frac{0.00529}{(T_r)^5}}}}$$

$$C_{p,water} = C_{vaporization} - C_g$$

$$C_{p,water} = e^{\sqrt{4.38230 + 77.88524\left(\ln\left(\frac{1}{T_r}\right)\right)^{0.1} + \frac{9.76781}{(T_r)^2} + \frac{5.34311}{(T_r)^3} - \frac{0.86975}{(T_r)^4}}} - e^{\sqrt{64.87678 + 11.76476\left(\ln\left(\frac{1}{T_r}\right)\right)^{0.35} - \frac{11.94431}{(T_r)^2} + \frac{6.29015}{(T_r)^3} - \frac{0.99893}{(T_r)^4}}}$$

From this equation, we can conclude that there are two system variables that are important to the functioning of the system, these variables are:

- Temperature of the steam
- Area of the nozzle opening // user input or based / on user input
- The geometry of the nozzle (determining the C constant)

This system must be determined based on the power and milk chemistry variables:

- Time required for steaming // given by observation/testing of professional machines >> this is 100% steaming intensity
- Milk type // user input

Assumptions that are made are:

- If the velocity of the steam is determined from the mass flow rate, the expansion of the steam must be taken into account.
- There are losses in the system that must be approximated and deducted from the pressure generated by the heating element.

To calculate the pressure that is required from the heating element, we must determine what system losses are present. Through identification there are two types of losses, heat losses and friction losses. Therefore we can create the following equation:

$$P_{HE,rating}[W] = \frac{Q_{fluid}}{t_{steaming}} + Q_{losses}$$

Energy is lost in the system through conduction and convection at startup of the system. Once the system reaches it's operating temperature, one can assume that only convection remains. At higher temperatures radiation of materials plays a crucial role in the heat losses, therefore also radiation should be included in the equation.

$$Q_{losses} = Q_{HE,loss} + Q_{piping,loss}$$

$$Q_{losses} = Q_{HE,rad} + Q_{HE,conv} + Q_{piping,rad} + Q_{piping,conv}$$

$$Q_{losses} = h_{c,he} * A_{HE} * \Delta T_{he} + \varepsilon_{HE} * A_{HE} * \sigma * (T_{\infty}^4 - T_s^4) + h_{c,piping} * A_{piping} * \Delta T_{piping} + \varepsilon_{piping} * A_{piping} * \sigma * (T_{\infty}^4 - T_s^4)$$

$$A_{piping} = \pi * r^2 * l_{piping}$$

Losses can be reduced using insulation on both the heating element and piping. By choosing a material in the piping with a low thermal conductivity, losses can also be reduced while keeping temperatures inside the machine lower. Length of the piping is obviously also very important, because it is a factor in friction and heat losses.

Conclusion

From the previously presented theoretical system model and the physical chemistry of foams, we can conclude the following variables to be of importance to the design of the product of this master thesis:

1. Temperature of the steam
    a. Has influence on the mass flow rate of the system, therefore on the 'power' of the system. The mass flow rate determines how fast the system can prepare a given volume of milk per time unit.
2. Diameter/area of the nozzle
    a. Has influence on the velocity and mass flow rate of the system.

Sources

Affandi, M., Mamat, N., Kanafiah, S. N. A. M., & Khalid, N. S. (2013). Simplified equations for saturated steam properties for simulation purpose. Procedia Engineering, 53, 722-726.

Buzzard, W. S. (2001). *Chapter 3 - Physical Properties of Fluids: Specific Heat and Ratio of Specific Heats*. GlobalSpec.

TLV CO., LTD. (n.d.). Calculator: Steam Flow Rate through an Orifice. TLV - a Steam Specialist Company (Worldwide). https://toolbox.tlv.com/global/TI/calculator/steam-flow-rate-through-orifice.html

$$\frac{m_{fluid} * c_{p,fluid} * (T_{start} - T_{desired})}{t_{steaming}}$$

$$= \frac{2.73 * C * \left(\frac{d_o}{4.654}\right)^2 * \left(1 - \frac{(p_{required} - 101.325)}{3 * F_y * x_T}\right) * \sqrt{(p_{required} - 101.325) * \frac{1}{e^{\sqrt{-7.75883 + 3.23753 * \left(\ln\left(\frac{1}{\frac{T_{steam,abs}}{T_{cr}}}\right)\right)^{0.4} + \frac{2.05755}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^2} - \frac{0.06052}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^4} + \frac{0.00529}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^5}}}}} * t_{steaming}}{3600}$$

$$* e^{\sqrt{4.38230 + 77.88524\left(ln\left(\frac{1}{\frac{T_{steam,abs}}{T_{cr}}}\right)\right)^{0.1} + \frac{9.76781}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^2} + \frac{5.34311}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^3} - \frac{0.86975}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^4}}}$$

$$+ \frac{2.73 * C * \left(\frac{d_o}{4.654}\right)^2 * \left(1 - \frac{(p_{required} - 101.325)}{3 * F_y * x_T}\right) * \sqrt{(p_{required} - 101.325) * \frac{1}{e^{\sqrt{-7.75883 + 3.23753 * \left(\ln\left(\frac{1}{T_r}\right)\right)^{0.4} + \frac{2.05755}{(T_r)^2} - \frac{0.06052}{(T_r)^4} + \frac{0.00529}{(T_r)^5}}}}} * t_{steaming}}{3600}$$

$$* e^{\sqrt{4.38230 + 77.88524\left(ln\left(\frac{1}{\frac{T_{steam,abs}}{T_{cr}}}\right)\right)^{0.1} + \frac{9.76781}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^2} + \frac{5.34311}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^3} - \frac{0.86975}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^4}}} - e^{\sqrt{64.87678 + 11.76476\left(ln\left(\frac{1}{\frac{T_{steam,abs}}{T_{cr}}}\right)\right)^{0.35} - \frac{11.94431}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^2} + \frac{6.29015}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^3} - \frac{0.99893}{\left(\frac{T_{steam,abs}}{T_{cr}}\right)^4}}}$$

$$* ((T_{steam,abs} - 273.15) - T_{desired})$$

Appendix V: Dutch Norm - NEN-EN-IEC 60661:2014

27 Steam function to froth-up milk and to heat-up water

The test procedure is considered as applicable for reproducible testing.

27.1 Steam function to froth-up milk

A glass container with a thickness of about 2 mm having an inner diameter of 80 mm ± 2 mm and a height of 75 mm ± 2 mm is placed perpendicular and centered below the steam tube of the appliance.

The distance of the outlet of the steam tube to the inner bottom of the container shall be 10 mm ± 1 mm.

An amount of 0,1 l ± 0,001 l of water is put into the glass container, and the water level is marked as level 1. An additional amount of 0,05 l ± 0,001 l is then put into the glass container, and the water level is marked as level 2. An extra amount of 0,05 l + 0,001 l is added on top of level 2 and that level is marked as level 3 (for water levels, see Figure 1). A supporting surface having a thermal isolation may be used (see Figure 2).

NOTE Varying steam tubes with different steam nozzles may cause differences in levels 1, 2 and 3

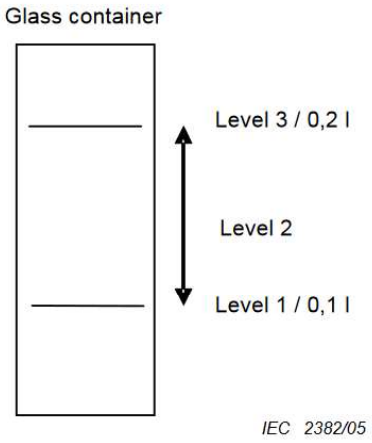


Figure 1 – Markings for levels 1, 2, 3

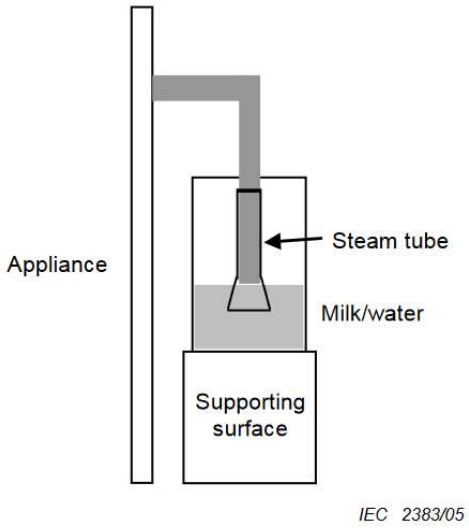


Figure 2 – Test assembly steam function

After that the glass container is emptied and dried.

The water container of the appliance is then filled with the maximum quantity of cold water as assigned by markings, labels or similar instructions of the manufacturer. In case of absence of such instructions, the water container is filled with the maximum quantity of cold water.

In order to avoid residual water in the steam valve, the steam function has to be operated before the test at least three times for about 5 s.

The glass container is then filled with 0,1 l ± 0,001 l of homogenized milk with a fat content of approximately 3,5 % at a temperature of 8 °C ± 1 °C.

A watertight thermocouple of class 1 according to IEC 60584-2, accurate to ±1,5 K and having a nominal diameter of 0,25 mm, is placed beside the steam tube and approximately 5 mm away and 10 mm below the marking for level 2 of the glass container.

The mass M_{L1} of the glass container including the milk shall be determined on a balance having an accuracy of at least 0,1 g and recorded.

The mass M_{L1} is expressed in grams.

After that the glass container is placed in the same way as described for the marking procedure (see Figure 2).

The appliance is operated with any controls at the positions specified by the manufacturer. In absence of such instructions, the steam function is operated at the max. setting of the steam function.

The steam function of the appliance is then operated until the upper level of the frothed-up milk reaches the marked level 3.

The time t_F to froth-up the milk to level 3 (double volume) shall be determined and noted.

The froth-up time t_F is expressed in seconds and rounded off to the next second.

The temperature T to the froth-up the milk to level 3 is measured with a temperature-recording instrument (accurate to ±3 K) and is noted.

Immediately after the frothing-up procedure the decomposition time t_{L2} of the frothed-up milk is determined and noted.

t_{L2} is the time taken for the volume of frothed-up milk to reduce to level 2 by natural loss of gas (air) and returning partly into liquid state.

The decomposition time t_{L2} is expressed in seconds and rounded off to the next second.

The time t_{L2} is determined while retaining the glass container at the same position as used for the frothing-up procedure.

NOTE This test is carried out to assess the quality of the frothing-up process and the stability of the frothed-up milk relating to bubble size and stability time.

The mass M_{L3} of the glass container with the frothed-up milk shall be determined on a balance having an accuracy of at least 0.1g and noted.

The mass M_{L3} is expressed in grams.

NOTE Special care has to be taken collect any dripping milk after the test. The measurement of the mass of the milk, including water from the steam function, has to be made after the dripping from the steam tube has finished.

The water absorption M_W of the frothed-up milk shall be determined and noted.

The water absorption M_W of the frothed-up milk is calculated as follows:

$M_W = M_{L3} – M_{L1}$

The result of the test is the water absorption M_W of the frothed-up milk and is expressed in grams per 0,1 l of milk and rounded off to 0,1 gram.

27.2 Steam function to heat-up water

A glass container as described in 27.1 is filled with 0,2 l ± 0,001 l of water at a temperature T_W of 15 °C ± 1 °C.

The mass M_{L4} of the glass container including the cold water shall be determined on a balance having an accuracy of at least 0,1 g and recorded.

The mass M_{L4} is expressed in grams.

After that the glass container is placed in the same way as described for the marking procedure.

In order to avoid residual water in the steam valve the steam function has to be operated before the test at least three times for about 5 s, before the glass container is placed in position.

A watertight thermocouple of class 1 according to IEC 60584-2, accurate to ±1,5 K and having a nominal diameter of 0,25 mm is placed beside the steam tube and

approximately 5 mm away and 20 mm below the marking for level 2 of the glass container.

The steam function of the appliance is then operated under the same conditions described in 27.1 for 120 s.

The temperature T_{120} of the heated-up water shall be measured with a temperature-recording instrument. The measurement shall be accurate to ±3 K.

The rise in temperature ΔT shall be determined and noted.

The rise in temperature ΔT is calculated as follows:

$\Delta T = T_{120} - T_W$

The result of the test is the rise in temperature ΔT for the heated-up water expressed in K rounded off to 1 K.

The mass M_{L5} of the glass container with the heated-up water including absorbed water from the steam function shall be determined on a balance having an accuracy of at least 0,1g and noted.

The mass M_{L5} is expressed in grams.

NOTE Special care has to be taken to collect any dripping water after the test. The measurement of the mass of the water, including water from the steam function, has to be made after the dripping from the steam tube has finished.

The steam (water) absorption M_{ST} of the heated-up water shall be determined and noted.

The steam (water) absorption M_{ST} of the heated-up water is calculated as follows:

$$M_{ST} = M_{L5} - M_{L4}$$

The result of the test is the steam (water) absorption MST of the heated-up water and is expressed in grams per 0,2 l of water and rounded off to 0,1 gram.

NOTE If the manufacturer does not describe the steam function to heat-up water this test is not carried out.

Appendix VI: Café machine evaluation

Machine characteristics

Merk	Type	Nozzle holes (#)	Hole diameter (mm)

Remarks

Test 1

1. Connect Arduino to laptop
2. Start CoolTerm software
3. Record data [CafeName_Test1]

4. Fill pitcher with 200g +- 0.1g of fridge cold water
5. Add a drop of dish soap
6. Measure and write down weight
7. Place NTC in pitcher
8. Wait 30 seconds
9. Purge steam wand for approximately 5 seconds
10. Start timer for 25 seconds
11. Start steaming
12. Stop steaming when timer ends
13. Remove pitcher immediately from steam wand
14. Measure and write down weight

15. Repeat step 4-14, 3 times total.
16. End data logging

#	Initial weight (g)	Initial temperature (°C)	End weight (g)	End temperature (°C)	Time (s)
1					
2					
3					

Test 2

1. Remove steam nozzle from steam wand
2. Attach steam nozzle to testing device
3. Secure tip to device
4. Connect Arduino to laptop
5. Start CoolTerm software
6. Record data [CafeName_Test2]

7. Fill pitcher with 200g water +-1g
8. Add a drop of dish soap
9. Measure and write down weight
10. Purge steam wand for approximately 5 seconds
11. Start timer for 45 seconds
12. Start steaming
13. Stop steaming when timer ends
14. Remove pitcher from testing device immediately
15. Measure and write down weight

16. Repeat step 7-15, 3 times total
17. End data logging

#	Initial weight (g)	End weight (g)	Time (s)
1			
2			
3			

Required materials

- Steeksleutel (10mm, 13mm, 15mm, 16/17mm verstelbare)
- Platkop schroevendraaier
- Schuifmaat
- Pitcher (2x)
- Spoon
- Ice cold water in thermos flask
- NTC
- Breadboard voor NTC
- Micro-USB kabel
- Testopstelling flow
- Weegschaal
- Laptop
- Coolterm software suite
- Arduino software suite
- 20 cm 10mm silicon tubing
- Exacto knife
- Tie wraps
- Slangenklemmen

Appendix VII: List of Requirements

Category	#	R or W	*Description*	Imp.	Note
1 Performance			*What main functions does the product need to fulfil?* *What functional properties should it have (speed, power, strength, precision, capacity, etcetera)?*		
	1	R	Product must be able to create foams with D_{32} smaller than 200µm using all types of (alternative) milk.		
	2	W	Product should create foams with as uniform bubble size spread as possible		
	3	W	Product must give user full control over the foaming process.		
	4	R	Product must be able to foam two drinks before the need for refilling/getting up to temperature.		
	5	R	Product must have a volumetric flow rate of 14.52 L/s		Professional machine test
	6	R	The product must be able to heat 200mL of whole dairy milk from 7 to 60 °C in 20 seconds.		Professional machine test, currently thought to be 25 seconds.
	7	W	Product should be ready for foaming as fast as possible.		Needs to be specified through user research.
	8	W	Product should require as few steps as possible to be cleaned		Specified through user research – ties in with materials.
	9	W	Product should feature a piggyback wall plug.		
	10	R	Product must be able to increase the volume of all types of (alternative) milk by 50% through foaming.		
	11	R	Product must retain a constant steam flow with maximum deviations of 5%		
	12	R	Product must not dilute the milk with water by more than 15%		

	13	W	Dilution of the fluid to be frothed should be as low as possible.		
	14	R	Product may not cause electromagnetic disturbance exceeding the level above which radio and telecommunications equipment or other equipment cannot operate as intended,		
	15	R	Product must have the adequate level of immunity to such disturbance which allows them to operate without unacceptable degradation of their intended use.		
2 Environment			*What kind of environmental influences does the product need to withstand during production, transport and use (temperature, vibrations, moisture, etcetera)?* *What effects of the product to the environment should be avoided?*		
	1		Parts must withstand temperatures above 100 °C		
	2		Parts must withstand humid environments.		Electronics must be shielded from water vapour
	3		Product must withstand splashes of water for short duration		
	4		Product may not give off to other surfaces due to heat or humidity		
3 Life in service			*With what intensity will the product be used and how long should it last?*		
	1		Product will be used at least 8 times a week for 15-30 minutes.		8 drinks per week (average of questionnaire)
	1	W	Product should last at least 15 years with prescribed maintenance without major repairs or replacements		Wish from company
4 Maintenance			*Is maintenance necessary and possible?* *What parts need to be accessible?*		

	1	R	Product must comply with the EU proposal for Right to repair.		
	2	R	Spare parts must be readily available.		
	3	W	Product must consist out of as many off the shelve components as possible.		
	4	W	Product must be easy to be disassembled.		
	5	R	Product must work without maintenance for at least a year at a time.		
	5	R	Product must be assembled without permanent connections		
5 Target product cost			*What is a realistic price for the product, considering similar products?* *What margin does it need to deliver?*		
	1	R	Product may not cost more than €300 to customers		Based on customer research
	2	R	Product must have a margin of at least 50%		To fund later batches without additional funding
6 Quantity			*What is the amount of units to be produced?* *In batches or continuous production?*		
			First batch at least 300 units		Based on Meticulous Milk purchases
7 Size and weight			*Are there boundaries to the size and weight of the product due to production, transport or use?*		How big is acceptable to customers?
	1	W	Product should require as little counter space as possible		Turn into requirement with more research.
	2	W	The centre of gravity should be as low as possible to prevent tipping over.		
	3	W	The product should be heavy, to feel premium.		Optimized weight for premium to shipping costs.
8 Materials			*Should certain materials (not) be used (because of safety or environmental reasons)?*		

	1	R	Materials used to construct the product must not endanger human health		
	2	R	Materials used to construct the product must not change the composition of the food it comes in contact with		
	3	R	Materials used to construct the product must not bring about deterioration in the organoleptic characteristics		
	4	R	Product may not contain more than 0.01% by weight in homogeneous materials for cadmium		
	5	R	Product may not contain more than 0.1 % by weight in homogeneous materials for lead, mercury, hexavalent chromium, polybrominated biphenyls (PBB), polybrominated diphenyl ethers (PBDE), bis(2-ethylhexyl) phthalate (DEHP), butyl benzyl phthalate (BBP), dibutyl phthalate (DBP) and diisobutyl phthalate (DIBP).		
	6	R	Materials must be selected from the the Union list of authorised substances set out in Regulation (EU) 10/2011		
9 Product life span			*How long is the product expected to be produced and sold?*		
10 Standards, Rules and Regulations			*What standards, rules and regulations (nationally and internationally) apply to the product and to the production process?* *Should standardisation within the company or with the industry be taken into account?*		
	1		Regulation (EC) 1935/2004		
	2		Regulation (EC) 2023/2006		
	3		Regulation (EU) 2022/1616		
	4		Regulation (EU) 10/2011		
	5		Directive 2011/65/EU		
	6		Directive 2012/19/EU		
	7		Electromagnetic Compatibility (EMC) Directive 2014/30/EU		Harmonised standards

	8		Directive 2014/35/EU		Harmonised standards
	9		Directive 2006/42/EC		Harmonised standards
	10		Regulation (EC) 1275/2008		
	11		Product must meet RoHS regulations		
11 Reliability			*What chance of failure is acceptable?* *What kind of failure and consequences to the functioning of the product should be avoided at all cost?*		
	1		Leaks are acceptable, but must be repairable by consumer.		
	2		Not acceptable that failure leads to human harm.		See 13 - Safety
12 Testing			*What quality tests are conducted on the product, both inside and outside of the company?*		
	1		In house testing using NEN-EN-IEC 60661:2014		
	2		Sample testing for ensuring product promises after production		
	3		Annex IV to Directive 2009/125/EC		
	4		Annexes VIII to X to Directive 2006/42/EC		
	5		Annex III module A to Directive 2014/35/EU		
13 Safety			*Should specific precautions be taken with regard to the safety of users and non-users?*		
	1	R	Product does not endanger persons, domestic animals and property in foreseeable conditions of overload.		
	2	R	Product must have fail-safes to prevent a heating element explosion.		
	3	W	Product should have sensors to prevent product self-damage.		
	4	R	Persons and domestic animals are adequately protected against the danger of physical injury or other harm which might be caused by direct or indirect contact;		Low-voltage ANNEX I

	5	R	Temperatures, arcs or radiation which would cause a danger, are not produced;		
	6	R	Persons, domestic animals and property are adequately protected against non-electrical dangers caused by the electrical equipment which are revealed by experience;		
	7	R	Product must protect against any risk caused by the use of machinery (mechanical risks, electrical risks, extreme temperatures, fire, explosion, noise, radiation, emission of gases, risk of being trapped in a machine, etc.).		
14 Reuse, recycling			*Can the material cycle be extended by reuse of parts and materials?* *Are parts and materials easy to separate for recycling or waste processing?*		
	1	R	The design and production of EEE must facilitate re-use, dismantling and recovery of WEEE.		

DESIGN FOR our future

TU Delft

Appendix VIII: project brief

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy". Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Piersma

initials: J T given name: Jeppe

student number:

street & no.:

zipcode & city:

country: The Netherlands

phone:

email:

Your master programme (only select the options that apply to you):

IDE master(s): ★ IPD ○ DfI ○ SPD

2nd non-IDE master:

individual programme: - - (give date of approval)

honours programme: ○ Honours Programme Master

specialisation / annotation: ○ Medisign

○ Tech. in Sustainable Design

○ Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Ruud van Heur dept. / section: HCD / AED

** mentor: Martin Verwaal dept. / section: SDE / DE Tech Support

2nd mentor:

organisation:

city: country:

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair _____ date ____-____-____ signature _____

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC

Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC

List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed

NO missing 1st year master courses are:

name _____ date ____-____-____ signature _____

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments

name _____ date ____-____-____ signature _____

Initials & Name J T Piersma Student number 4654129

Title of Project Creation of a stand alone milk steamer for home use

Creation of a stand alone milk steamer for home use — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 01 - 05 - 2023 — 30 - 10 - 2023 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Global coffee market has grown massively since the corona pandemic. Especially the premium coffee market has seen a big jump in demand over the last few years. In that market, the focus is mostly on the coffee (or espresso) itself. However, ~80% of coffees ordered in cafes in The Netherlands are milk based drinks, at home this number is drastically different. This might be due to people being unable to achieve the milk texture at home, like they get it in their favourite café.
We also see a growing demand for supply of Latte Art Workshops in cafes all over the country. People really want to learn to pour pretty latte art at home. In these cafés people find €10.000+ machines that grant them very high steaming power and flow stability, something that is not available for consumers at the moment.
SteamUp, a group of students on the brink of becoming a startup, have come up with a solution to provide a milk steaming apparatus to the households. They see a big opportunity for a product that will fill the gap between cheap mechanical milk frothers and expensive espresso machines with integrated steam wand. They want to offer a premium household product with the sole purpose of steaming milk with the quality that is expected from professional espresso machines.

The main stakeholder of this project is the consumer of the milk steaming apparatus. From our research we found that the first users will be coffee enthusiasts that use a manual lever espresso machine to make their espresso at home. It is important to this group that the product features a boiler for steam generation. The steaming pressure – and the control of this pressure – is also extremely important to the user group. Next to this, because they are paying a premium price, they also expect premium (design) features found in expensive espresso machines. Currently these consumers either (unhappily) resort to the use of mechanical frothers or do not make milk based coffee drinks at all.
SteamUp is the other stakeholder in this project. As this group consists only of students with little experience in developing and launching products to the European markets. The first prototype of the SteamUp has been built with great enthusiasm and interest of the espresso community. It is important to SteamUp to have a well thought out development cycle due to small funds. Next to this it is very important for them to be aware of and compliant with legislative requirements.

Current milk frothers available to consumers almost exclusively make use of a mechanical way of adding air to the milk. The products are mostly entirely automated and allow input from the user. This results in milk that does not reach the texture and temperature that people are used to from their favourite café. This is especially true for non-dairy milk.
Users of these mechanical milk frothers also report that cleaning of these appliances is rather annoying and hard.
A product that gives consumers a possibility to steam milk at home, just like the barista does at their favourite café does not exist yet, however we see a growing demand for such a product. Therefore I think there is a big opportunity to develop such a product and offer it to coffee enthusiasts.

This project has been started by a group of students, only 6 months ago. Therefore it is at the beginning stage of development. It also means that little product development knowledge is available in the startup and that funds are rather low. It is therefore really important to find mentors from the industry for guidance in the project.
Next to this, products that are developed within well established companies usually have a development time of 3-5 years, therefore it most likely will not be possible to develop the entire product for this graduation project.

space available for images / figures on next page

introduction (continued): space for images

image / figure 1: Current milk foam consistency (left) compared to desired situation (right)

Market placement

image / figure 2: Market placement for proposed product "SteamUp"

Initials & Name J T Piersma Student number

Title of Project Creation of a stand alone milk steamer for home use

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

There are a few challenges within this project that I want to tackle. The first and major challenge is to mimic or equal steaming performance achieved by professional espresso machines within the small form factor and budget of a home appliance. With that, it is very important that a boiler is at the heart of this appliance, since that is what the customer base asks for.

The second challenge is that all parts in the product need to comply with the regulations in the targeted countries of the Kickstarter campaign. Therefore there must be a big emphasis on sourcing of parts as well as certification for parts that are designed in house.

The last challenge of this project is in the 'dirty' fluids which the appliance will be in contact with, namely milk and tap water. The milk that will be steamed, which, if not cleaned properly can spoil and contaminate the next brewed beverages. Tap water can cause limescale build-up, which can block off the tubing and boiler and eventually damage the appliance. Both things to take into account when designing the product.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Develop a system prototype (Evans, 2014) for a new type milk steamer for home use that produces similar quality milk foam as professional espresso machines. It is important that the concept complies with EU regulations and norms. Lastly, concept should feature a boiler while other features are based on user needs.

In this project the goal is to generate fully functional and mass-producible internals for the new type of milk steamer. This will be achieved by analysing professional espresso machines on their performance and the way they are currently designed. Next to this, extensive user research will be conducted, to find out who exactly fits the target audience and what they want and wish for the product to entail. These two parts of research will be combined with the company vision to form the list of requirements.

From this point on, decisions have to be made on what parts will form the system of SteamUp. Which parts will be sourced and where and what other parts need to be designed in house to achieve the required performance. For parts that are designed in house, it is important that manufacturability and norms are kept in mind.

In the end the result of this project would be a system or final hardware prototype of the internals of the new type of milk steamer. The prototype should produce similar or improved performance compared professional espresso machines and be able to steam different types of milk.

Other important parts of the project are making sure the product is designed to last and can be easily serviced, that limestone buildup is kept at a minimum by design and lastly that it complies with the upcoming changes of regulation regarding PFAS in 2025.

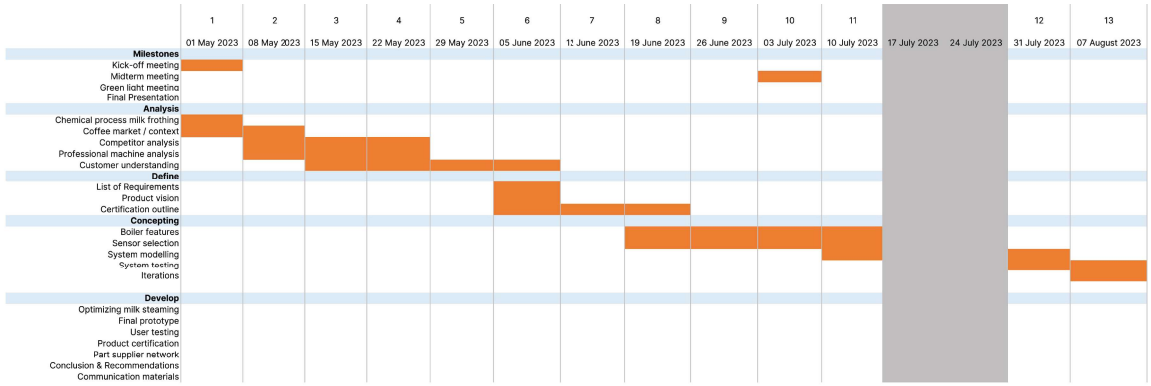
Initials & Name J T Piersma Student number

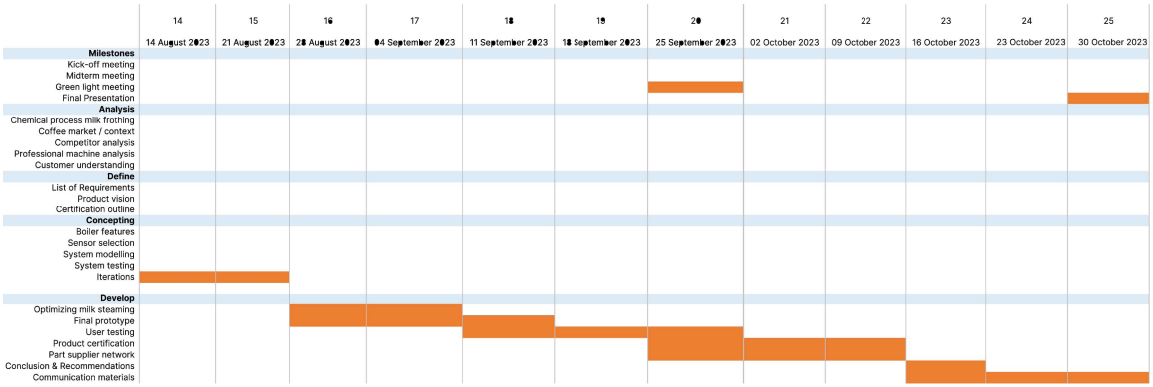
Title of Project Creation of a stand alone milk steamer for home use

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 1 - 5 - 2023 30 - 10 - 2023 end date





I plan to work on my graduation for 4 days a week, the other day I will work towards generating funds required for the startup and living expenses. There will be a blend between working at the faculty, my home and flex workspaces. This is all to keep motivation high.

I chose to take two weeks of summer break, other than that, all other days are study days (also dates such as bevrijdingsdag and hemelvaartsdag).

Initials & Name J T Piersma Student number

Title of Project Creation of a stand alone milk steamer for home use

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

Years ago, when I moved out of a house that had a great espresso machine where I made my cappuccino daily myself, I found out that a stand alone milk steamer did not exist. Therefore I started thinking whether it was possible to make a machine myself and market that. Until the course of Build Your Start-up, I had not come back to that thought I had all those years before. In the course I found out that there was a market for such a product and I now want to chase that opportunity.

During my internship I was introduced to Product Engineering for Manufacturing and I immediately fell in love with that. From then on, my goal was to become a product engineer. Now in my graduation I would love to learn how to design a product that complies with all regulations of different markets. This will grant me additional skills that I have not developed during my bachelors or masters degree yet.

Lastly, since this project is an individual project that is also initiated by me, I want to learn to gather a team of experts around me that can tutor me during my graduation. This allows me to learn fast and in the end, hopefully, present a product that is nearly ready for manufacturing.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Evans, M. (2014, 30 december). iD Cards. Loughborough University. https://www.lboro.ac.uk/schools/design-creative-arts/research-innovation/projects/id-cards/

Initials & Name J T Piersma Student number

Title of Project Creation of a stand alone milk steamer for home use