Technical challenges for the microfluidics industry and the role of the Microfluidics Association

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enablingMNT micro nano technology

Microfluidics Association

MFMET Establishing Metrology Standards in Microfluidic Devices

Technical challenges for the microfluidics industry

- Microfluidics is driven by the diversity of the medical diagnostic market.
- On top of that we have many other applications in research, industry, farming etc.
- The main technologies originates from universities and are as diverse as its applications.
- As a consequence:
  - It is difficult to combine components from different suppliers.
  - We lack generic test tools and protocols to guarantee quality.

Indicative overview connectors

	Chips		Pumps				Other				Comments
	glass	polymer	Pressure regulated	Peristaltic	Membrane	Syringe	Flow sensor	Other sensors	Valves	Cell cultures / Organ on chip	
Hose		(X)			X				X	X	
(mini)Luer		X	X			X		X		X	Mostly Luer
glued	(X)										
1/4-28 etc.			X			X	X	X	X	X	Mostly 1/4-28
clamped	X										
Manifold or docking station	X								X	(X)	
Other			(X)			(X)					company unique, push in etc.
None				X						X	

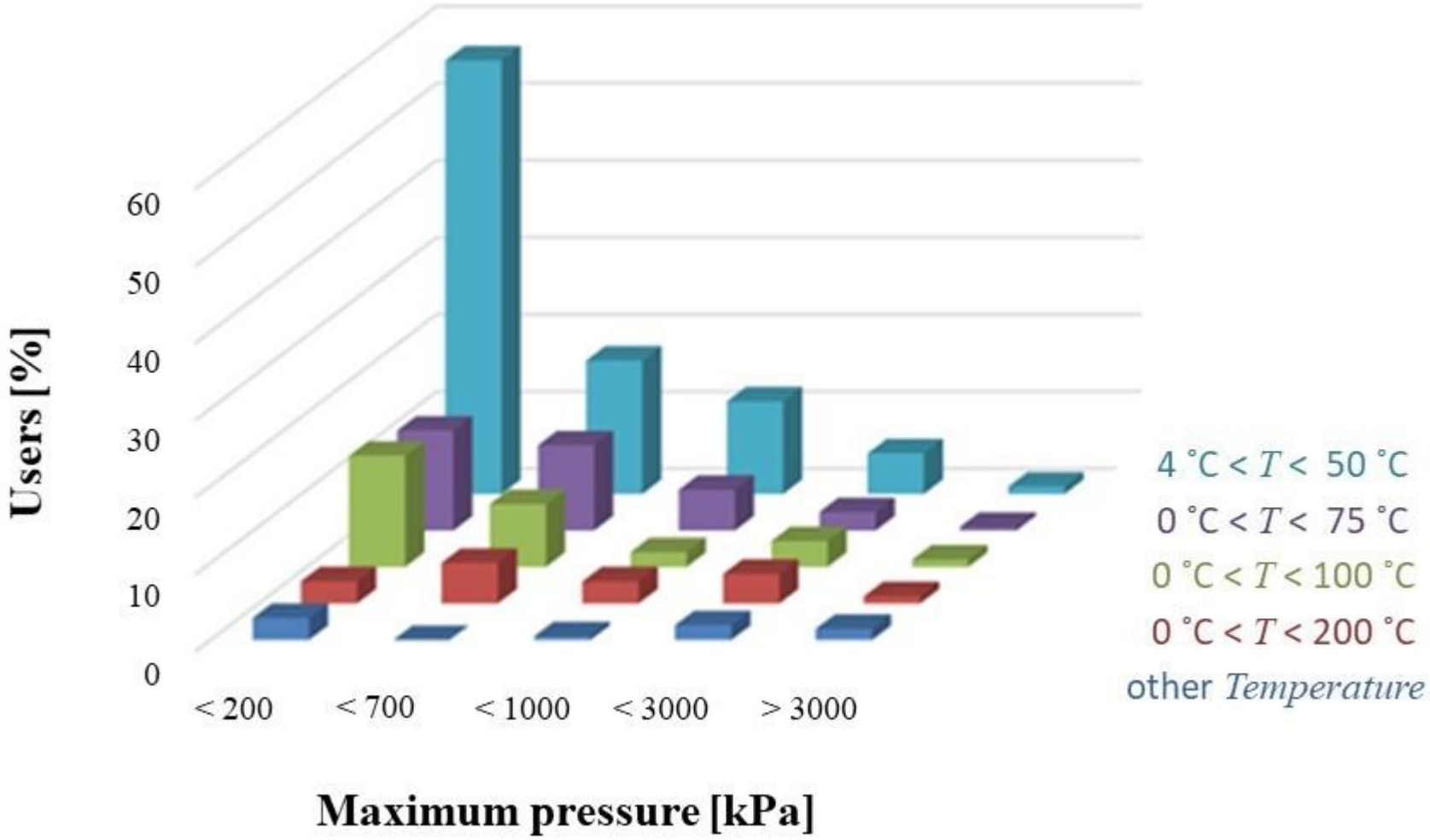
To wards plug and play

- Make it easier for customers selecting microfluidic flow control components and devices, install them and use them: democratisation of microfluidics or microfluidics 4.0: Components and devices are divided in well described classes.
- Within these classes components and devices operate seamlessness with each other, can be integrated by non experts: plug and play.

Operational classes

- What are the key performance parameters that define microfluidic classes?
- Based on these parameters, what are the three most popular classes?
- Does everyone agrees with this?
- What are the requirements for connectors that could be used in these classes?
- Are there connectors that meet these requirements?

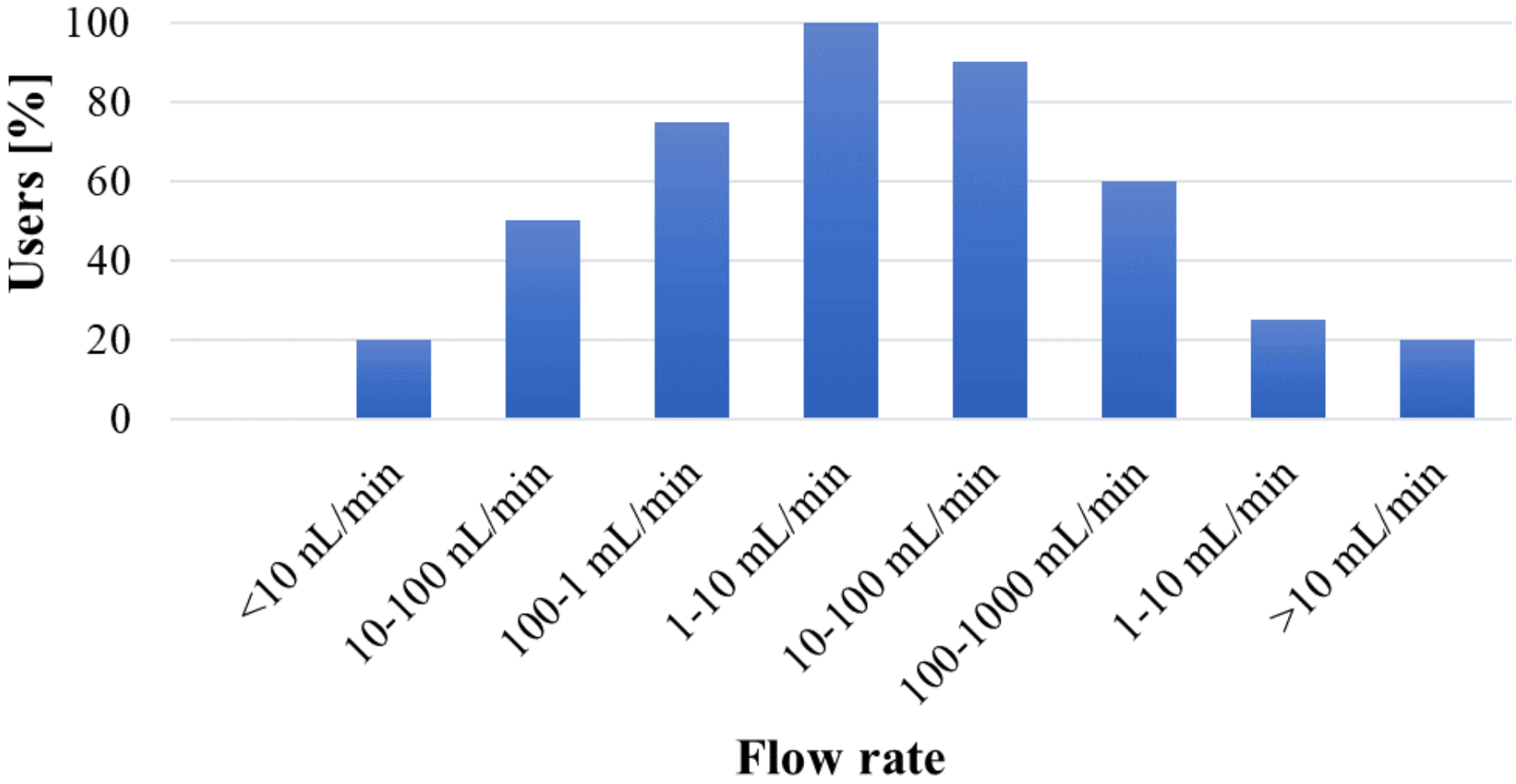
Survey result (1)



Classes based on pressure and temperature

Class	Maximum pressure [KPa]	Maximum temperature [°C]	Minimum temperature [°C]
Capillary devices	---	50	4
PT 200/50	200	50	4
PT 200/75	200	75	4
PT 200/100	200	100	4
PT 700/50	700	50	4
PT 700/100	700	100	4
PT 3000/50	3000	50	4

Survey result (2)



Proposed classes based on flowrate

- Low flow rate: up to 1 µl/min -> calibration by optical methods preferably, or low-flow volumetric methods in general. National metrology standards (best calibration uncertainty) would be around 1% in general (1 nl/min and higher).
- Middle flow rate: 1µl/min to 100µl/min (hot spot) -> calibration by gravimetric or volumetric methods, national metrology standards (best calibration uncertainty) would be around 0.5% in general.
- High flow rate: 100µl/min to 10ml/min -> calibration by gravimetric methods, national metrology standards (best calibration uncertainty) would be around 0.1% in general.

Measurement priorities during fabrication.

(based on interviewing industry experts)

1. Anything that affects pressure decay and flow resistivity in the device (wettability, deviation from the ideal dimensions etc.).
2. Anything that affects bonding quality of polymer devices (glass transition temperature, melting temperature, molecular weight number and distribution, ….)
3. Leakage test / burst pressure test / maximum operational pressure test.
4. Agreement about quality information of incoming materials like: optical transmission / auto fluorescence of polymer materials, thickness of glass substrates etc.
5. Measurement of fast changing flowrates.
6. Bio viability check after deposition of biomaterial on the chip / in the device.

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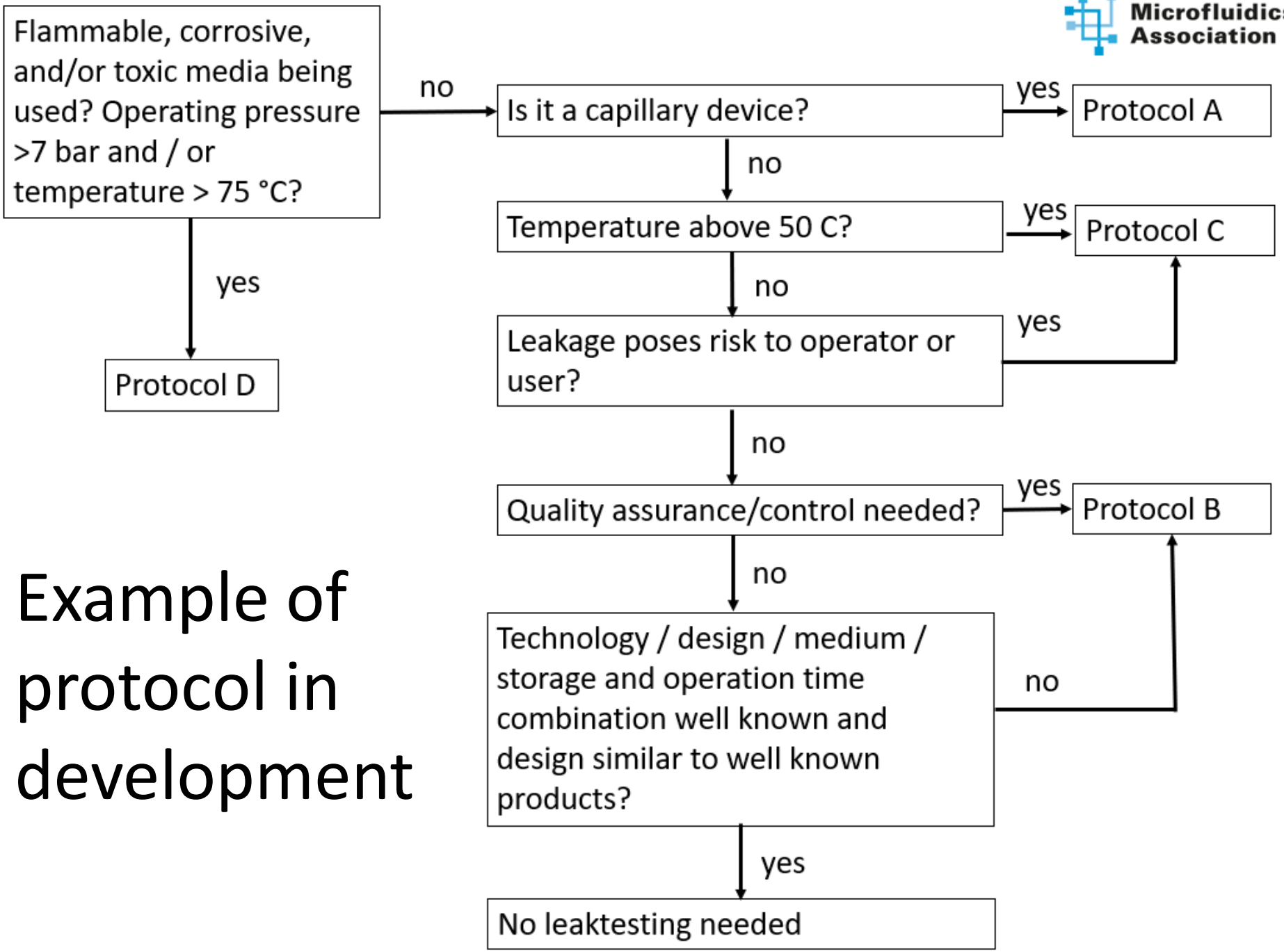
Example of protocol in development



In conclusion the MFA aims at:

- Plug and play microfluidics:
  - Interconnection and assembly standards
- Improving quality and shortening the time to market:
  - Testing guidelines
- Understanding product specifications and easily comparing products:
  - Vocabulary