

Public Invention Q4 (Annual) Report, 2022

-- Robert L. Read (Rob), December 5th, 2023

This the Q4 (Annual) quarterly report of Public Invention for 2022.

Q4-Specific Summary

Global Open Source Quality Assurance System (GOSQAS) alliance formed

In October, Public Invention and Open Source Medical Supplies (OSMS) led a symposium attended by about 15 thought leaders around the problem of assuring quality in rapidly manufactured emergency and medical devices based on free-libre open designs. There was broad agreement that this is a serious problem and most of the attendees agreed to create a [Global Open Source Quality Assurance System \(GOSQAS\)](#) alliance. Robert L. Read of Public Invention and Victoria Jaqua (board member of Public Invention and OSMS) and Christina Cole of OSMS are leading this effort.

Our initial approach is to develop a completely open provenance tracking system.

Participants in the GOSQAS alliance include:

- Public Invention
- Open Source Medical Supplies (OSMS)
- University Health Network Advanced Perioperative Imaging Lab (APIL)
- Every Breath Counts Coalition (EBCC)
- Helpful (Helpful Engineering)
- IoPA (Internet of Production Alliance)
- UBORA
- OSHWA (Open Source Hardware Alliance)

A lively conversation has already occurred around our [technical proposal](#). We will continue to improve our website. Our plan is to make a formal launch of an open source project around this technical approach. However, our final goal is to create a systematic culture of global cooperation to improve quality assurance to save lives.

NASA Contract Completed and New Contract Signed

Public Invention successfully completed a contract with NASA (the US National Aerospace and Space Administration) with the help of (paid) volunteer Geoff Mulligan. This contract was to deliver a report on a digital control system for a ceramic oxygen generator. This fundamental technology is needed for space as it has profound implications for global health in rural places ill-served by cryogenic O₂ production.

We delivered [a report](#) and also constructed a toy [proof-of-concept](#) with running code. This code was based on work done by representatives from Helpful Engineering in cooperation with a Public Inventor (i.e., Ben Coombs). Public Invention will likely continue this work in 2023 under a new contract.

In early January, we signed another contract for \$50,000 with NASA. Some of this money will be required to be spent on hardware, and probably half of the remainder will be paid to Geoff Mulligan, a senior IoT specialist who collaborates with Robert Read on this concept.

PolyVent Educational Ventilation Platform

In December, Nathaniel Bechard and Robert Read traveled to Rice University in Houston TX, to demonstrate the PolyVent Education Platform. They gave a talk in the morning to about 18 engineers, students and teachers. Twelve biomedical engineering students there worked through six troubleshooting exercises for extra credit. A [survey](#) completed by the students after the exercise was very positive.

Our goal for the next year is to sell 5-10 PolyVents for \$3-5K in order to place this unique educational tool in front of hundreds of students worldwide. The ultimate goal of this is to build a community of practice that will eventually spawn a firm that makes a regulated medical ventilator that will save lives.

2022 Annual Report

Financial Position

Here is our Balance Sheet:

Public Invention

Statement of Financial Position

As of January 5, 2023

	TOTAL
ASSETS	
Current Assets	
Bank Accounts	
Fidelity Z40323246	689.26
PayPal	1,171.67
Wells Fargo Simple Business Checking (7066)	13,490.72
Total Bank Accounts	\$15,351.65
Other Current Assets	
Petty Cash	-0.90
Total Other Current Assets	\$ -0.90
Total Current Assets	\$15,350.75
TOTAL ASSETS	\$15,350.75
LIABILITIES AND EQUITY	
Liabilities	
Current Liabilities	
Other Current Liabilities	
Robs personal contributions	0.00
Total Other Current Liabilities	\$0.00
Total Current Liabilities	\$0.00
Total Liabilities	\$0.00
Equity	
Opening Balance Equity	-1,421.08
Retained Earnings	16,861.83
Net Revenue	-90.00
Total Equity	\$15,350.75
TOTAL LIABILITIES AND EQUITY	\$15,350.75

Donors and Income in 2022

In 2022, we received \$69,399.56 in donations from 11 donors. However, \$37,000 of that amount was targeted for the Glia Tourniquet project, of which we took a small administrative fee before transferring that money to Glia (a Canadian corporation.)

Public Invention				
Account QuickReport				
January - December 2022				
	Date	Name	Account	Amount
Donation				
	01/03/2022	Margaret R. Read	Donation	3,000.00
	02/16/2022	Anonymous	Donation	25,000.00
	03/28/2022	Darcy Goff	Donation	248.62
	06/14/2022	Goldman Family Fou	Donation	15,000.00
	06/20/2022	Eric and Darcy Goff	Donation	10,000.00
	07/12/2022	Randol R. Read	Donation	2,000.00
	07/13/2022	Robert L. Read	Donation	10,000.00
	4/18/2022	Nancy Reed	Donation	53.42
	3/4/2022	Katherine Zuckerman	Donation	97.52
	12/12/2022	Margaret Robinson R	Donation	3,000.00
	12/12/2022	David Jeschke	Donation	1,000.00
Total for Donation				\$69,399.56
TOTAL				
Thursday, Jan 05, 2023 09:49:01 AM GMT-8				

Additionally, we had \$22,400 in income from the NASA contract, but \$15,000 of that was paid to Geoff Mulligan, and there were various hardware expenses for which we were not reimbursed, so it generally represented about \$4000 in new revenue.

The NSF POSE Grant

Public Invention paid \$5,000 to professional grant writers to prepare a grant for the “Pathways to Opens Source Ecosystems” around our Freespireco concept (which predated the grant opportunity by years.)

Sadly, we did not win this grant. All of the 20 awardees were Universities. Although we seemed to receive very good review marks, we were not selected. The awardees appear superficially to be similar (but in different domains) to our own proposal.

The reviewers misunderstood two aspects of our proposal: They seemed to fault us for not addressing the process of FDA approval even though we were not going to manufacture any medical devices, and they seemed to penalize us for the fact that I draw no salary, thinking of that as a negative instead of a positive.

This was a very disappointing result; but I am encouraged and believe that if they open the same system in the future we stand a good chance of winning.

Important Projects

PolyVent

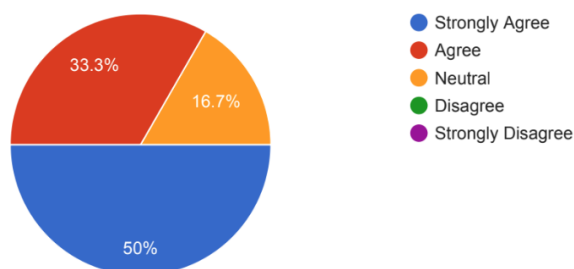
As mentioned before, this year we completed the PolyVent Education Platform II, and demoed it as a useful classroom exercise at Rice University.

A class survey of the 12 students demonstrated it was well received:

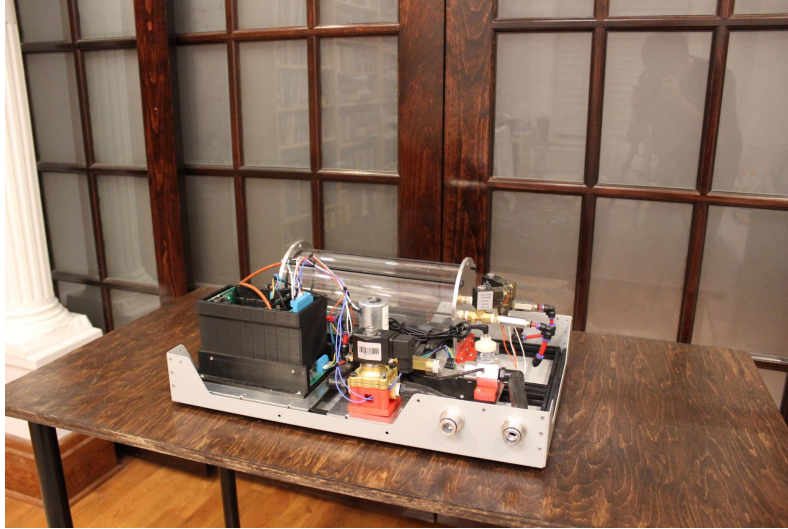
I would recommend this type of experience to other bioengineering programs in universities.



12 responses



Here is a photo of the PolyVent:



Since Nathaniel is now in college, it is our duty not to rely on him except for things that can absolutely only be done by him. We have tentatively made an agreement with Lee Erickson to continue his role as lead electrical engineer on the project. Nathaniel has completed the second machine, which will be shipped to Austin soon. We are developing a well-designed shipping case to avoid damage in shipping. We give our sincere thanks to Nathaniel for his work over three years on the PolyVent, and wish him well in his college career.

The PolyVent may be the most sophisticated fully open medical device ever produced and documented with fully open licenses, despite the fact that we have no immediate intention of seeking FDA approval. The PolyVent is not for use on human patients. But nonetheless, if a new pandemic forces us as a planet once again to rush to build ventilators, I claim that the PolyVent would be the best starting point for this effort. Public Invention has been in the center of the open source respiration device effort spurred by the pandemic, and we know of no other ventilator which is as fully open.

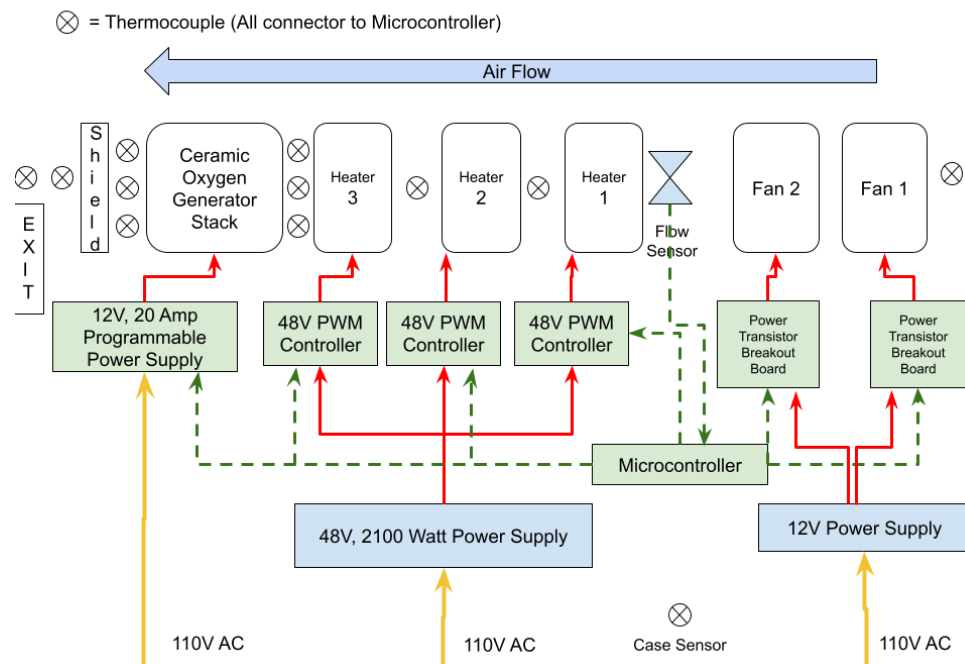
That said, the development effort needs to continue. We have a GUI, but have not integrated with the device. We are building a [General Purpose Alarm Device \(GPAD\)](#), which is also needed.

A critical goal of ours is to sell five PolyVents at \$5,000 USD to institutions of higher learning and teaching hospitals. This is not to make money (this would be a little more than our costs) but would create a community of practice that will keep the technology alive. To that end we are discussing the PolyVent at the FOSDEM 2023 in Brussels in February, and have had an abstract tentatively accepted to the American Society for Educational Engineering Conference (co-authored with Sabia Abidi and Nathaniel Bechard).

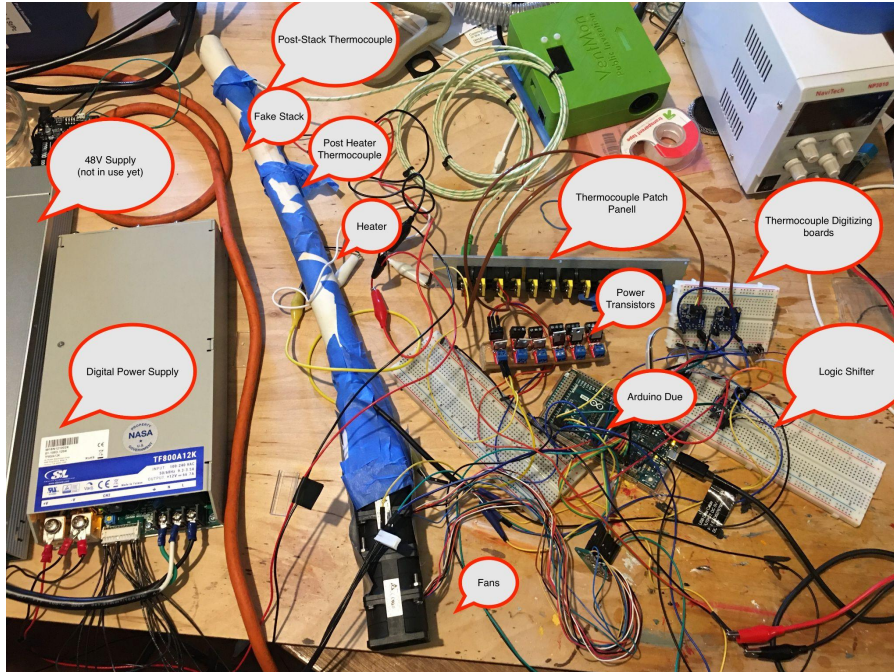
We can offer a discount to purchasers in low- and middle-income countries.

NASA Ceramic Oxygen Generator Project

Public Invention, with the assistance of Geoff Mulligan, successfully completed a 160-hour contract with NASA (for \$140/hour) to write a report on recommendations for a digital control system for a technology they have developed. American Oxygen, a firm supported by NASA, has developed a ceramic wafer that can extract pure oxygen from air and other gases when a voltage is applied to it at more than 700C. This is essentially a solid-electrode fuel cell operated in reverse. This technology is a huge improvement of pressure-swing adsorption in that it is immune to fouling due to moisture and dust, which plagues clinics in the developing world. While potentially equivalent to cryogenic oxygen separation, cryogenic separation is only done on a large scale; this requires large investments, trucks to ship cylinders, and good roads. NASA's technology could make small-scale oxygen production for a 4-bed clinic lacking air-conditioning extremely practical. This technology could have a huge impact on the 700,000 kids that die due to childhood pneumonia every year. Our work here could help commercialize this idea faster.



Of course, we didn't just write a report. We constructed a desk-top prototype of the control system to remove risk in our approach, and wrote a complete [Arduino-based control system](#) for it. This code is a fork of Ben Coomb's "the Ox" oxygen system, which is in turn a fork of the Helpful Engineering VentOS system (which was mostly written by Robert L. Read and Ben Coombs.)



NASA has extended our contract. It is our goal to do this while also supporting global health in this way.

Marc Jones has pointed out that this action will require us to get professional tax help for the 2022 tax year, since it is possible this “other business income” will be taxed. In general, we would prefer to receive “grants” rather than “contracts”, but our primary goal is to assist this technology coming to market. Dr. John Graf has mentioned the possibility of seeking grants (outside of NASA) for this technology from a global health point of view; we are happy to participate in that.

In January, we extended this contract with NASA for an additional \$50,000 and began serious work on improvements and planning a digital control system for a 500-L/min system that could be funded to revolutionize rural oxygen delivery.

General Purpose Alarm Device (GPAD)

I am pleased to say that our collaboration with the [Sustainable Progress and Equality Collective \(SPEC\)](#) has produced in short order an important “invention” (although light on research and heavy on engineering.) Lee Erickson and Lawrence Kincheloe did a great job designing the printed circuit board (below), which was received just recently and is ready for software testing (by Robert Read).



The GPAD device is designed to be used as a multi-purpose “alarm device.” This device includes: bright LEDs on the right that can be programmed to show “alarm level,” a built-in buzzer that can produce a variety of pitches, a “mute” button on its face, and a large LCD display to show the cause of the panic condition.

We dream that someday this will be a product sold at Adafruit, for example, to hobbyists where it can be used for anything from a cat door to a burglar alarm to a solar installation monitor system. However, one immediate use is to provide medical alarms for the PolyVent (this is not yet integrated). Every mechanical ventilator needs an alarm system. Very few of the emergency pandemic ventilators had one. In keeping with the PolyVent philosophy, this system is highly modular and supports local manufacturers.

We have now decided that the next iteration of the GPAD requires a better audio system and some minor fixes to the board. We are actively working on that. Additionally, we may provide some mentoring to students at Oklahoma University that may undertake this as a Senior Capstone project.

Glia Tourniquet Project

Public Invention has been acting as a fiscal sponsor for GLIA, a Canadian firm that makes an [open source tourniquet](#), which is particularly in demand in Ukraine. We have raised over \$37,000 in partnership with them (included in our donations), which have already been transferred to their team. They have also given us quarterly reports in writing as we have requested.

Part of our agreement with Glia relies on us maintaining our 501c3 status with quarterly written status updates; I'm happy to say they have produced good reports for the [third](#) and [fourth](#) quarters of 2022. In a nutshell, this project is under budget, but it has had scheduled setbacks; even so, they are now making a desktop-sized injection mold. The plan remains to make at least 1,000 of these tourniquets, and to make the design completely open source.

Passive Ferrofluid Check Valve

Veronica Stuckey, the public inventor behind the Ferrofluid project, published her team's original paper at [Engineering ArXiv](#). Rob, the Invention Coach, put significant work into building a pump using this valve, by hand winding iron semi-circles and programming power transistors. The initial use of this pump failed due to leaks. This project is well worth continuing, but was put on hold due to the NASA contract displacing it.

Standards and VentOS

VentOS is a project of Helpful Engineering. However, it utilizes data standards and software created by Public Invention for the VentMon, including VentDisplay, PIRDS and PIRCS. We recently expanded PIRCS based on input from Erich Schulz, MD. These standards continue to evolve.

VentMon

Mr. Ben Coombs is designing the VentMon T0.5. The design is nearly complete, and manufacturing of 15 units may begin soon. These will likely be delivered in March, 2023, and are an essential part of the PolyVent teaching classroom experience.

A project developed in tandem with the VentMon and VentOS is the Freespireco project which is our largest project (i.e., has many components).

Financial Position

We have about \$10,000 in cash.

Partnerships

Public Invention continues to support other teams wherever possible. Rob is an active board member of Helpful Engineering. We have encouraged a network of nonprofits including: EBCC, GOSH, Helpful, FieldReady, OSMS, OSHWA. We have attempted to apply (separately) to the NSF POSE grant and are advising them accordingly.

Outreach

Miriam Castillo continues to recruit volunteers. We have improved the presentation of projects at our website, although we are still updating our active projects accordingly.

Megan Cadena, our paid contract assistant, has taken a full time job, which caused an interruption in her work, but she continues to work 5/hours per week.

Events

We hosted a working symposium, on October 13th, with many other nonprofits and some university based researchers to attempt to solve the global problem of developing a process and culture for quality assurance of distributed manufacturing for open-source designs within the medical device sector. Victoria Jaqua is co-hosting this collaboration and it will be attended by representatives from UBORA, EBCC, Helpful Engineering, Nation of Makers, Internet of Production Alliance, and many others. This event is an experiment, but demonstrates real leadership on Public Invention's part.

Additionally, we held a number of monthly "happy hour" sessions, which had about 15 participants. These were a big success, especially Megan's jeopardy game. On January the 19th, 2023, we did a fun exercise of evaluating several inventions using the "Fuller Scale." This was attended by about 7 people.

Here are the results:

<i>All Measurements in milli-fullers (1/1000th of a Fuller)!</i>					
Inventions	PolyVent	Color-bas e Writing	Volumetric Colony Counting	A Soft FerroFluid Pump	Conserved Quantities
Rob	50	70	15	10	30
Geoff Mulligan	40				
Lawrence	20	50	20	50	1
Joe T.	80	12	8	75	16
Joe H.	19	1	9	15	0.1
Miriam	20	60	1	10	
Megan	30	10	15	60	15
Melanie		20	12	40	2
Avg:	37.00	31.86	11.43	37.14	10.68

Peer-reviewed Publications

We published a major paper on segmented helices, the culmination of significant work, in a [journal "Mathematics"](#).

Other Publications

Talks

Rob spoke on April 22nd at the [Open Hardware Summit](#). Also, he spoke at a GOSH community call alongside Thomas Landrain of JOGL. Rob presented a talk on Freespireco at the Southern California Linux Expo (Scale 19x). It was attended by about 20 people and well received.

Upcoming Talks

Rob is speaking separately on GOSQAS and PolyVent at [FOSDEM](#) in early February in Brussels. An abstract of a paper to the American Society of Engineering Education has been accepted (full paper needs to be submitted), which is in June in Baltimore. Rob will speak on a panel virtually at [XIX Biennial IASC](#) (International Association for the Study of the Commons) Conference in June. We have submitted several talks to the Open Source Hardware Association conference, but have not heard back yet.

Partnerships and Cooperation

Public Invention continues to actively cooperate with Rice University, Helpful Engineering, OSMS, JOGL, and the Every Breath Counts Coalition.

Rob mentored a Freshman Design team at Rice University that designed an outdoor musical instrument for a park. As well, our work with SPEC has been particularly fruitful.

Social Media Growth

Because of our Social Media Coordinator and Admin Staffs' efforts, our social media presence has grown by the following amounts in 2021:

1. Our [YouTube](#) channel now has 303 subscribers.
2. Our [Twitter](#) handle now has 257 followers.
3. Our [Google Group](#) now has 86 members.
4. Our [LinkedIn](#) page now has 322 followers.

This is about a 25% growth over the beginning of this year.

Strategy for the Coming Year

Sadly we were not awarded the grant for Freespireco from the NSF. However, we will continue to work on the Freespireco concept. Public Invention continues to grow slowly. We have been successful in obtaining “gravitas, influence, and credibility” but have not created the army of volunteers that we are hoping to energize, though we probably have as many high-quality volunteers right now as ever.

A long-term goal is to raise enough money to hire an executive director so that Rob can focus on being head invention coach.

The priorities for the full year of 2023 are:

1. Making the new NASA contract successful, which is one building block of a revolutionizing therapeutic oxygen delivery in low- and middle-income countries.
2. Selling five of the PolyVent Educational Platforms around the world and building a community of practice.
3. Completing my book (currently 72 pages):
<https://github.com/PubInv/intro-public-invention/blob/main/intro-pubinv.pdf> and finding a publisher for it.
4. Writing a technical paper for VentOS (with Dr. Schulz and Ben Coombs)
5. Writing a technical paper for the PolyVent system (with Dr. Suturin, Nathaniel, and Antal.)
6. Creating a second version of the General Purpose Alarm Device (GPAD) and productizing it.

The 2022 Annual Awards

Public Invention does not ordinarily pay its volunteers, but our sincere thanks and acknowledgement is essential to motivating volunteers. To this end, we give out Annual Awards, commemorated by an engraved plaque on cherrywood. The 2022 winners are the following:

Annual Awards 2022

Forrest Lee Erickson
Best Public Inventor, 2022
For the General Purpose Alarm Device

Lawrence Kincheloe
Best Invention Coach, 2nd Place, 2022
For the General Purpose Alarm Device

Victor Suturin
Best Invention Coach, 2022
For the PolyVent Educational Platform

Nathaniel Bechard
Best Public Inventor, 2nd Place, 2022
For the PolyVent Educational Platform

Megan Cadena
Best Paid Staff Contribution, 2022
For Outreach Coordination

Miriam Castillo
Best Volunteer Staff Contribution, 2022
For Volunteer Recruitment

Veronica Stuckey
Best Academic Paper, 2022
For "Passive Ferrofluid One-way (Check) Valve"

Geoff Mulligan
Best External Expertise, 2022
For NASA MCOG Extensions

Antal Zuiderwijk
Best Mechanical CAD Design, 2022
For PolyVent

Avinash Baskaran
Best External Ambassador, 2022
For creating the Auburn PIHE

Victoria Jaqua
Most Active Board Member, 2022
For GOSQAS

Sabia Abidi
Most Active Board Member, 2nd Place, 2022
For PolyVent Evaluation and University Relations