Tidewave – from start-up to successful launch

An innovation journey

TIDEWAVE™

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Managing Innovation

Tidewave - a case study of a healthcare technology start-up

THE TEAM: Elen Haugs Langvik, Bjørn Lorentzen, Andreas Smith, Arvid Bjerre and Nina Fagerheim Åmodt. (Photo: Hilde Garlid, Validé)

Tidewave

Bedsores are bad news. Lying in bed all day might sound fun on a lazy Sunday morning with the newspapers and TV to entertain you. But spending days on end unable to move because of some debilitating illness or a broken bone is something different. The skin, especially in older people, rubs and scratches and pretty soon you have a pressure

ulcer, a wound. Bedsores are sadly very common and, untreated, can lead to complications, especially if they become infected.

The best way to prevent bedsores is to keep moving - but with ill and incapacitated people that's not always so simple. Nor is the alternative of having someone else help turn them; human bodies are surprisingly heavy and difficult to manoeuvre. So for nurses and carers there's a big physical challenge and a heavy workload to add to an already crowded working shift.

It's a significant issue in healthcare. Estimates suggest that one in five patients at European health institutions suffer from pressure ulcers and apart from the painful patient experience it is a high cost problem. According to the Agency for Healthcare Research & Quality (AHRQ) these run at around $10bn per year in the USA alone. So there's plenty of incentive for innovators to work on finding solutions.

One person who joined the quest was Augun Haugs, a successful engineer and inventor. He was head of the Christian Michelsen research laboratory in Bergen, (an institute specialising in medical research)and also very active in the local Inventors' Association. He figured that if it was difficult to move the patient then an alternative solution lay in moving the bed, or more specifically the mattress. So he set about developing a mattress which could be used to keep the patient gently moving - lateral rotation therapy. Not such a simple task since the movement needs to be specific enough to keep the patient from getting pressure sores but gentle enough not to wake them. Working with the medical staff at Haukeland University Hospital he developed a design which drew on some earlier experience developing a soft grip tool for the petroleum industry. His idea for a curved turning mattress showed promise in terms of health improvements and this gave him the confidence to apply for, and secure, a patent. But his sudden death in 2008 meant that the project got put on hold.

Ten years later it came back to life. Augun's granddaughter Elen was studying for a business degree at the University of Stavanger (UiS) and as part of her course on

entrepreneurship she had to undertake a project. Looking round for an idea for which she had to develop a business plan she remembered his invention and decided to use that. Working alongside her colleague, Nina they developed and pitched their plan, not only scoring high marks but planting the seed which led to the formation of their company, Tidewave.

A student start-up

Like many universities around the world UiS had a student startup competition and seed funds and facilities and so Elen and Nina decided to try to take the idea further. With the help of a friend (Bjørn Lorentzen) with an engineering background to supply the technical skills they joined the university's startup accelerator program ITSA (Ipark Tech Startup Accelerator). Within iTSA they received training on key tools such as lean startup and how to take ideas to market.

Their work paid off and they were placed as runners-up in the national final of the Venture Cup, having won their local and regional rounds. They competed against 90

other student startups from across Norway and the accumulated prize money (around $5000) was a welcome funding boost. This was topped up further by their idea winning an award from a major insurance company, Tryg, who gave them another $2500 for the potential impact their idea could have on preventing injury to Norwegian citizens.

With both financial support and a sense of confidence in their idea they took the next big step and formally established their company, Tidewave R&D AS in January 2017.

Their first step involved taking advantage of a university Accelerator programme ITSA which forms part of a wider support agency, Valide. (for more about valide see this link https://valide.no/en/what-valide)

The team were able to use student incubator space and to make use of training and resources to support start-up entrepreneurs. Their first step was to create a Minimum Viable Product, (MVP) , an early stage prototype which could showcase their thinking. They produced this in February 2017 and it gave them not only something for their own development to focus around but also a way of sharing their ideas and getting feedback from the market.

The MVP was essentially a short film with the concept in 3D illustration but it served its purpose, giving them valuable feedback on functions, design and user experience when introducing it to potential users and customers, health professionals and industry designers.

By April it was clear that they needed to strengthen their technical skills base and recruited Andreas Smith a contact of Bjorn's. Taking on an employee was a big step but the timing worked well because they had the prize money from the contests and had also been successful in securing further research grants to progress their idea.

In particular they were able to take advantage of an initiative called Pumps and Pipes. The Norwegian economy, especially around Stavanger, was heavily linked to the North Sea oil and gas business and this had been a source of strong economic growth for decades. But as the reserves began to decline so there was concern to re-orientate local industry to new markets including healthcare. Pumps and Pipes was one of a series of initiative designed to help transfer technology between sectors and plant the seeds for future growth. The possibility of using oilfield technology in the TideWave product allowed them new routes to solving the technical problems originally identified by Elen's

grandfather in filing for his original patent. They made a successful application with support from Aarbakke Innovation and secured $30,000 to explore potential technology applications.

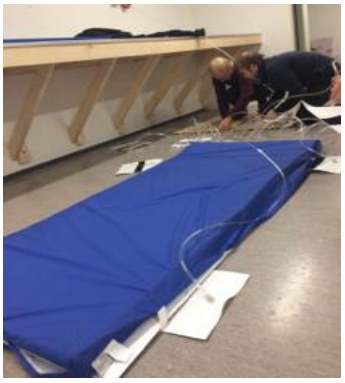
They were also able to get help on the market side to learn about potential customers and extend their network, testing the original concept and MVP and refining their ideas. This funding, a further $10,000, came from the national Innovation Norway fund.

The third - and major - strand of support came from the Norwegian Research Council and provided them with $100,000. This is a dedicated programme to support student entrepreneurs and gave them resources for a research project with the requirement that at least one member of the team has graduated from a masters degree programme. Since all three of the original founders had just submitted their final theses this fitted well and they were awarded the grant in May 2017.

So with funding in place to support both technical and market exploration they were finally in a position to go full-time and develop their venture in August 2017.

The first major task was to move from concept testing and various MVPs to create a full-scale working prototype and this was ready in September 2017. They used a simple 'Lego' style approach, keeping components modular so they could play around with different configurations rather than build a permanent structure. For example they used simple Velcro fixings for the coverings so they could explore different configurations to enable different types of movement.

Core concept



The basic idea behind the Tidewave product is to replace a conventional mattress with an inflatable one containing a number of separate cells. Each of these can be separately controlled, keeping the patient in a constant but gentle state of motion. The key to the innovation lies in the control technology, using sensors and actuators to maintain this motion. The core concept is based on Augun Haug's original work with the gripper technology he developed but the team have been able to take advantage of significant advances in control technology and machine learning.

(You can find more details on the specific product features and their relative advantages over conventional approaches here

https://www.tidewave.no/news/prototype-getting-digital

and a short film about the product here
https://www.tidewave.no/new-index-1_

Their work on the technical side was matched by further market exploration and by late September they were able to conduct their first user test. A local nursing home in Bryneheimen found a resident willing to help and they installed the prototype. He was able to give them direct user feedback, describing his experience with the turning mattress as comfortable, giving him a feeling of secure positioning.

In parallel with their technical development they team also participated in the international University Start-up World Cup (USWC) and won recognition (against competition from around 40 companies) in the largest category as 'Best HealthTech start-up'.

By October 2017 they were in a position to test their prototype in another user context, this time at the University Hospital. This offered access to second-year nursing students who had to do practical training at the hospital as part of their course. It enabled TideWave to get valuable insights and feedback about how their concept might be used and key areas of concern for a key target group of potential users. They were also able to tap into this group's ideas for how else the product might develop and be used.

November saw them secure further support from Innovation Norway, this time through a programme linked to promoting environmental technology. This further injection of $50,000 offered resources to help with further prototyping and product development.

Their first year of trading finished on further high notes, seeing them reach the final round of the annual DNB Healthcare Prize. Holding off competition from over fifty other companies they came within one vote of pulling off the price but finished in the top three. Not bad for a six-month old start-up!

Perhaps more significant was the news that, after extensive work with patent specialists they were cleared to apply for and be granted a patent pending, confirmation that their technology was innovative enough not to compete with pre-existing solutions. This intellectual property protection opened up the field for them to discuss their product ideas much more openly.

So the beginning of 2018 saw them in a strong position for a start-up. After one year Tidewave had achieved a number of key milestones including :

- **Developing from MVP to a sophisticated and testable prototype**
- **Secured patent pending status for their IP**
- **Raise around $200,000 in funding**

They had also clarified their own vision which saw the company's role not just in providing relief from pressure sores but contributing to sustainable elderly care in the future - a much wider strategy aspiration.

(This short film (in Norwegian) explains the key features of their business idea [http://news.tidewave.no/contributing-to-a-sustainable-elderly-care/)](http://news.tidewave.no/contributing-to-a-sustainable-elderly-care/)

The new year began well with their work being helpfully endorsed by the Norwegian Health Minister who offered them as a good example of the potential for smart care in the future. The accompanying news coverage was very helpful in giving the fledgling company an image and some welcome publicity.

The next period was one of careful development, trying to be agile and learn fast on both technological and market trajectories. This process, of learning and pivoting, built on connections they had made including extensive work with the University hospital, in user sites at care homes and via further technical development and testing in the workshop. The results began to produce an evidence base showing that their product had a demonstrable and positive effect on pressure relief and bedsore prevention.

For example one of the unique features of the Tidewave product is the distributed nature pressure relief; close work with experts identified three key zones where lying without movement can quickly lead to pressure ulcers and this information helped focus and improve the design to ensure pressure relief in these areas.

In April they were featured on national television in a segment sharing the experiences of a 75 year old patient. The publicity was very helpful; in particular it drew the attention of a number of municipalities who wanted to buy or at least explore the product further. So Tidewave were able to begin to assemble a community of potential lead users/early adopters.

As part of their continuing efforts to build networks of support the company decided to participate in Vitalis, a major health technology fair in Scandinavia held in May. This gave them the chance to expose their product and receive extensive feedback and interest including a number of expressions of purchase interest. Since their market is essentially business to business, (the key customers being care homes often operated by different municipalities) the role of a trade fair in building their reputation is significant.

Much of the financial underpinning for Tidewave so far had been via 'soft' money (around $200,000 from the Norwegian Research Council, Innovation Norway, and IRIS). Together with prize money from various competitions and in-kind support in terms of early incubator space at the university this provided the basic foundation for setting up the business. But its further development required attracting other sources of funding and in June they were able to secure a commitment of $140,000 from several investors including a humanitarian fund, a key industrial collaborator and a number of private investors. Success in this funding round gave them further confidence in the viability of the venture as it moved towards launch of the product.

http://news.tidewave.no/first-private-investment-round-complete/

In addition they were able to attract a further $140,000 from Innovation Norway to enable pilot testing of 10 prototypes with ten patients in 4 municipalities over a 3 month period.

http://news.tidewave.no/14-mnok-grant-from-innovation-norway/

This detailed field testing allowed them to validate both functionality and user friendliness of the product for both patients and healthcare professionals. A key feature of the testing programme was a set of weekly meetings to review progress and capture ideas and feedback.

Spreading the net widely in searching for funding had been part of their approach from the beginning and this often led to surprising connections. For example in August they applied for - and received - a grant of €40.000 from the European Space Agency!

This came about because their development process had highlighted a challenge with measuring the slow turning movement from the mattress. They identified an interesting component that could possibly provide more precise measurements - the Macro Fiber Composite Sensor & Accuator (MFC). This small, flexible and intelligent sensor was initially developed by a company, Smart Material Germany for use in space tech.

The local newspaper, Rogalands Avis, made an article for the occasion:

http://news.tidewave.no/40-000-eur-grant-from-esa/

More external recognition came in September in the form of their winning the award for the 'Best Health Tech Startup' category in the national round of Norwegian Startup award. The jury's evaluation was that *'Tidewave R&D was the startup company with the strongest technical development during the year and that their mission stood out as an important innovation for the health tech industry'*. This also enabled them to take part in the Scandinavian finals of the competition, held in Copenhagen.

October saw the start of their pilot testing at scale Ten turning mattresses were delivered to patients at four nursing homes in four municipalities for a pilot test lasting over three months. The purpose was to investigate the usability and functionality of the Tidewave turning mattress in actual conditions. Health personnel filled out daily reports about the status and progress of the patient and the product, and status meetings were held every week to gain more qualitative response.

http://news.tidewave.no/pilot-test-has-started/

In November 2018 another door opened for the development of the company. Tidewave received a $15,000 grant for developing a customized turning mattress for children. Through the Innovation Frame programme (Innovasjonsrammen) they began collaborating with Bardum AS, a supplier of helping aids for children with disabilities. They had already received enquiries for such an application and this funding enabled them to explore a degree of product diversification.

http://news.tidewave.no/150-000-nok-grant-for-making-a-childrens-mattress/

By December 2018, two years from initial start-up, the company had a product which worked both at a technical level and one which seems to make a difference to people's lives. A newspaper article ran a feature on the use of their mattress in a local care home and talked with one of the pilot testers who was very happy with her positive experience of using the Tidewave mattress during rehabilitation.

http://news.tidewave.no/satisfied-pilot-customers/

Overall progress by the end of their second year was good. Not only had they secured a firmer financial base but technical and user testing was well advanced. Perhaps most important, their product seemed to be performing well against key performance criteria in this critical area of patient wellbeing. Extensive testing in collaboration with NORCE and the Norwegian Smart Care Lab were showing promising results

http://news.tidewave.no/researching-tidewaves-movement/

The scale of the 'market' opportunity was significant; in Norway estimates suggested that ***"Every year, 30,000 new bed sores occur in Norway, 1,000 people die from it and 900 mill NOK ($90m) are used for prevention and treatment".***

The company were also beginning to build a reputation amongst patients and professional carers in terms of the value of their product. A 4 page feature in a magazine for health professionals commented positively on their experiences of using the turning mattress

which included good patient outcomes like ' better sleep, reduced stiffness and less pain' as well as less strain for the staff involved.

http://news.tidewave.no/positive-review-by-health-personnel/

Their presence at a technology fair in Helsinki drew the attention of a German magazine ('Home and Smart') which ran a story on the product, highlighting the Tidewave turning mattress as an important example of how to live better and longer at home with smart homes.

https://www.homeandsmart.de/tidewave-matratze-dekubitus-vorsorge?fbclid=IwAR1pXismuZE7fMtVMqaLqkCwCWaUxGzN-dEnWkmOE86YgfU6RZ8D62L0g5k

By the start of 2019 the company was beginning to plan for scaling up, thinking about developing the network of suppliers who could support volume production of the mattresses. Their aim was to keep production as local as possible but some key components would need to be sourced from abroad, for example from Denmark and Sweden.

http://news.tidewave.no/preparing-for-mass-production/

Product development now moved into the stage of refinements and cost engineering. One key development was to create a version suitable for home use (as opposed to being installed in care homes and hospitals). This required the development of a remote control so that users could control the turning mattress themselves. With an already preset custom program set on the control unit, only ON/OFF is needed to get the necessary movement stimuli.

http://news.tidewave.no/remote-control-for-independent-use/

March 2019 saw the first installation of their domestic product in a private home.

http://news.tidewave.no/first-installation-at-home/

In April they were successful in another investment round, attracting over $0.5m from private equity, expanding both the volume and range of support.

TIDEWAVE-EMISJON

Tar opp kampen mot ligge

HELSE: **– Liggesår er et globalt problem som ikke forsvinner av seg selv, sier Tidewave-sjef Bjørn Lorentzen. Fem gründere i Stavanger har en løsning som kan hjelpe de svake pasientene.**

ANDERS HORNTVEDT
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STAVANGER: – Den ser ut som en vanlig madrass, men den er proppfull av sensorer, sier Bjørn Lorentzen, daglig leder i gründerbedriften Tidewave, som har utviklet en ny type vendemadrass for eldre.

– Hensikten med madrassen er å gi bevegelsesstimuli og på den måten å forhindre at pasienten får liggesår, påpeker han.

De 13 madrassene bedriften så langt har laget er i daglig testbruk av pasienter i fire kommuner i Rogaland, både på sykehjem og i privatboliger.

Liggesår kan i utgangspunktet høres uskyldig ut, men det er en hud- eller vevsskade som skyldes at blodsirkulasjonen til et bestemt hudområde blir redusert.

Er man frisk, slipper man å bekymre seg fordi kroppen vender seg på refleks, selv om man sover. Er man gammel, svært syk eller får sterke medikamenter, kan liggesår bli et problem som pasienten i verste fall kan dø av.

Hentet 5 millioner i investorkapital

Tung jobb for de ansatte

Vendemadrassen fungerer som en slags vugge i sakte kino. Effekten blir at trykket spres til forskjellige deler av kroppen.

– Alternativet til en vendemadrass er at ansatte må gå rundt og vekke pasientene hver ganger i løpet av natten for å hjelpe dem med å endre sittestilling. Det gjør at pasientene våkner, og det kan ta lang tid før de sovner igjen. I tillegg er det en tung jobb for de ansatte fordi pasientene kan veie mye, sier markedssjef Nina Fagerheim Åmodt.

Sensorene i madrassen sender informasjon til en liten boks som henger i fotenden av sengen. Den avgjør hvilken bevegelse madrassen skal gi.

Ideen til vendemadrassen kommer fra bestefaren til medgründer Elen Haugs Langvik, men i hans levetid kom ikke produktet til markedet.

Langvik, Lorentzen og Fagerheim startet bedriften i 2016 som studenter ved Universitetet i Stavanger. Senere kom teknisk sjef Andreas Smith og produktsjef Ar-

TIDEWAVE		
(Mill. kr)	2018	2017
Driftsinntekter	0,0	0,9
Driftsresultat	-0,3	0,0
Resultat før skatt	-0,3	0,0
Årsresultat	-0,3	0,0

PROTOTYPER: De 13 madrassene bedriften så langt har laget er i daglig testbruk av pasienter i fire kommuner i Rogaland. FOTO: ANDERS HORNTVEDT

heltidsansatte i bedriften.

Så langt har gründerne brukt rundt 7 millioner kroner til produktutvikling og markedsarbeid. 5 millioner kroner er kommet inn fra ulike offentlige støtteordninger, mens 2 millioner kroner er innskutt kapital fra private investorer.

Ytterligere 5 millioner kroner kom inn i en emisjon som ble gjennomført i mars. Da sto eksisterende investorer for halvparten av beløpet, og et par nye investorer kom til.

Blant investorene i Tidewave er Ove Nilsens Humanitære stiftelse og Egdir, som er morselskapet til IT-selskapet Egde Consulting på Sørlandet.

Internasjonale ambisjoner

Våren 2020 skal Tidewave ha et produkt som er klart for salg. Madrassene og den tilhørende elektronikken skal i høst serieproduseres hos elektronikkbedriften Westcontrol.

Parallelt jobber gründerne med to nye utgaver av madrassen: En barneversjon og en bredere variant til tyngre pasienter.

– Hvem er konkurrentene deres?

– Dynamiske trykkvekslingsmadrasser er den vanligste konkurre-

> Spørsmålet er hvor raskt vi kan og bør skalere opp

In May the company were successful in attracting a further investment from Innovation Norway of $0.18m to support the development of a variant of their product for use with children. There is a limitation in terms of solutions available on the market for patients weighing less than 40kg and the Tidewave technology could help fit the segment. Their earlier development work with Bardum, a major supplier of assistive aids for children which began a year ago had paid off and the collaboration now moves to testing at scale with users.

https://www.tidewave.no/news/18-m-nok-funding-from-innovation-norway

July saw them take on another full-time team member, Hamed who (with a strong background in applications within the petroleum sector) provided much needed software expertise.

And in August they presented some results at a major international conference on wound care. This drew on their growing evidence base showing the benefits of their system in terms of patient outcomes and experience. This won the award for best Research Poster, adding to the technical credibility of the team and the product.
https://www.tidewave.no/news/winners-of-best-research-poster

Their continuing efforts to built interest and make connections led them to exhibit at Nordic Edge, one of the largest Scandinavian conferences and exhibitions in September. They now had a fully-functioning demonstrator and a plan to launch in early 2020 so could focus on detailed discussions with interested potential customers.

Meet us at **Nordic Edge**! We are demonstrating the last version of the turning mattress, which will be produced in a 0-series Q1 2020!🛏️🌟 So excited about the high interest and we look forward to follow up new plans that have been established throughout this week😀🤝

Validé AS Norwegian Smart Care Cluster - NSCC (Arena Velferdsteknologi)

Innovation Norway

November saw them nominated once again in the Nordic Start-up Awards and they went on to win (for the second year in a row) the prize for 'Best Health Tech Startup'. The jury's evaluation criteria recognised them as ***"the company showing most development progress within the last year".***

2020 Launch time…….

Despite the looming presence of the Covid-19 pandemic the company progressed with its plans to launch and move to scale during 2020. It continued to refine the product and the packe of service and support around it – for example by testing the user manuals with nursing students at the university hospital. It also laid the foundations for wider export marketing by applying for – and receiving – the EU CE mark. This required extensive stress testing of their product in a variety of situations to comply with the rigorous EU standards. The process demonstrated the value of partnering and networking for Tidewave; it was able to use the test facilities and expertise of one of its larger suppliers of control systems, Westcontrol to help with the process.

The same networking approach helped them in their choice of a distributor for their product; in April they announced a partnership with Bardum AS, a major player in the healthcare sector and with whom they ready had two years of collaboration. Bardum's experience and distribution channels offered a powerful route to market for Tidewave.

They had further indications of the potential market interest in their product in April; having published a call for pilot users to test their production model they were overwhelmed with interest. This gave them not only some reassurance but also a practical list of potential lead users with whom they could continue to work and refine the product.

By September their mattress was finally in production with Westcontrol producing the first batch of 20 mattresses for sale. And on October 1st they finally launched their product, fully certified and tested and embodying the experience of many pilot users in its design. Their success was recognised in a prime-time TV feature highlighting their start-up story.

2021 and the journey to scale continues

Four years on form their founding as a company Tidewave were up and running as a commercial business with sales and orders booked and with a strategy for expansion. In February they were able to sell their first child's mattress and received positive feedback about the significant advantages their product offered in a segment which was poorly served by other solutions.

They began hiring new staff to help cope with the increasing workload and at the same time continued to develop their network, recognizing that for a small business being

connected is critical. Their funding for further development continues to be a mixture of their own capital and money raised by accessing support loans and grants to help them grow. For example in October they joined the Bridgehead programme which is an EU-funded initiative to help European health start-ups to internationalise. They received €40,000 to support R&D and market development under this programme. At the same time they have continued to participate in various networks around healthcare technology and business, strengthening their links and establishing a presence.

It was gratifying for them to attend the MEDICA conference and exhibition in November in Dusseldorf. This is the biggest trade fair for the healthcare sector and Tidewave had visited previously in order to understand the market place and competiton. This time they were appearing as exhibitors, their company alongside several others in a pavilion designed to showcase the best of Norwegian healthcare companies.

Resources

You can find multiple video films (and transcripts) of the Tidewave journey from start-up to established business here:

- **The early stages of start-up**
- **Original history of the idea**
- **Prototyping and development**
- **Business model and strategy**
- **Capturing value**
- **Lessons learned**

Transcripts of all videos

Questions