

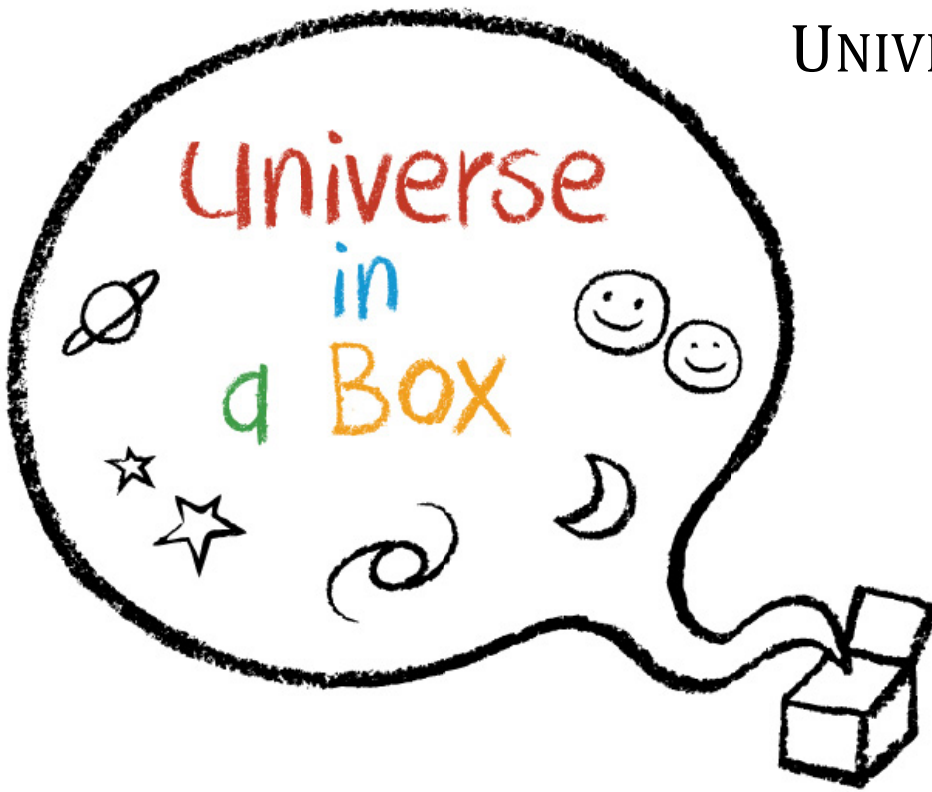
INTERNSHIP REPORT: UNIVERSE IN A BOX

Jaya Ramchandani

S0939307

Supervisor: Pedro Russo

June 2012





Inspiring every child
with our wonderful cosmos

*Tierra mi Cuerpo, Agua mi Sangre
Aire mi Aliento, Fuego mi Espíritu*

Earth is my body, Water is my blood
Air is my breath, Fire is my spirit

—Ode from South America

Contents

Preface.....	5
1 Theoretical Deepening.....	8
1.1 Practical Activity Kits.....	8
1.2 New Product Development	10
1.3 Production Networks and Hubs.....	11
2 Product and Market Definition	14
2.1 Product Description	14
2.2 MINT Box Features, in Detail.....	16
2.3 Mission Statement.....	18
3 Project Plan	19
4 Business Model Evaluation.....	22
4.1 Material Costs	22
4.2 Shipping Costs	23
4.3 Conclusion.....	24
5 Prototyping.....	25
5.1 Itemwise Analysis for Changes and Localization Needs	25
5.2 Request for Proposals.....	26
5.3 Sample and Invoice.....	29
5.4 Prototype Production and Distribution	30
6 Recommendations for Production and Distribution.....	31
6.1 Business Framework	31
6.2 Note on Web Commerce	32
6.3 Financials.....	32
6.4 Note on Fundraising.....	33
6.5 OAD and DIY Kits.....	34
7 Project Handover	35
Bibliography	37
Appendix	38
Credit List.....	39

PREFACE

From a very young age, children are fascinated with the beauty of the starry sky, its mysteries, and its infinite vastness, and slowly begin to form perceptions of our universe and our place in it. Many scientists also trace their passion for our cosmos to a subtle but impactful moment in their childhood. Our universe plays a special role in science because it integrates physics, mathematics, biology, and chemistry, presenting a more holistic view of our world. Recognizing this, the Universe Awareness (UNAWA) programme was established by George Miley from Leiden University, The Netherlands, with two broad visions: to use our interconnected and multicultural sky to introduce children aged 4 to 10 years to science through astronomy, inspiring them and igniting their curiosities; and to put our *pale blue planet* Earth in a borderless perspective and stimulate a sense of global citizenship.

Since its establishment in 2006, UNAWA has strengthened its international network to 41 countries and over 500 educators sharing the same vision. The network focuses on two main objectives: to provide training to teachers and other educators of young children, focusing on enhancing their confidence in introducing astronomy and other science topics in the classroom, and to develop educational resources that are exciting and fun, helping educators in their ambitious mission. UNAWA has been developing and collecting several useful resources such as the inflatable EarthBall and an



Credit: UNAWA Sri Lanka

astronomy news service for kids called *Space Scoop*, and newer educational materials will include illustrated hands-on games, adventure books, activity kits and magazine features. It is also building an educational repository with a peer-review platform for its many wonderful affiliated resources, with the goal of providing educators with quality resources. Some of these resources are currently available for download from the website's *Resources* section.

I was given the opportunity to complete a 23-week internship (Feb to June 2012) at the UNAWA International Office as a part of my Science Based Business track of a Master of Astronomy at Leiden University. I have a background in business and management and am interested in working in the field of science communication, education, and outreach in the near future, and UNAWA's vision matches my ambitions closely. I hoped to learn a tremendous amount about the framework of educating young children in science, while also contributing to the development of the organization and astronomy outreach in more than part of our world.

The focus of my internship was to develop a production and distribution framework for a UNAWA product / resource concept called *Universe in a Box*—an activity kit developed by the House of Astronomy in Heidelberg, Germany (also EU-UNAWA, Germany), under the MINT Box program for STEM education, supported by a grant by the Baden-Württemberg Foundation. It

has been designed to explain the difficult and sometimes abstract concepts of astronomy to young children (4 to 10 years) by providing practical activities as well as the materials and models required to do them. The resource has been in development since 2010 and in use since February 2011 and was ready for newer markets with similar needs. The target audience for Universe in a Box is schools / teachers, educators, and science and outreach centres from UNAWE's Consortium and National Programme countries.

Apart from my main project, I participated in a number of other activities:

- Attended an EU-UNAWE workshop at the Lorentz Centre, The Netherlands, titled *Astronomy to Inspire and Educate Young Children* (26–30 March 2012), where I had the opportunity to meet astronomy educators from twenty-six different countries across the globe. I also presented and promoted the box at this workshop. In addition, I contributed to the educational resources team, brainstorming on next steps for the organization and the distribution of educational resources. As a side project, I documented video stories from the participants on the UNAWE network. These remain to be edited and put online.
- Presented a talk on UNAWE at the 67th Dutch Astronomy Conference (NAC, 23–25 May 2012) with the aim of reaching student ambassadors from the Netherlands for the *EU Universe Awareness Student Ambassador Programme*.¹
- Part of organizing an educational project in Timor-Leste (also known as East Timor) in South-East Asia on the occasion of the Transit of Venus 2012 (1–7 June 2012). This project was the largest scientific event organised in Timor-Leste (attended by 3800 people) and was the first time astronomy came to the country since they declared their independence 10 years ago.² It involved two weeks of preparation—editing proposals, creating flyers, drafting of a panel series on astronomy, preparing activities for children and teachers, and event management of the transit of Venus 2012 in the capital Dili, Timor-Leste. And two weeks on route and in Timor Leste executing the planned activities. A photo story of the journey can be found on Flickr³.



Credit: Lorentz Centre, Leiden

¹ <http://www.unawe.org/ambassadors/>

² <http://www.unawe.org/updates/unawe-update-1240/>

³ <http://www.flickr.com/photos/scratchpost/sets/72157630092497640/>



Credit: EU-UNAWE, Puzzled on Children's Day (1 June 2012)

- Developed a mock up for an educational product idea of a solar system stencil scale. The product is currently under development and is targeted to be given out at the International Astronomical Union's General Assembly (IAU GA) in China later this year (20–31 August 2012). I will also be presenting a poster on Universe in a Box along with the International Project Manager Pedro Russo at the IAU GA.

This internship experience was extremely enlightening presenting many opportunities to learn about astronomy education for young children on a global scale. And it's opened a gateway to a wonderful network of future collaborators in the changing face of education in today's economic system.

The aim of my project is to recommend a framework for the production and distribution of Universe in a Box to UNAWE's Consortium and National Programmes. I launched into the project with a theoretical deepening on activity kits, new product development theory, and production networks and hubs (Section 1). I then analyzed the product details and defined a market and mission for the box (Section 2). This is followed by a road map and project plan (Section 3). The next milestone was to evaluate the business model, involving material cost and shipping analyses from one country to different countries across the world. Making prototypes, which involved requesting for proposals, choosing a vendor, and negotiating price, was next, as detailed in Section 4. The prototypes are currently in development and will be delivered in July 2012. Finally, I recommended a framework for the regional and national production and distribution of Universe in a Box (Section 6). The internship report concludes with handover notes for the project (Section 7).

1 THEORETICAL DEEPENING

This section includes the background knowledge acquired in order to formulate a strategy for the production and distribution of Universe in a Box. I investigated three aspects: the market for practical science activity kits, and the theory of new product development, and possible production networks and hubs.

1.1 PRACTICAL ACTIVITY KITS

Practical activities are regarded as one of the necessary elements to promote understanding of scientific principles for children of all ages. A typical example is ‘the origin of seasons’. It is much easier for children to understand this phenomenon with a visual three-dimensional model rather than a two-dimensional diagram in a book or on the blackboard.

A World Bank report states that ‘practical work in science education increases comprehension of scientific principles and their application in the real world’ (Musar 1993). Musar also outlines certain problems faced when implementing over 100 projects introducing specific science education equipment in schools, mainly in developing countries⁴:

1. Technical unsuitability of the equipment
2. Educational unsuitability of the equipment
3. Faults in the procurement procedures
4. High cost of the equipment
5. Lack of teacher and technician training
6. Lack of incentives to use the equipment
7. Faults in the distribution
8. Inadequate supply of consumable materials
9. Inadequate maintenance, repair and replenishment

The report also purports that the use of *low-cost and locally produced* equipment may change the situation because of the following benefits: ‘low cost, easy maintenance and repair, better availability of spare parts, higher relevance to curriculum, higher local content, contributions to self-reliance, and flexible adaptation for new topics in the curriculum’.

Investigations into Science Activity Kits (Online Search)

I conducted a brief investigation into the educational activity kits available for science. The purpose of the search was not a detailed market analysis (not the focus of the project) but to attain a general overview of activity kits available for science. The search (<http://www.google.com>) highlighted more than 100 companies who produce science activity kits. The search was restricted to companies in English-speaking countries that have an online presence and that serve our target age group of 4 to 10 years. Regional searches are required for knowing about other products. I present some representative examples below:

⁴ ‘The designations “developed” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process.’ (United Nations Statistics Division 2006)

Delta Education (<http://www.delta-education.com>)

- Offers products that correlated with the curriculum instead of selling science supplies separately. Today, Delta Education is the largest producer of curriculum-based elementary school science kits in the United States.
- Target customer: Schools, Teachers, Parents
- Price: Ranging from 200–1000 USD



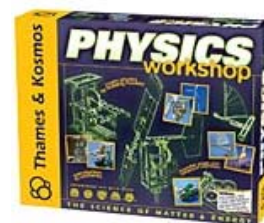
Science in a Box® (<http://www.primarysciencematters.com>)

- Offers 8 laboratory kits: Physical Phenomena, Earth and Its Surroundings, Living Things, Science of Materials, Science, Science of Toys, Composite Box, Design your Own Box. Each box contains all the equipment required for up to 30 students to do a series of experiments on the above topics.
- Target customer: Schools
- Price: Average Box Price 2300 AUD



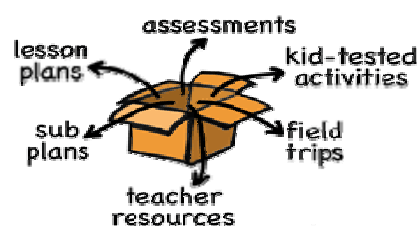
Home Science Tools (<http://www.hometrainingtools.com>)

- Offers topic-based science kits for all ages as well as science curriculum-based kits for different curricula in the US. They also offer individual science products. The kits follow these themes: Life Science, Chemistry, Electronics & Technology, Physics & General Science, Earth & Space Science Kits, Dunecraft Science, Thames & Kosmos Kits, Magic School Bus Science, Environmental Science
- Target customer: Individuals as well as schools. Focus on homeschool.
- Price:
 - Single Kit Costs: 20–85 USD
 - Curriculum Kit Costs: 45–250 USD



My Science Box (<http://www.mysciencebox.org>)

- Offers curriculum boxes. Develops plans not products. Out of 260 science concepts, 8 are focused on astronomy
- Target customer: Teachers / Educators
- Price: None
- License: Creative Commons Attribution-NonCommercial 2.5 License



Some Overall Impressions

- Astronomy kits restricted to the Solar System and Space Science and do not cover the breadth of topics listed in the EU-UNAWA Benchmarks for Astronomy Literacy (Appendix 1)
- Activity kits are mostly sold to schools, although there is also a home market as science toys
- Prices range from
 - Home: 20 to 200 USD

- Schools: 200 to 2500 USD depending on size, level, engineering of equipment used
- School kits peak at 500 USD
- No low-cost kits focussed on astronomy
- Trend of adapting to curriculum

1.2 NEW PRODUCT DEVELOPMENT

In business, new product development (NPD) is the phrase used to describe the process of bringing a new product from idea to market. It involves several stages and in this section I elaborate on the stages relevant to this project.



Adapted from: Wikipedia's *New Product Development* page

The key questions to ask or points of investigation are listed below by stage (Wikipedia New Product Development, accessed February 2012):

Idea Screening

- Eliminate unsound concepts before devoting time and resources
- Initial market analysis
 - What is the size and growth forecasts of the market segment/target market?
 - What are the industry sales and market trends the product idea is based on?
 - Will the product be profitable when manufactured and delivered to the customer at the target price?
- Competitive pressure

Content Development and Testing

- Who is the target market and who is the decision maker in the purchasing process?
- What product features must the product incorporate?
- How will consumers react to the product?
- How will the product be produced most cost effectively?
- What will it cost to produce it?

Business Analysis

- Estimate likely selling price based upon competition and customer feedback
- Estimate sales volume based upon size of market
- Estimate profitability and break-even point

Beta Testing

- Produce a physical prototype or mock-up
- Conduct focus group customer interviews
- Make adjustments where necessary
- Produce an initial run of the product and sell it in a test market area to determine customer acceptance

Technical Implementation Plan

- Resource estimation
- Supplier collaboration
- Logistics plan
- Distribution pipeline
- Product review and monitoring
- What-if planning

1.3 PRODUCTION NETWORKS AND HUBS

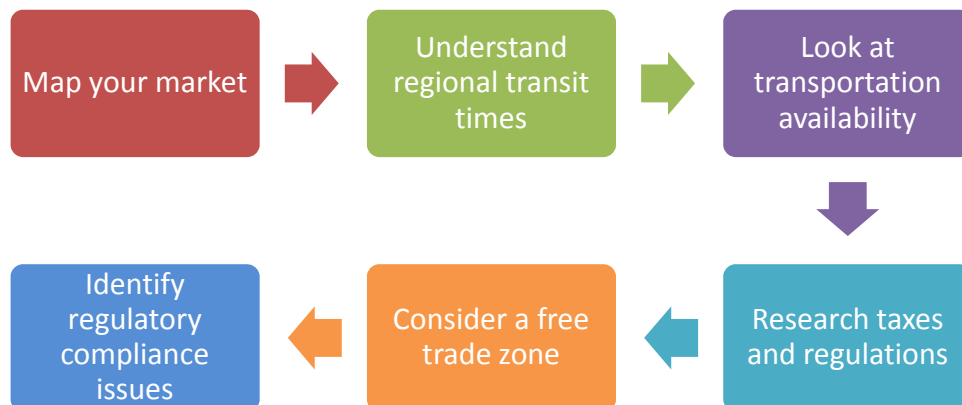
There are several approaches to the supply for educational equipment, broadly (Musar 1993):

1. Production by teachers and students
2. Establishing central production units
3. Central development and assembly of kits
4. Decentralized development and production, and
5. A combined approach

For Universe in a Box, we investigate a regional production hub model to gain the following benefits:

- Affordable costs
- Better availability of spare parts
- Higher relevance to curriculum (and flexible adaptation)
- Higher local content
- Direct marketing

Locating a regional production hub is a complex process and greatly depends on the product in question. Online literature presents the following process (Inbound Logistics 2010):


















Adapted from: Inbound Logistics (2010)

Based on the below criteria, I shortlisted 12 country groups to include UNAWE's 41 network countries

- Geographical proximity (Ref: Google maps)
- Infrastructural capabilities (Ref: Bayern International GmbH 2005, Hideyasu 2011, Ruriani 2010, Shong-Iee 2007)
- Ease of communication (Ref: Collective knowledge of language and localization)
- Relations between countries (Ref: Collective knowledge of world politics and economics)

The countries highlighted in the map below the table are the target locations. In some cases, I have highlighted competing countries where the decision was uncertain (denoted by pins).

Country Groups				Target Hub Locations	
AFRICA					
South & South-East South Africa Mozambique Ethiopia Kenya Tanzania	North Morocco Tunisia	Central Nigeria Benin Congo			South Africa
					Tanzania
					Morocco
					Nigeria
ASIA					
Central China	South India Bangladesh Nepal Sri Lanka	East Indonesia Philippines Timor-Leste Japan	Middle-East Turkey Egypt (from Africa) Iran		China
					India
					Sri Lanka
					Indonesia
					Japan
					Egypt
					Turkey
EUROPE					
West and North Germany (Baden-Württemberg) Belgium Netherlands Iceland United Kingdom Ireland	South Portugal Spain Italy Malta	East Poland Slovenia Romania Serbia			Germany
					Portugal
					Spain
					Poland

THE AMERICAS

North America

Canada

United States

Latin America

Colombia

Brazil

Guatemala

Mexico

Chile

Uruguay

Venezuela



Canada



Brazil



Colombia

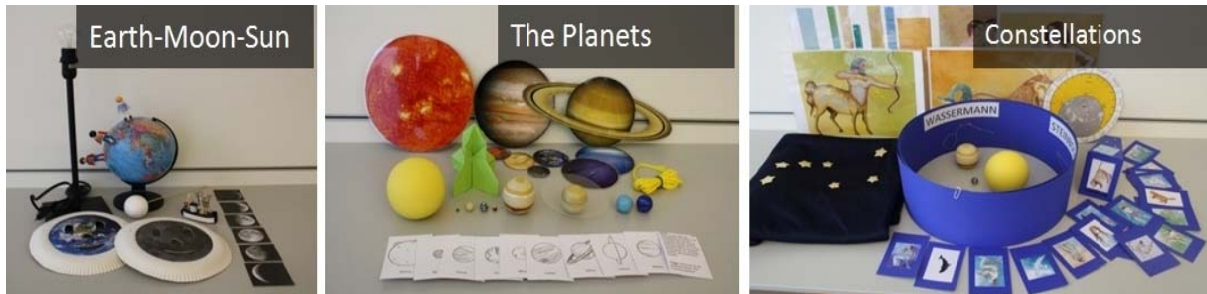


Created using: Google Maps (Key in Table above)

The following criteria will help narrow down the decision on further analysis:

- Demand of region
- Execution ability of coordinators
- Ease of coordination

How can I tell? It then moves on to the Sun and the concepts of year and seasons to come into play. Then we go to the moon, why does the moon change its form? What is a month? How long is a lunar day? What can we learn from the shapes of the moon craters? It then emphasises that planet Earth is not just a planet, but a special one, and asks questions like can we live on another planet? What do we need to live? Finally, we head out to the stars and identify constellations. Questions like is the life of a star eternal and do they all have the same colour are answered.



Credit: EU-UNAWE Germany

Either individual activities or entire modules can be used in the classroom, both with large and small groups. Add on modules on the life of a star, galaxies, and the Earth-Human system are currently in development, and educators are also encouraged to customize the box with additional activities and material of their own. Apart from the relevant background and activity descriptions, the activity handbook also offers ideas for teaching integrated astronomy with other disciplines, guidance on further experimentation, and photocopyable craft templates to extend and apply the newly learned knowledge.

The product features are summarized below.

Resonates with UNAWE's mission of inquiry-based, interdisciplinary, and cultural content

Modular and Customizable

Low-cost Materials

Localizable with UNAWE Network

Easy to Reproduce

Universe in a Box Features

Universe in a Box is also a product that resonates with Article 29 (1) of the Convention on the Rights of the Child, U.N. Doc. CRC/GC/2001/1 (2001), which states that the education of the child should be directed to:

(a) The development of the child's personality, talents and mental and physical abilities to their fullest potential;

(b) The development of respect for human rights and fundamental freedoms, and for the principles enshrined in the Charter of the United Nations;

(c) The development of respect for the child's parents, his or her own cultural identity, language and values, for the national values of the country in which the child is living, the country from which he or she may originate, *and for civilizations different from his or her own*;

(d) *The preparation of the child for responsible life in a free society, in the spirit of understanding, peace, tolerance, equality of sexes, and friendship among all peoples, ethnic, national and religious groups and persons of indigenous origin*;

(e) *The development of respect for the natural environment.*

2.2 MINT BOX FEATURES, IN DETAIL

This section details the features of MINT Box from Fisher's (2011) final report to the Baden-Württemberg Foundation.

2.2.1 EDUCATIONAL GOALS

- Promotion of numerous primary school competencies through astronomical themes
- Linking astronomical topics with other subjects (mathematics, art, religion, etc.) to support interdisciplinary learning and sustainability
- Awareness of children to respect others cultures, the miracle of life, and to protect the earth by the realization that we are all inhabitants of a small, blue planet Earth

2.2.2 AUDIENCE

- Use in both elementary school (4 to 10 year old children) and extracurricular activities at science centres, observatories, planetariums, museums, outreach programs, amateur astronomy centres

2.2.3 APPROACH

Modular Design

- Pre-selection of topics forming three modules: Earth-Moon-Sun System, The Planets, and The World of Constellations. The topics follow a didactic order and activities have an interdisciplinary / cultural focus
- Educational models provided for teaching
- Add on modules on galaxies, stars, and the Earth-Human system currently in development



Credit: EU-UNAWWE, Germany

Practical Guide

- Guide includes
 - A complete description of the materials and the activities
 - Astronomy background information on the science behind the activity
 - Suggestions for interdisciplinary activities
 - Suggestions for further reading and experimentation
 - Photocopiable craft templates

- Guide in loose-leaf folder format for customization and easy updating

Flexible Design

- Educators can use the box in a modular fashion depending on topic
- Educators can customize with additional activities and material
- Educational materials are low-cost and can be easily reproduced or purchased

Teacher Training

- Teachers with no experience in astronomy benefit from a teacher training workshop
- Ideal student-to-teacher ratio of 1:20
- An astronomy pen drive (AstroDrive) with quality free resources for educators is planned

2.2.4 MATERIALS AND ACTIVITIES

The box is made of a sturdy plastic with dimensions of 465 x 270 x 290 cm. Twenty percent of the box is left empty so that educators can customize it with additional materials. The table below lists the materials and the corresponding activities, which are covered in the handbook.

Materials	Activities
Module 1: Earth-moon-sun	
<ul style="list-style-type: none"> • Globe • Three small PLAYMOBIL® children • Patafix • Small ship • Bulb holder • Bulb • Styrofoam moon • Moon and Earth masks 	<ul style="list-style-type: none"> • Characteristics of the moon, moon distance, lunar laboratory, lunar landscape games, reflected light, 3D visualization of the phases of the moon, moon phase box, moon phases, mosaic pictures of the moon from other countries and cultures, pictures and stories about the moon, Mini research project: The lunar orbit • Round Earth, dialogue between children at opposite ends of the Earth, Earth mosaic, our planet, day and night, seasons, tilted Earth's axis • Sun's Apparent size I, Apparent Size II, Invisible Light, Path of the sun across the sky, sun shade, construction of a sundial, solar surface convection, Mini research project Sun: Solar rotation
Module 2: The Planets	
<ul style="list-style-type: none"> • 2m string • Planetary system of wooden balls • Card game • Laminated pictures of the planets • Origami rocket 	<ul style="list-style-type: none"> • Card game on the sun and planets, model of our solar system, when can I see planets, ellipses, construction of a planetary path, construction of rockets
Module 3: The world of constellations	
<ul style="list-style-type: none"> • Zodiac band • Constellation projector with time cards 	<ul style="list-style-type: none"> • Zodiac band with planets and constellations, visibility of the constellations, function of a Planisphere, the constellation Cassiopeia, Constellations of the year, Constellation viewer

- Images of the zodiac
- Zodiac book
- 10 stars
- Blue cloth
- Planisphere (handmade)
- Planisphere (sourced)

2.2.5 PERFORMANCE

Eighteen MINT boxes were assembled, 15 of which were distributed to schools, and another 10 Do-it-Yourself kits were also given to schools. The MINT team implemented the box through several workshops:

- Elementary school workshops (total 5, total 185 children)
- Kindergarten workshops (total 7, total 122 children)
- Teacher training (9 facilities in 5 training, total 44 teachers)



Credit: EU-UNAWE, Germany

The training feedback was positive and both teachers and students were enthusiastic about the workshops. Many participants felt more confident to teach after a first introduction to the subject.

2.3 MISSION STATEMENT

As Universe in a Box has been designed to be used by any educator, the mission for the audience and reach of the box is as follows: One localizable box | 41 countries | 3 years

Target Audience

- Schools / Teachers: Playschools, primary, secondary
- Educators: Amateur astronomy centres, Afterschool activity centres
- Science Centers: Planetariums, Observatories, Museums

Target Reach

- UNAWE Consortium and National Programmes
- Maximum reach in both urban and rural Areas

Universe in a Box Mission

3 PROJECT PLAN

Based on the exercise of theoretical deepening and after gaining a complete understanding of the product, the following project plan was developed. The figure below gives the road map.



Project Plan Roadmap

The following table provides the activity plan. The entities involved in the project plan will be explained in Section 6.1.

Status	Activity	Involvement	Responsible	Review	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012
Product Development									
Completed	Product and market definition	Coordination	Jaya	Natalie, Pedro					
Completed	Theoretical reasoning for Box	Documentation	Jaya	Pedro					
<i>Educational + Cultural Adaptation</i>									
Completed	Item wise analysis for changes	Analysis	Jaya	Pedro					
Handover	Translation + Localization	Coordination	OAD + National PMs	Pedro					
Handover	Educational changes	Coordination	EU-UNAWE, Germany	Pedro					
<i>Prototype Development and Testing</i>									
Completed	Design: Logo	Coordination	Pedro	Jaya					
Completed	Content : Website	Coordination	Jaya	Pedro					
Handover	Content + Design: Handbook	Coordination	Pedro, EU-UNAWE, Germany	Pedro					
Handover	Design: Box Cover	Coordination	Pedro	Jaya					
Completed	Request for Quotation for Box Development	Coordination	Jaya	Pedro					
Completed	Determine Test Countries based on National PM Response	Analysis	Jaya	Pedro					
Handover	Buy 50 Prototypes from chosen vendor	Execution	Jaya	Pedro					
Completed	Make survey for prototypes	Documentation	Jaya	Pedro					

Production and Distribution							
Market Definition and Forecast							
Handover	Determine demand among UNAWE PMs	Analysis	Jaya	Pedro			
Model Evaluation							
Completed	Material and shipping cost analyses to determine overall model	Analysis	Jaya	Pedro			
Completed	Recommend production hubs (theoretical deepening)	Analysis	Jaya	Pedro			
Planning							
Completed	Production and Distribution Plan	Documentation	Jaya	-			
Completed	Funding Options	Research + Documentation	Jaya	-			
Output Documentation							
Completed	DIY Universe in a Box Toolkit	Documentation	Jaya	Pedro			
Completed	OAD-Hub Manufacturing & Distribution Toolkit	Documentation	Jaya	Pedro			
Reports							
Completed	Internship Report (UNAWE)	Documentation	Jaya	-			
Completed	Internship Report (SBB)	Documentation	Jaya	-			
Completed	Final Presentation: SBB Internship	Documentation	Jaya	-			

4 BUSINESS MODEL EVALUATION

To evaluate what business model to follow, the two most important parameters are material costs and shipping / distribution costs.

4.1 MATERIAL COSTS

4.1.1 ITEMWISE COST ANALYSIS

As a preliminary analysis, I compared the material costs for the box between the actual costs for the production of the MINT Box in Germany and a rough estimate of the price of the same materials in India based on collective knowledge.

Item	Sourced / Developed	Germany Production Costs (in EUR)	India Production Costs (in INR)
Module 1: Earth-Moon-Sun System		29.26	560.00
Small globe	Sourced	8.95	400.00
Three small PLAYMOBIL® children	Sourced	1.75	10.00
Patafix	Sourced	0.70	10.00
Small boat	Sourced	1.66	10.00
Bulb socket	Sourced	5.00	10.00
Light bulb	Sourced	1.20	20.00
Styrofoam moon	Developed	0.00	0.00
Moon and Earth masks*	Developed	0.00	0.00
Flashlight	Sourced	10.00	100.00
Phases of the moon images*	Developed	0.00	0.00
Module 2: The Planets		0.89	2.00
2 m string	Sourced	0.80	2.00
Planetary system of wooden balls	Developed	0.00	0.00
Planet card game*	Developed	0.00	0.00
Laminated pictures of the planets*	Developed	0.00	0.00
Origami rocket	Developed	0.09	0.00
Module 3: The World of Constellations		29.70	275.00
Zodiac band	Developed	0.90	0.00
Constellation projector (paper) and time cards	Developed	1.50	0.00
Images of the Zodiac*	Developed	0.00	0.00
Book on Zodiac signs	Sourced	10.00	150.00
10 Stars	Sourced	1.00	5.00
Blue cloth	Sourced	9.80	100.00
Planisphere (Handmade)	Developed	1.00	0.00
Planisphere	Sourced	5.50	20.00
Other		67.88	490.00
Handbook	Developed	17.63	50.00
Rubber bands	Sourced	0.25	10.00

Ziplock bags (about 10)	Sourced	0.50	25.00
Big plastic box	Sourced	15.50	100.00
Paper clips	Sourced	0.00	5.00
Copy shop (* included in copy costs)	Sourced	34.00	300.00

Development Costs - Supplies		15.00	200.00
-------------------------------------	--	--------------	---------------

Rubber band			
Scissor	common		
Staples & stapler	common		
White paper			
Blue thick paper			
White thick paper			
Glue	common		
Special pencils	common		
Styrofoam for Moon			
Wooden balls		8.50	100.00

Assembly Costs		40.00	300.00
-----------------------	--	--------------	---------------

Labour - 5 hours		40.00	300.00
------------------	--	-------	--------

Total Cost Of Materials And Assembly	182.73	1,827.00
Final Cost Price in EUR (EUR 1 = INR 65)	182.73	28.11

4.1.2 RECOMMENDATIONS

From this, it is clear that the price of the materials may vary significantly across countries. Thus, to get maximum economic benefit, local production would be preferred.

4.2 SHIPPING COSTS

Next, I evaluated whether it is cheaper to manufacture in one country and ship to all other countries or to manufacture locally and to determine how local is local.

Assumptions:

- Weight of Box: 4 kg (current weight is 4.2 kg on the whole and 1.4 kg is the weight of the empty box)
- Cost Price: EUR 20
- Shipping Location: Mumbai, India
- Customs amount excluded
- Post prices take from http://www.indiapost.gov.in/SPInternational_Tariff.aspx
- Bulk options excluded

4.2.1 SCENARIO A: INDIA TO ALL UNAWE COUNTRIES TO DETERMINE FEASIBILITY OF 'ONE-POINT SUPPLY'

The test countries are chosen from different regions across the globe with strong UNAWE programs.

	Price .25kg (INR)	Price every additional .25kg (INR)	Total for 4.5 kg (INR)	Total (EUR 1 = INR 65)
Brazil	775	175	3400	52.31
Netherlands	845	100	2345	36.08

UK	865	100	2365	36.38
Colombia	775	175	3400	52.31
Poland	745	75	1870	28.77
Indonesia	390	50	1140	17.54

4.2.2 SCENARIO B: INDIA TO UNAWE COUNTRIES IN ASIA TO DETERMINE FEASIBILITY OF 'REGIONAL SUPPLY'

The test countries are countries within the region of South and Central Asia with UNAWE programs.

	Price .25kg (INR)	Price every additional .25kg (INR)	Total for 4.5 kg (INR)	Total (EUR 1 = INR 65)
Bangladesh	460	30	910	14.00
China	500	50	1250	19.23
Indonesia	390	50	1140	17.54
Iran	865	50	1615	24.85

4.2.3 RECOMMENDATIONS

1. Scenario A is not feasible because the shipping rates are 1.5 times the cost price of the box
2. Scenario B is possible. Bulk shipment rates need to be investigated
3. The weight of the box should be optimized to 3 kg
4. As the postal rates vary quite widely from country to country, the shipping component can be presented separately and not included in the costs.

4.3 CONCLUSION

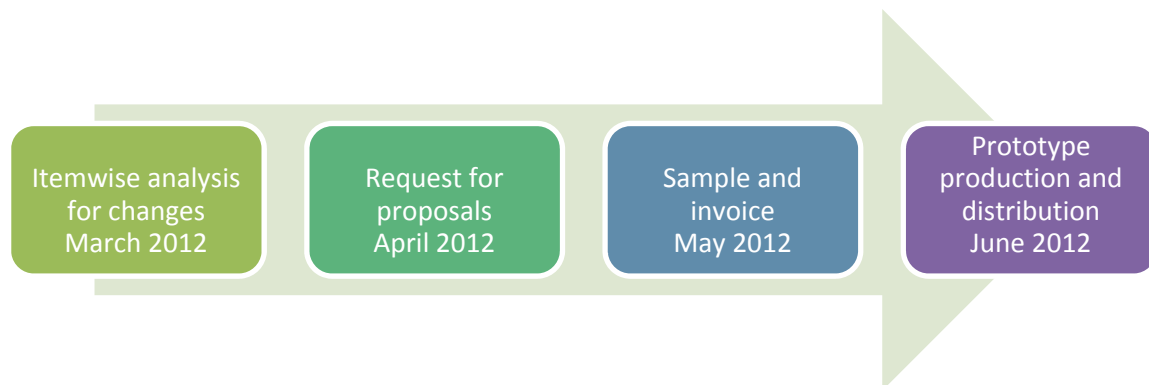
Based on the above two analyses, a regional supply is preferred over a one location supply. The choice between a regional supply over a country supply is time and resource constraints of the UNAWE program coordinators.

The regional hubs recommended in Section 1.3 closely match the plans of the International Astronomical Union (IAU) Office of Astronomy for Development (OAD)⁵ to establish regional nodes and language expertise centres across the world to ensure local input and wide inclusiveness into strategic planning and implementation of a visionary decadal strategic plan entitled 'Astronomy for the Developing World'. The OAD nodes are expected to play a critical role in the production and distribution pipeline of UNAWE products. The nodes are expected to be selected by the end of 2012. Their role in the business framework will be detailed in Section 6.1.

⁵ Established by the International Astronomical Union (IAU) in partnership with the South African National Research Foundation (NRF)

5 PROTOTYPING

We decided to buy 20–50 prototypes depending on the final cost. This involved making an itemwise analysis of changes and localization needs for the box, requesting for proposals, finalising the specifications and costs with the vendor, and clearing the invoice, and finally receiving the prototypes. The timeframe is presented below.



Prototyping Timeline

5.1 ITEMWISE ANALYSIS FOR CHANGES AND LOCALIZATION NEEDS

The table below lists the changes required to the box to meet the customer needs better and to reduce costs.

Item	Sourced / Developed	Recommended Changes	Localization Needs
Module 1: Earth-Moon-Sun System			
Small globe	Sourced	-	Translation required
Three small PLAYMOBIL® children	Sourced	-	-
Patafix	Sourced	-	-
Small boat	Sourced	Make origami boat	-
Bulb socket	Sourced	-	-
Light bulb	Sourced	Multi-country socket	-
Styrofoam moon	Developed	-	-
Moon and Earth masks	Developed	-	-
Flashlight	Sourced	-	-
Phases of the moon images	Developed	-	-
Module 2: The Planets			
2 m string	Sourced	-	-
Planetary system of wooden balls	Developed	Explore other materials	-
Planet card game	Developed	-	Translation required
Laminated pictures of the planets	Developed	-	-
Origami rocket	Developed	-	-

Module 3: The World of Constellations			
Zodiac band	Developed	-	Translation required
Constellation projector (paper) and time cards	Developed	More sturdy material because frequently used item ⁶	Include timecards for Southern hemisphere
Images of the Zodiac	Developed	-	Region-specific images
Book on Zodiac signs	Sourced	-	Region-specific book
10 Stars	Sourced	-	-
Blue cloth	Sourced	-	-
Planisphere (Handmade)	Developed	Replace item	Star chart design for both Northern and Southern hemispheres
Planisphere	Sourced	Remove item	-
Other			
Handbook	Developed	Changes to content and layout	Translation, Content localization
Big plastic box	Sourced	Two options: Plastic and cardboard depending on intended use ⁷	Design variations

The localization needs have been identified. However, the prototypes are not localized.

5.2 REQUEST FOR PROPOSALS

I contacted three companies in India from an online search on manufacturers of educational toys from <http://www.tradeindia.com> in Early April and also requested for a quotation from a contact provided by Pedro in Spain in Early May.

Name	Phone	Country	City	Website	Email
Elenco India	+919880274087	India	Bangalore	http://www.elencoindia.com/	-
Sai Baba Educational Aids	+911122041749	India	Delhi	http://saibabaeducationalaids.com/about-us.htm	saibabaeducationalaids@yahoo.co.in
Curion Education Pvt Ltd	+919702459003, 9702459004	India	Mumbai	http://www.curioneducation.com/	vishal@curioneducation.com
Sergio López Borgoñoz	-	Spain	Barcelona	http://www.antares.es	sergio@antares.es

The request for proposal contained the following information (Appendix 2):

1. A description of the box
2. The materials list including constraints and suggested changes
3. Itemwise images
4. Quotation format (in Excel) to capture the itemwise breakup
5. An English translation of the 130 page handbook

⁶ Based on discussion with EU-UNAWA, Germany.

⁷ Cardboard for single location use, and plastic for multiple location use.

6. The source files necessary to reproduce the box

Out of the three companies in India, one responded favourably, Curion Education Pvt. Ltd. (hereafter, the vendor), with a rough estimate of EUR 15 per box, excluding assembly costs, as detailed below. The table also lists the specifications.

Item	Specifications	Material Costs (1 Box) in INR		Vendor Notes
Module 1: Earth-Moon-Sun System		144		
Small globe	Diameter 15 cm. Does not need to be precise.	70		
Three small PLAYMOBIL® children	This will be donated by PLAYMOBIL®. Will be added.			
Patafix	You can use an equivalent. One strip is about 12 cm long	10	9 cm	
Small Boat	Origami boat: http://www.origami-make.com/howto-origami-boat.php . The first one on this page.	1		
Bulb socket	Height of stand should match globe	35	12 cm acrylic base	
Light bulb	40 Watts; Energy saving preferred	14	20 watts	
Styrofoam moon + wooden stick	Diameter: 5 cm. Styrofoam because it is attached to a wooden spit. Thin wood stick length 25 cm	2		
Moon and Earth Masks*	These have been made with paper plates.	10		
Phases of the moon images*	7 * 7 cm per image	2	31-page moon phase flipbook?	
Module 2: The Planets		247		
2.5 m thick string	Yellow colour	5		
Planetary system of balls	Diameter of Jupiter: 5 cm. Details of the planet surface should be there. You don't need to use wood. Another durable material that is cheaper is fine.	200		Will investigate styrofoam. 3d printing expensive. Alternative is strip of water colours Rs. 10-15 and children and teachers paint it
Planet Card game*	9 * 6 cm. Images of the planets in front, and text to the back. Right now the images are illustrations. But the front can be nice high res images and the back the text. Could you show us some options?	10		Small box for cards. Keep option. Extend concept to trump cards. Create and show. Add design to back of cards to give better finish
Laminated pictures of the planets*	Diameter of Jupiter: 15 cm. I have put the images but please look for better quality or detailed images preferably from ESA.	30		
Origami rocket	20 * 20 cm paper. Insert as an	2		

	assembled rocket. Instructions on how to make the rocket are in the handbook		
Module 3: The World of Constellations		205	
Zodiac band	11.5 * 300 cm. Please see the table for the English names of the constellations. Blue thick paper	30	
Constellation projector (paper) and time cards	Dimensions of constellation time cards: 9 * 6 cm. Holes need to be poked into the area of the star. Use thick paper for the constellation cards--the holes come at the place of the stars. You can print the images on white paper and stick them on the constellation cards.	25	Will make in PVC
Constellation book	This will be printed in-house	0	
Loose Stars	Maybe about 15 stars -- Same colour, different sizes. 1 to 3 cm across.	5	Punch cost extra
Images of the Zodiac*	A4 + Lamination	75	
Blue cloth	2 square meter. Dark Blue	50	
Planisphere (Handmade)	This needs to be made -- one version.	20	We have one for the Northern hemisphere
Planisphere	We will print the map in-house depending on the location of from http://drifted.in/space/app/index.xhtml .	0	
Other		375	
Handbook	This will be about 150 single pages. Colour printout. The handbook should also include 10 thick separator coloured papers.	225	Offset printing. 1.5 rupees. Colour: Rs. 4 per page
Big plastic box	Please give 2 options for plastic and cardboard. You will need to judge the dimensions depending on the contents and packing. Note that 25–30% of the box should be empty space so teachers can add more material.	150	
Material Costs (INR)		971	
Material Costs (EUR; EUR 1 = INR 65)		15	

The Spanish company responded with a rough estimate of EUR 177 per box. Their quotation will be pursued post-project to follow through if they are a recommended partner for west Europe.

5.3 SAMPLE AND INVOICE

Based on the request for proposal and on further clarifications, the vendor prepared the sample prototype in the first week of May 2012 and shared the result over Skype and video documents and images. The sample and invoice are added to Appendix 3. Some further changes were suggested to the items:

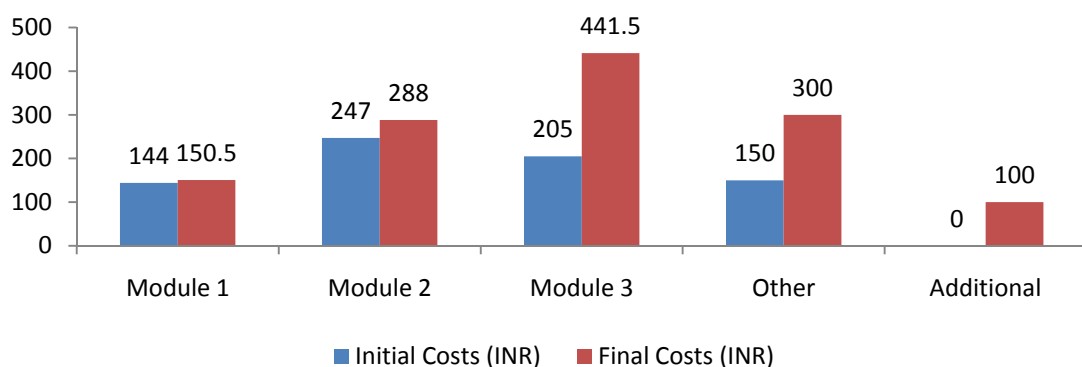
Item	Changes
Bulb socket	Improve design and finish
Phases of the moon images	Add flipbook
Planetary system of balls	Diameter of Jupiter: 5 cm. Details of the planet surface should be there. You don't need to use wood. Another durable material that is cheaper is fine
Planet Card game	Design for back approved
Constellation projector (paper) and time cards	Projector in PVC. T-shape for time cards to fit into slots. Improve design and finish
Planisphere	Vendor star map
Handbook	Only buy file and colour separator sheets. Handbook will be printed in-house after revision

The final invoice including all costs and assembly rates was INR 89,500 or EUR 1377 at an exchange rate of EUR 1 = INR 65 (Appendix 3).

Invoice Component	Total (in INR)	Total (in EUR) (EUR 1 = INR 65)
Part A: Professional fees	7,000	107.69
Part B: Material and Production costs (50 prototypes)	82,500	1269.23
Total	89,500	1376.92⁸

Prorated, this is EUR 27.6 per box. The difference from the initial quotation is explained by

- Professional fees of EUR 108 (INR 7,000)
- Production and all misc costs of EUR 254 (INR 16,500) for all 50 Boxes
- Approved additional material costs of EUR 8.2 (INR 534) per box and differences in the actual price of materials. An itemwise comparison is also provided in Appendix 3.



Comparison between Initial and Final Material Costs

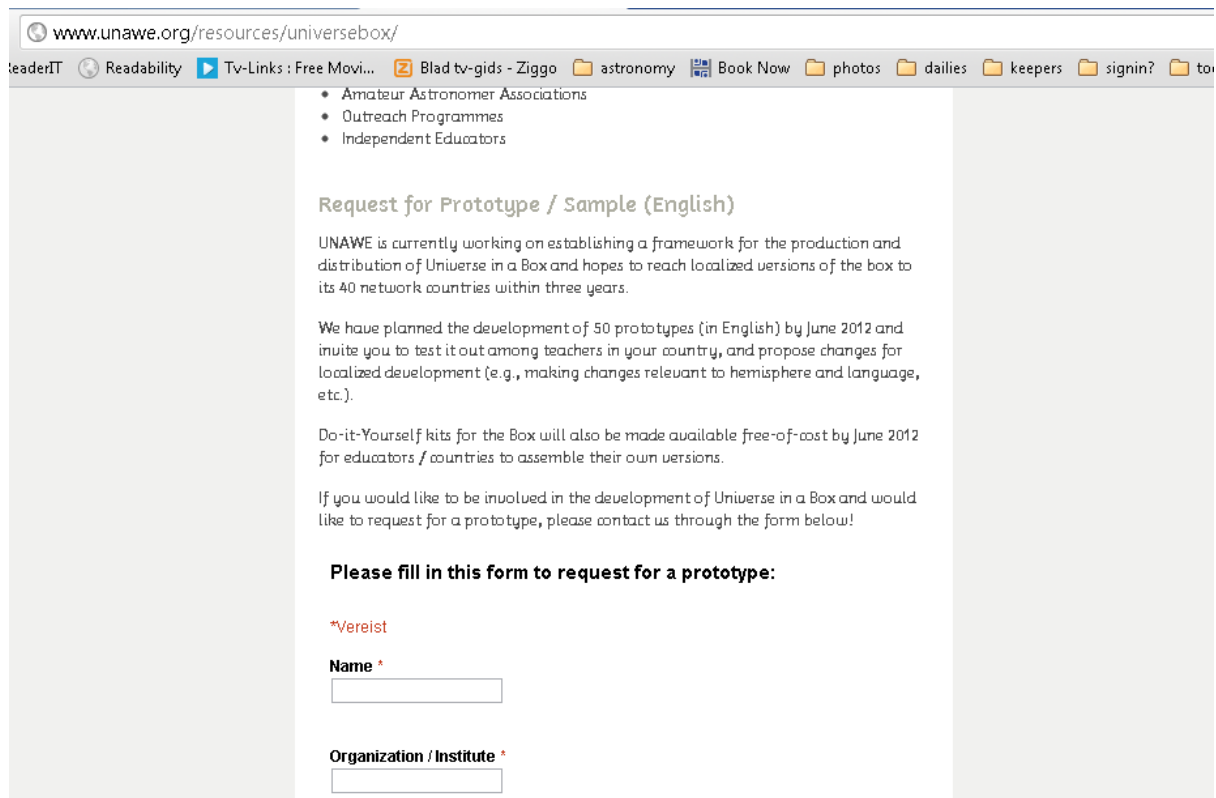
⁸ The final amount will vary depending on the exchange rate at the time of transfer.

The final invoice was received from the vendor on May 17 and was forwarded to the invoice department of Leiden University on the same day.

5.4 PROTOTYPE PRODUCTION AND DISTRIBUTION

The terms of invoice are 50% pre-payment and the vendor is yet to receive the payment, which has been cleared by Leiden University in mid-June. The vendor will complete production of the prototypes two weeks after the funds are cleared (expected delivery date: 15 July 2012).

A webpage was added to the international UNAWE website to invite parties who are interested in being involved in the educational development, production, distribution of the box: <http://www.unawe.org/resources/universebox/>.



The screenshot shows a web browser window with the URL www.unawe.org/resources/universebox/. The page content includes a list of bullet points: Amateur Astronomer Associations, Outreach Programmes, and Independent Educators. Below this is the heading 'Request for Prototype / Sample (English)'. The text explains that UNAWE is working on establishing a framework for the production and distribution of 'Universe in a Box' and hopes to reach localized versions of the box to its 40 network countries within three years. It mentions that 50 prototypes (in English) will be developed by June 2012 and invites users to test them out among teachers in their country, propose changes for localized development (e.g., making changes relevant to hemisphere and language, etc.), and that Do-it-Yourself kits will be made available free-of-cost by June 2012 for educators / countries to assemble their own versions. It concludes by asking if the user would like to be involved in the development of 'Universe in a Box' and would like to request for a prototype, please contact us through the form below!

Please fill in this form to request for a prototype:

*Vereist

Name *

Organization / Institute *

Credit: EU-UNAWE

Twenty-eight requests have been received so far through promotion at the UNAWE workshop in March 2012 and through Pedro's contacts. A user survey will also be sent with the prototypes to determine involvement and educational changes, with a timeline for return (Appendix 6).

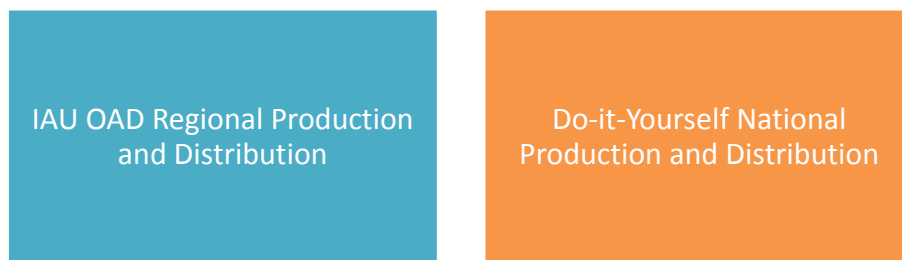
6 RECOMMENDATIONS FOR PRODUCTION AND DISTRIBUTION

6.1 BUSINESS FRAMEWORK

The proposed production and distribution model is to produce the boxes at the regional nodes identified by the IAU OAD, and distribute the boxes from these nodes. The nodes will be finalised by December 2012.

There are two major components to the pricing of the box: manufacturing and shipping. The pricing is expected to vary depending on where the node is situated and can range from EUR 25 to 100, excluding shipping. As bulk ordering ensures lesser rates, UNAWE PMs should be involved in raising bulk orders and distributing it in their country. The UNAWE PMs should also be responsible for localization support, local promotion, and demand input.

Apart from the option of purchasing the box from an OAD regional node, a Do It Yourself (DIY) kit will also be made available for countries where it would be more economical to self-produce the box rather than order it from any of the nodes.



Production and Distribution Options

The international office will be responsible for the overall coordination and website maintenance, while the EU-UNAWE Germany team will be responsible for the educational input and development. That is, four entities will be involved in the production and distribution with the following roles and responsibilities.

UNAWE IO	IAU OAD Regional Nodes
<i>Contact:</i> Project Officer, Universe in a Box	<i>Contact:</i> Regional Node Head
<i>Reports to:</i> Pedro Russo, International Project Manager	<i>Reports to:</i> Kevin Govender, Director
<ul style="list-style-type: none"> • Project management • Web commerce • Global activities for promotion • Global fundraising • Performance tracking of box 	<ul style="list-style-type: none"> • Demand forecasting • Vendor management • Point of sale • Order management and distribution • Regional promotion • Regional fundraising

<ul style="list-style-type: none"> • Distribution of DIY kits • Online distribution of localized DIY kits • Quality management 	<ul style="list-style-type: none"> • Coordination with UNAWE PMs for Localization
<p>UNAWE PM</p> <p><i>Contact:</i> UNAWE National Programme Coordinator</p> <ul style="list-style-type: none"> • Localisation support • Local activities for <ul style="list-style-type: none"> ○ Promotion ○ Fundraising ○ Distribution • Educational support to user • Demand input • Possible point of sale 	<p>EU-UNAWE, Germany</p> <p><i>Contact:</i> Cecilia Scorza, Natalie Fisher, EU-UNAWE Germany</p> <ul style="list-style-type: none"> • Educational development • Reviewing add-on modules

The type of licensing required for the box is yet to be decided.

6.2 NOTE ON WEB COMMERCE

The online interface should have a well designed calculation tool for the costs once the OAD nodes are decided. The following parameters need to be taken into account

- The number of boxes
- The selling price at the regional node
- The shipping costs to destination

A note on the philosophy of regional pricing can also be added to the page, with the following merits:

- Affordable to maximum of the market in region
- Contributing to economic development of the region

6.3 FINANCIALS

Universe in a Box is the first UNAWE project to distribute such an educational resource. It is akin to IAU's Galileoscope (<http://www.galileoscope.org>) project. It is also an opportunity for OAD nodes or UNAWE national programmes to raise funds for other local projects if reasonable profit margins are added. It is recommended that the profit margin be kept within 20% in order to ensure maximum affordability and reach, but this can vary by distributor depending on the market reach.

The scope of this project does not include making financial models as the OAD nodes have not yet been determined. However, here is an example case of the profits that can be expected from the production and distribution of 1000 boxes by a vendor with the necessary infrastructure and staff.

Expenses for 1000 boxes (in EUR) (Material cost 20 EUR per box)		Revenue for 1000 boxes (in EUR) (Selling price 42 EUR per box)	
Production costs	20000	Earnings	42000
Distribution costs	10000		
Promotion costs	3000		
Misc costs	2000		
Total	35000	Total	42000



6.4 NOTE ON FUNDRAISING

To raise funds for the development of the box, the following options can be explored:

1. Raising finances through project grants: Most countries have local / government organizations and outreach centres with funds for educational development activities. A proposal can be written to request for funds.
2. Crowd funding: Crowd funding enables entrepreneurs to raise external finance from the public (the 'crowd'), where each donor provides a very small amount, instead of soliciting investors. The entrepreneur uses social networks and platforms on the Internet.



Adapted from: springleafstrategies.blogspot.nl

There are a few main models of crowd funding for individuals (Belleflamme 2012):

- Donations to a cause or a project (usually a token gift is provided in return)
- Pre-order or order the product (platform to sell; pre-ordering enables entrepreneurs to raise capital for developing the prototypes)
- Advance a fixed amount of money in exchange for a share of future profits (not recommended for Universe in a Box)

The project can either be posted on the UNAWE website, or on existing project sites:

- <http://www.indiegogo.com>
- <http://www.kickstarter.com>

- <http://www.rockethub.com>
- <http://scifund.wordpress.com>
- <http://eurekafund.org>
- <http://fundscience.org>

A future idea for UNAWE is to start its own crowd funding platform for astronomy outreach, demonstrating its vision. It can be used by the entire UNAWE network for posting projects.

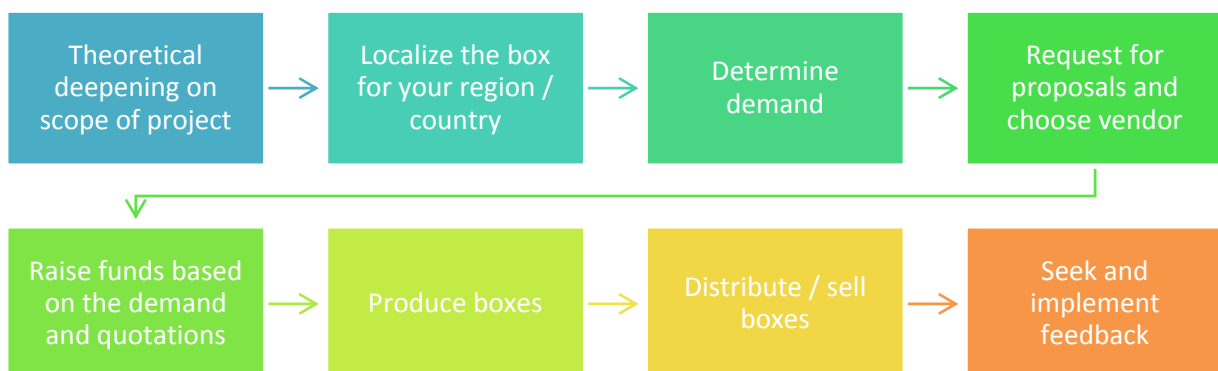
3. A 'Buy One, Donate One' scheme can be implemented at points of sale where entities with additional funds can donate a box to underexposed communities.

6.5 OAD AND DIY KITS

The OAD and DIY kits will contain the following information necessary for the production and distribution of Universe in a box (Appendix 4).

1. Project description and roadmap (filetype: doc)
2. Universe in a Box Prototype (English version) (physical box)
3. Request for quotation package
 - Materials list and quotation format (filetype: xls)
 - An English translation of the handbook (filetype: doc)
 - The source files necessary to reproduce the box (misc filetypes)
4. User survey form (filetype: doc)
5. This report (filetype: pdf)

Twenty of the fifty prototypes should be reserved to send out with the production and distribution kits for the OAD nodes and DIY initiatives. Two can be kept at UNAWE IO for demonstration and promotion. The details of the requests are documented by a Google web form entered from the webpage⁹. The project roadmap presents a simplified process for the next steps after receiving the OAD or DIY kit:



Project Roadmap for Producers and Distributors

⁹ Link to form: <https://docs.google.com/spreadsheet/cc? key=0Apv5Ui5jcg8NdEVfbEJ6OHZJM0ZIZGd1S0FtUzF0ZWc#gid=0>

7 PROJECT HANDOVER

Universe in a Box is a very good educational tool and I had some first-hand experience with using it on an educational project in East Timor to celebrate the transit of Venus 2012. The models and materials greatly simplified explaining astronomical phenomena. The mission to have the box distributed in 41 countries over the next three years is a realistic one, and I hope to see it happen in the future.

I handover the project to the UNAWE International Project Manager. The following activities are to be completed which were included as a part of the project plan.

EU-UNAWE, Germany

- Revamp the content of the handbook to have an introduction chapter of each module plus activity descriptions on independent pages. In this way, future modules can be followed in the same format and the activities will follow the template currently being created by UNAWE IO as a part of an educational repository.
 - Refer to Tomita's comments on the box
(Ref: Google docs: <https://docs.google.com/document/d/1PDUjMOQjPSyP-fZuBN59S7npmFbwjSCJ2jD6MLC6nZk/edit>)
 - Approve design of Planisphere for both the Southern and Northern hemisphere and adapt to handbook
 - Add instructions of Origami boat to handbook
 - Add source files of redesigned planet card game
- Constellation designs for the Southern Hemisphere to be added to the box.
- Evaluation form on the educational aspects of the box required for user survey for prototype users.
- Evaluation toolkit to measure the change of knowledge/perspective after or before the use of the box.

International Office

- Receiving prototypes. A partner of Sirius Interactive (Mumbai, India) can inspect the boxes before they are shipped. Follow up with the vendor on shipping costs
- Distributing boxes to the individuals / organizations who have requested for a sample
(Ref: Google docs: <https://docs.google.com/spreadsheets/cc?key=0Apv5Ui5jcg8NdEVfbEj6OHZjM0ZIZGd1S0FtUzF0ZWc>)
- Store 20 boxes for OAD / DIY kits

- Complete and send letter to PLAYMOBIL®
(Ref: Google docs: <https://docs.google.com/document/d/1SloNWfCSM7-3L02Z3Y5U7k10pveZhPFmBQuzBj8w4Wk/edit>)
- Additions to be box before distribution
 - Receive and add PLAYMOBIL® children
 - Print handbook at Leiden University and add to box
 - Add educational survey from EU-UNAWG Germany in User Survey (Appendix 4) and make improvements to User Survey form
 - Develop and add AstroDrive containing educational resources for teachers on a pen drive
 - Print constellation book and add to box
- Logo design completed. Box design is pending (recommendations added in Appendix 5).
- Update quote from Cecilia on website: 'All beginnings are difficult - but it must not be! Universe in a Box helps teachers overcome the initial hurdle of preparing to teach astronomy with exciting activities and models' ~Cecilia Scorza, EU-UNAWG Germany.
- After the prototypes are received individual images of the items need to be added to the OAD + DIY kits (folder ItemwiseImages Appendix 4). In addition, the revised handbook content needs to be replaced in Appendix 4.
- Follow up on licensing of the box
- The annual performance of the box can be evaluated using the following metrics:
 - Number of boxes distributed (IO, IAU OAD, DIY)
 - Number of teachers trained to use the box (IO, IAU OAD, DIY)
 - Number of children reached (IO, IAU OAD, DIY)
 - Number of countries reached (IO, IAU OAD)
 - Number of low gross domestic product (GDP) countries reached (IO, IAU OAD)
 Need to define baselines and different values to measure impact.
- Follow up on quotation from Spain
(Ref: Google docs: <https://drive.google.com/?tab=mo&authuser=0#folders/0B5v5Ui5jcg8NcGNDcVIUVVJRTDZ2ajhOWlFHVERrZw>)

BIBLIOGRAPHY

Bayern International GmbH, Invest in Bavaria—a joint project between the Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology and Bayern International Edition, Print: OrtmannTeam GmbH, 2005

Belleflamme, Paul, Lambert, Thomas and Schwenbacher, Armin, Crowdfunding: Tapping the Right Crowd (April 25, 2012). CORE Discussion Paper No. 2011/32. Available at SSRN: <http://ssrn.com/abstract=1578175> or <http://dx.doi.org/10.2139/ssrn.1578175>

Convention on the Rights of the Child, Article 29 (1), U.N. Doc. CRC/GC/2001/1, 2001

European Centre for the Development of Vocational Training, Skills Supply and Demand in Europe, CEDEFOP, Luxembourg: Publications Office of the European Union, 2010

Fischer Natalie, Final Report: 'MINT Box Astronomy Adventure - A journey through space for elementary school students' (translated from German), House of Astronomy, Heidelberg, Germany, 2011.

Hideyasu Tamura, ASEAN Plus Logistics Connectivity, Symposium on ASEAN Efforts and Results in Market Access Liberalization, 23 September 2011

International Astronomical Union, Astronomy for the Developing World: Building from the IYA2009, Strategic Plan 2010–2020, 2009, Available from http://iau.org/static/education/strategicplan_091001.pdf

Musar, Ales, Equipment for Science Education: Constraints and Opportunities, Education and Social Policy Department, The World Bank, October 1993

New Product Development, Retrieved June 2012 from http://en.wikipedia.org/wiki/New_product_development

Ruriani Deborah Catalano, Locating a Global Distribution Hub, Inbound Logistics, September 2010, Retrieved June 2012 from <http://www.inboundlogistics.com/cms/article/locating-a-global-distribution-hub>

Shong-lee Ivan Su, The emerging global direct distribution business model: industry and research opportunities, Transportation Journal, 2007

United Nations Statistics Division- Standard Country and Area Codes Classifications (M49)

APPENDIX

The following folders or files have been placed in the documentation folder for Universe in a Box in Dropbox. The login details are available with the International Office.

1. EU-UNAWWE Benchmarks for Astronomy Literacy
2. Request for Proposals
3. Sample Prototype and Invoice - Curion Education Pvt. Ltd
4. Universe in a Box OAD + DIY Toolkit
5. Recommendations for Box Design

CREDIT LIST

Concept: Cecilia Scorza (EU-UNAWE Germany/House of Astronomy)

Project Management: Pedro Russo (UNAWE/Leiden University)

Educational Development: Cecilia Scorza and Natalie Fischer (EU-UNAWE Germany/House of Astronomy)

Business Development: Jaya Ramchandani (UNAWE/Leiden University)

Educational Support: Sara Khalafinejad (UNAWE/Leiden University) and Jos van den Broek (Leiden University)

Prototype Development: Curion Education Pvt. Ltd. (India)

Logo Font: David Kerkhoff (Netherlands); Logo Design: Nikki Hartomo