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Robert Nowak  
Jerzy Chrzaszcz  
Stelian Brad (Eds.)



# Systematic Innovation Partnerships with Artificial Intelligence and Information Technology

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## About this book

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This book constitutes the refereed proceedings of the 22nd International TRIZ Future Conference on Automated Invention for Smart Industries, TFC 2022, which took place in Warsaw, Poland, in September 2022; the event was sponsored by IFIP WG 5.4. The 39 full papers presented were carefully reviewed and selected from 43 submissions. They are organized in the following thematic sections: New perspectives of TRIZ; AI in systematic innovation; systematic innovations supporting IT and AI; TRIZ applications; TRIZ education and ecosystem.

## Systematic Innovation Partnerships with Artificial Intelligence and Information Technology

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## Editors and Affiliations

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- **Warsaw University of Technology, Warsaw, Poland**  
Robert Nowak, Jerzy Chrzęszcz
  - **Technical University of Cluj-Napoca, Cluj-Napoca, Romania**  
Stelian Brad
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# Author information

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## Authors and Affiliations

1. Institute of Social Informatics and Technological Innovations, University of Malaysia Sarawak (UNIMAS), 94300, Kuching, Sarawak, Malaysia

Timothy George Mintu & Narayanan Kulathuramaiyer

2. People's Association for Development and Education of Penan Sarawak (PADE), Miri, Sarawak, Malaysia

Franklin George & John Phoa Chui Leong

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## Corresponding authors

Correspondence to [Timothy George Mintu](#), [Narayanan Kulathuramaiyer](#), [Franklin George](#) or [John Phoa Chui Leong](#).

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# TRIZ-based Approach in Co-creating Virtual Story-maps

Narayanan Kulathuramaiyer<sup>1[0000-0002-1278-8419]</sup> and Timothy George Mintu<sup>2[0000-0002-4606-1197]</sup>

<sup>1,2</sup> Institute of Social Informatics and Technological Innovations,  
University of Malaysia Sarawak (UNIMAS), 94300, Kuching, Sarawak, Malaysia

<sup>1</sup>nara@unimas.my

<sup>2</sup>timothygeorgemintu@gmail.com

**Abstract.** TRIZ based models are particularly instrumental in formulating knowledge-based solutions in a variety of areas. The knowledge engineering capacity gained by systematic approaching problems according to the TRIZ structuring and modelling of problems, enables a powerful mechanism for drilling into the core conflicting or operating zone of the problem. This research then explores the knowledge engineering capacity of TRIZ to enable inventive solutions to solve even complex socio-technical problems. This paper presents a TRIZ-based methodology in the participatory design of shaping community-based virtual tourism programmes for indigenous communities living in the highlands of Borneo. In this paper, we demonstrate digital story-maps as a platform for unlocking tacit knowledge and giving indigenous communities a capacity to promote the uniqueness of their culture and heritage. Based on the initial TRIZ based framing of the problem, the use of digital story-maps has given rise to a systems-approach that has managed to bring out untold stories. These models have also supported the characterization of parameters of the virtual story-map solutions.

**Keywords:** TRIZ, Virtual tourism, Story-maps, Indigenous knowledge-base, Inventive principles

## 1 Introduction

### 1.1 Introduction to Story-maps

A story-map is a system that is developed to fulfill a purpose of sharing information with a pinpoint accuracy in the geospatial field [3]. The term *story-map* has been popular since the release of StoryMapJS in 2013 [7]. The tool highlights a place of interest as a marker on a map while being able to parse multimedia contents such as text and video in a slideshow format. In essence, it can give the viewer a better understanding of the geographic environment in the story.

The methods of collecting stories with visual representation is not a new thing. Based on Scherf [17], its aim in identifying communities' assets and using the knowledge to boost tourism sectors has been successfully adopted. System development is led by the communities with the stakeholders giving their opinions that in the end can result in

improved development. The mapping of an area is done by evaluating a frequently visited place and it is considered a hotspot therefore putting the marker on the map.

A study for the indigenous people of Sarawak also has been done in the past to incorporate cultural values in emoji messaging system. The TRIZ-based socio-technical model has been proposed to aid them in describing the actual workflow for designing and incorporating emojis in the messaging system [4].

We can see that there have been efforts to serve as a visual catalyst to enhance an operation. This paper will also explore the use of co-creation and participatory approach methods as a guide for us to shape the workflow of this research.

As a society that is surrounded by technology, people are getting more familiar in using GPS (*global positioning system*) for directions in our daily lives, for a variety of purposes. On the same note, the use of GPS in storytelling has offered a potential market opportunity in the field of digital tourism during the state of the coronavirus epidemic across the world.

## 1.2 Indigenous People of Sarawak

This project is aimed at the digital enabling of tourism leadership in the indigenous areas in Sarawak, primarily, in the Heart of Borneo. Our target has been to support community-based tourism initiatives by empowering these remote communities in co-creating story-maps through a partnership with researchers from the Institute of Social Informatics and Technological Innovations. The project has explored as a community-university partnership project working closely with communities living in Bario, Bakelalan and Long Lamai. The community-based knowledge extraction and organization capacity target the development of a connected story-mapping system to support virtual tourism for remote Bornean communities.

The people in these areas are of diverse background of Lun Kelabit and Lun Bawang and Penan community. The economy mainly sourced from their agriculture with unique tourism products such as Bario rice and other crops such as pineapples. Other than that, they are also known for their handicrafts which consists of traditional attires and bead-works [6].

In Bakelalan, their economic strength comes from the industrialization of the mountain salt. It was hundreds of years ago the salt came from the spring located in the mountain where villager noticed that there are animals drinking water from the source [9]. But, even before the discovery of the salt springs, their economy is focused mainly on agriculture.

Meanwhile, in Long Lamai, the Penan people in majority. They are the people who in past are practicing nomadic lifestyle. Nowadays, they have their settlements while some are still practicing semi-nomadic lifestyle [18]. In the case of the Penans, their livelihood is very dependent on the jungle in terms of sources of food and shelter. Nowadays, they are still practising handicraft and slowly adopting agriculture in their livelihood which will be their new economic strength.

### **1.3 Indigenous Stories into Story-maps**

The stories from the indigenous communities are often documented by visiting researchers and curious visitors in the form of digital prints or other multimedia formats.

Collecting stories in story-maps format is fairly a new concept in the hearts of Borneo, though a tremendous potential has been observed in the cultural heritage and rich bio-diversities. In terms of the contents, the story-map is often depicted in the perspective of the story-map authors instead of the related communities. Thus, the emphasis on local capacities for value-creation in the tourism industry harnessing on local knowledge and traditions is explored.

## **2 Story-map as a Tool for Virtual Tourism**

### **2.1 Virtual Tourism**

In recent days, COVID-19 has impacted the tourism sector the most, but there are still ways to recover from this with the help of current technologies [1]. To move forward in this tourism industry, we are seeing the tourism sectors are adapting to technology [16].

According to Kayumovich [8], virtual tourism is a method of digitalizing the tourism industry by implementing information technologies that are used by mobile technologies, internet, or even 3-dimensional methods.

Since the impact of a pandemic to the tourism industry is already known to be susceptible to the economy, this is where virtual tourism takes its next step to be adapted by tourism industry and travel agencies to stay sustainable in the coming years.

### **2.2 Related works in employing Story-map in the area of Tourism**

A storymap is a web-platform tool used to represent the stand-alone resources, created with deep thoughts in the purpose of showing information in the form of text, image, video and it also provides the functionality such as map markers to show the reader the geographical information of a story [3].

The use of geospatial technology is has helped to obtain the characteristics of the surrounding area [12]. Furthermore, the use of storymaps will increase the promotional growth of the tourism industry while providing visualization of the potential tourism sites [11].

Other than that, the combination of visual and narrative methods is used to showcase the everyday life of the local community [10]. It is an effective method to show outsiders the degree of their sustainability which leaves an impact to the outsider's opinion the community. The process also is also supported using web-based GIS technology which are very useful to the rural community because it is inexpensive to implement with supports from stakeholders [14],[3].

Therefore, the use of storymaps in tourism will shape the future of the industry and will help struggling tourism sites to attract more potential tourist.



### 2.3 StorymapJS by Knightlab

The first alpha release of the StorymapJS was around 2013 and it was marked as a new tool for storytelling [7].

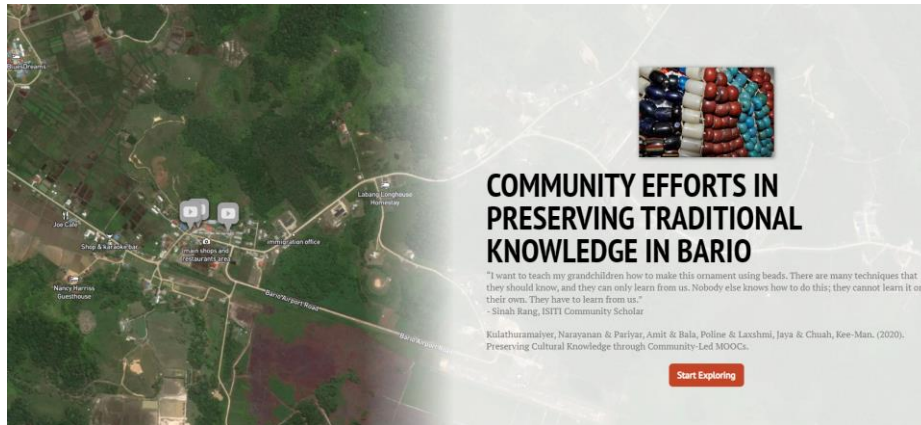


Fig 1. Snapshot of the Community Culture Preservation site in Bario

One of the main reasons why we chose StorymapJS instead of ArcGIS Storymap is because it is open-sourced, highly manageable and have third-party extensions for the multimedia contents. Other than that, the map is highly customizable with the use of third-party services.

## 3 Co-creating Storymaps powered by a TRIZ Approach

### 3.1 Integrating TRIZ with Storymaps

The integration of TRIZ with the problem faced in the co-designing of storymap requires an elaborate planning with the structural story-telling while helping to preserve the community values and way of life. TRIZ tools were initially adopted in problem modelling to identify the key problems for a abstract storytelling tasks.

This chapter will cover the use of *Cause-and-effect chain analysis* to find the key problems. Then, we will perform *Component Analysis* to form a *Function Analysis* to see the relationship of the components and the use of *39 Parameters* to extract the possible principles used in *40 Principles*.

### 3.2 Co-creation and Participatory Practices in a Community

In a study done with the full involvement and participation of a community, careful steps are required as a way to put the community members and organizers in charge of the content creation and in the purpose driven site management .

By adapting the co-creation practices in [5], we start by building connections for connectivity and collaborative customs. A collaborative project design is adopted together with locals, and it goes down to the community consultations, oral history interviews and storytelling.

Through the participatory practices, we can start by performing several participatory methods which are the informal description practices, preservation practices, post-custodial practices and using social media as a forum for community participation. Meanwhile, we conducted targeted interviews with community leads to collect multiple narratives.

### 3.3 Cause and Effect Chain Analysis

In adopting TRIZ at a problem modeling stage the cause-and-effect chain analysis was applied to acquire the characteristics and requirements in the design of story-maps as a potential virtual tourism and as a business enabler tool for these communities (see Fig.2).

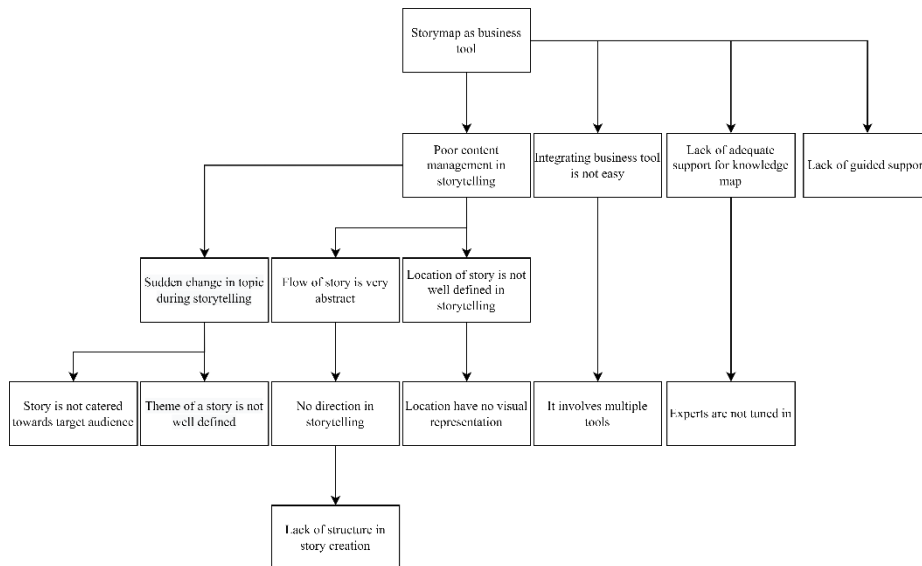
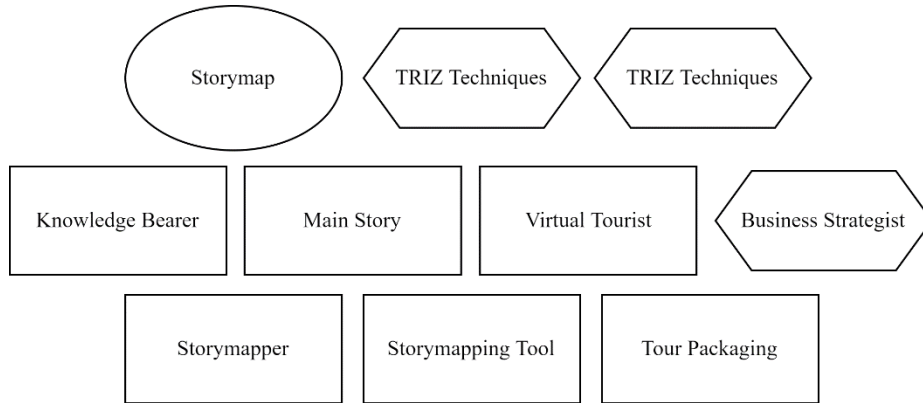


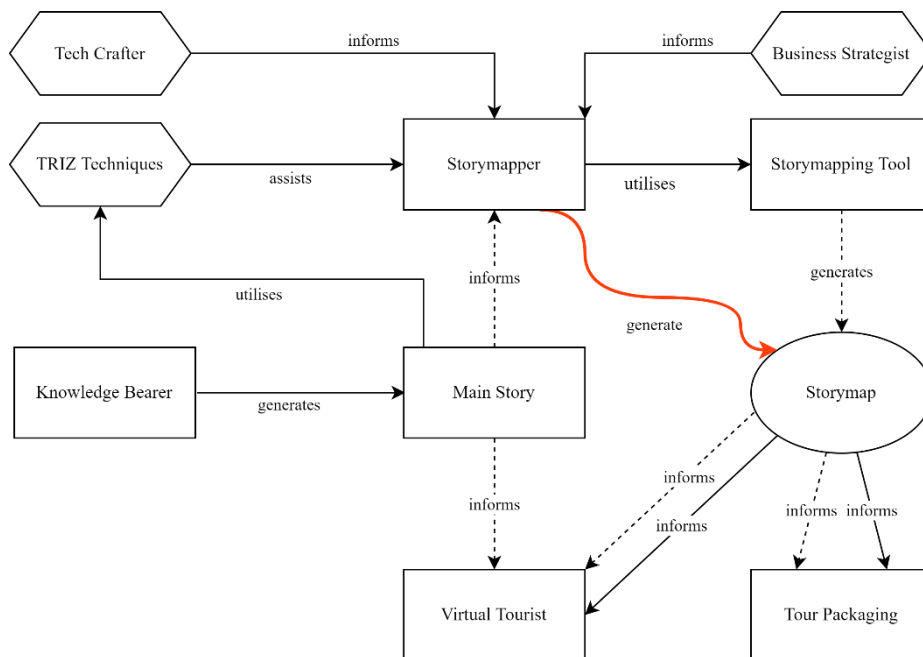
Fig. 2. Cause and Effect Chain Analysis

### 3.4 Component Analysis and Function Analysis

Component Analysis is then performed to acquire all the possible entities within a system design. The relationship between the entities will be connected during the function modelling. After performing the function model, function analysis was performed to determine the strength of each connection with the entities (see Fig. 4). The outcomes of the function analysis have provided linkage to formulate the design model [13].



**Fig. 3.** Component Analysis



**Fig. 4.** Function Analysis for story mapping scenario

### 3.5 Engineering Contradictions

This model uses the condition with improving and worsening parameters where it mimics the engineering contradiction. The use of engineering contradiction enhances the understanding and logical model involving the key parameters [15]

The next step would be us to determine the 39 parameters based on the given condition. Lastly, we can see the suggested 40 principles as our pivot point to solving a particular contradiction. The table below are the collection of generated If-then-buts based on the previous analysis (see **Table 1**).

**Table 1:** Generation of following engineering contradictions

<b>Engineering Contradiction #1</b>		
<b>IF</b>	Storymap is used as a way of capturing and preserving communities' traditional knowledge	<b>Parameter</b>
<b>THEN</b>	The interaction between knowledge capture will be instantaneous	<b>39. Productivity</b>
<b>BUT</b>	Story is limited to audience's attention span	<b>35. Adaptability or Versatility</b>
Suggested Principles	26. Instead of reading the text, audio aid is added 17. Adding another dimension of the business process as additional layer 19. Include short dialogues periodically between the long ones 1. Divide contents into sections of the main story	
<b>Engineering Contradiction #2</b>		
<b>IF</b>	Story is catered towards target audience,	<b>Parameter</b>
<b>THEN</b>	the content will appear to be useful towards the audience	<b>18. Illumination Intensity</b>
<b>BUT</b>	it leads to slower story generation	<b>9. Speed</b>
Suggested Principles	10. Storymaker generate rough story outline for target audience 13. Determine what target audience wants instead of creating stories on the fly 19. Create scenarios where during periodic changes in activities can be captured by using templates	
<b>Engineering Contradiction #3</b>		
<b>IF</b>	Theme of the story is well defined	<b>Parameter</b>
<b>THEN</b>	the content of the story will be concise	<b>13. Stability of the object</b>
<b>BUT</b>	storytelling will show less expression	<b>18. Illumination intensity</b>
Suggested Principles	32. Apply chromatic storytelling during sessions with kindergarten children 3. Engage with community inputs when highlighting indigenous flavor in stories 27. Use of cheap objects as props and backdrops to maximize immersion 16. Use a platform where exaggeration in storytelling is encouraged	
<b>Engineering Contradiction #4</b>		
<b>IF</b>	A story is created with a solid structure	<b>Parameter</b>
<b>THEN</b>	the flow of a story will be organized	<b>39. Productivity</b>

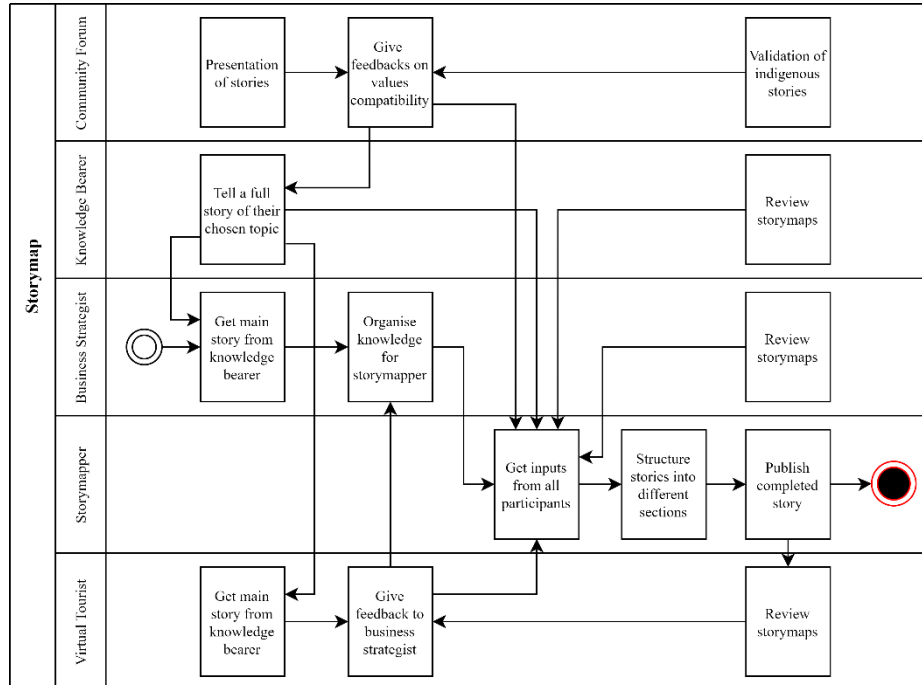
<b>BUT</b>	knowledge bearer will have to follow the structure	<b>35. Adaptability or Versatility</b>
Suggested Principles	1. Divide the structure into different sections 35. Make the story to be more flexible for knowledge bearer by allowing free flow	
<b>Engineering Contradiction #5</b>		
<b>IF</b>	Tourist is fully involved in designing the story-map	<b>Parameter</b>
<b>THEN</b>	We can see what other tourists want to see	<b>29. Manufacturing Precision</b>
<b>BUT</b>	The suggestions from tourist could disrupt the flow of story	<b>31. Object Generated Harmful Effect</b>
Suggested Principles	17. Rather than asking what tourist wants to see, put tourist in the perspective of the storyteller 34. Use only acceptable opinions from tourist while preserving all ideas	
<b>Engineering Contradiction #6</b>		
<b>IF</b>	Business strategist is involved in storymap development	<b>Parameter</b>
<b>THEN</b>	Storymapper can create a richer story	<b>29. Manufacturing Precision</b>
<b>BUT</b>	Creating content together is not always easy	<b>39. Productivity</b>
Suggested Principles	10. Expose the information to the business strategist 32. Story-mapper and business must always be transparent in knowledge exchange	

The use of functional models and TRIZ modelling tools have provided insights into the core modelling of systemic elements relating to the software design steps. As we started the process of building pilot models of story-maps highlighting various tourism products and services, the guidance in an insightful modelling has been instrumental.

## 4 Discussions and Future Works

### 4.1 Implementation of TRIZ in Indigenous Community

In the effort of simplifying the methods, we have subsequently produced a model that is easier for the community to visually understand our aim and concepts. As the goal was to translate the TRIZ modeling outcomes to serve as requirement specification and design descriptors for a high-level software design process.



**Figure 5.** Community story-maps overview for virtual tourism.

The results of our initial co-creation, co-design and interactive co-development has demonstrated the value of TRIZ modelling tools in the area of software and content development. The need to learn from experiences of TRIZ knowledgebases in guiding the interactions and component formulation has insightful in the initial models.

#### 4.2 TRIZ Components in Generating Storymaps

In generating storymaps, several TRIZ tools such were used from the beginning until the end of the procedure. In the table below, the importance of each TRIZ tools usage are justified for it is very crucial for each step of the process.

**Table 2. Importance of TRIZ Tools in storymapping**

TRIZ Tools	Importance in Storymapping
<b>Cause-and-effect Chain Analysis</b>	In Chapter 3.3, we made storymap as a business tool for the paper. By performing CECA on this point, we can see some underlying problems that relates to the flow and structure of the storymap.
<b>Component Analysis</b>	Next, in Chapter 3.4, component analysis is done to lay out all possible components (component, supersystem) that affects the buildup of the storymap.

<b>Function Analysis</b>	Subsequently, in Chapter 3.4, all possible functions of the components are defined in a way whether it has a degree of relationship (excessive, useful, harmful or insufficient).
<b>Engineering Contradiction</b>	Engineering contradictions are represented as If-Then-But. Based on function analysis in Chapter 3.4, we can identify the improving and worsening parameter as a sentence of 'If-Then-But'. For example,  IF – represents the problem model element (story-teller, story structure, business value) based on function analysis THEN – Improving parameter for the focused targeted systems design BUT – Worsening parameter for the focused targeted systems design
<b>39 Parameters</b>	The improving and worsening parameters will be mapped to a selected engineering 39 Parameters.
<b>Original Engineering Contradiction Matrix</b>	After the Parameters has been identified, then a quick reference to the contradiction matrix will lead to the set of recommended partial solutions with selected Inventive Principles as triggers.
<b>40 Principles</b>	40 Inventive Principles serves as triggers to solve the problems that arise from our function analysis phase.

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# TRIZ-based Approach in Co-creating Virtual Story-maps

Narayanan Kulathuramaiyer<sup>1[0000-0002-1278-8419]</sup> and Timothy George Mintu<sup>2[0000-0002-4606-1197]</sup>

<sup>1,2</sup> Institute of Social Informatics and Technological Innovations,  
University of Malaysia Sarawak (UNIMAS), 94300, Kuching, Sarawak, Malaysia

<sup>1</sup>nara@unimas.my

<sup>2</sup>timothygeorgemintu@gmail.com

**Abstract.** TRIZ based models are particularly instrumental in formulating knowledge-based solutions in a variety of areas. The knowledge engineering capacity gained by systematic approaching problems according to the TRIZ structuring and modelling of problems, enables a powerful mechanism for drilling into the core conflicting or operating zone of the problem. This research then explores the knowledge engineering capacity of TRIZ to enable inventive solutions to solve even complex socio-technical problems. This paper presents a TRIZ-based methodology in the participatory design of shaping community-based virtual tourism programmes for indigenous communities living in the highlands of Borneo. In this paper, we demonstrate digital story-maps as a platform for unlocking tacit knowledge and giving indigenous communities a capacity to promote the uniqueness of their culture and heritage. Based on the initial TRIZ based framing of the problem, the use of digital story-maps has given rise to a systems-approach that has managed to bring out untold stories. These models have also supported the characterization of parameters of the virtual story-map solutions.

**Keywords:** TRIZ, Virtual tourism, Story-maps, Indigenous knowledge-base, Inventive principles

## 1 Introduction

### 1.1 Introduction to Story-maps

A story-map is a system that is developed to fulfill a purpose of sharing information with a pinpoint accuracy in the geospatial field [3]. The term *story-map* has been popular since the release of StoryMapJS in 2013 [7]. The tool highlights a place of interest as a marker on a map while being able to parse multimedia contents such as text and video in a slideshow format. In essence, it can give the viewer a better understanding of the geographic environment in the story.

The methods of collecting stories with visual representation is not a new thing. Based on Scherf [17], its aim in identifying communities' assets and using the knowledge to boost tourism sectors has been successfully adopted. System development is led by the communities with the stakeholders giving their opinions that in the end can result in

improved development. The mapping of an area is done by evaluating a frequently visited place and it is considered a hotspot therefore putting the marker on the map.

A study for the indigenous people of Sarawak also has been done in the past to incorporate cultural values in emoji messaging system. The TRIZ-based socio-technical model has been proposed to aid them in describing the actual workflow for designing and incorporating emojis in the messaging system [4].

We can see that there have been efforts to serve as a visual catalyst to enhance an operation. This paper will also explore the use of co-creation and participatory approach methods as a guide for us to shape the workflow of this research.

As a society that is surrounded by technology, people are getting more familiar in using GPS (*global positioning system*) for directions in our daily lives, for a variety of purposes. On the same note, the use of GPS in storytelling has offered a potential market opportunity in the field of digital tourism during the state of the coronavirus epidemic across the world.

## 1.2 Indigenous People of Sarawak

This project is aimed at the digital enabling of tourism leadership in the indigenous areas in Sarawak, primarily, in the Heart of Borneo. Our target has been to support community-based tourism initiatives by empowering these remote communities in co-creating story-maps through a partnership with researchers from the Institute of Social Informatics and Technological Innovations. The project has explored as a community-university partnership project working closely with communities living in Bario, Bakelalan and Long Lamai. The community-based knowledge extraction and organization capacity target the development of a connected story-mapping system to support virtual tourism for remote Bornean communities.

The people in these areas are of diverse background of Lun Kelabit and Lun Bawang and Penan community. The economy mainly sourced from their agriculture with unique tourism products such as Bario rice and other crops such as pineapples. Other than that, they are also known for their handicrafts which consists of traditional attires and bead-works [6].

In Bakelalan, their economic strength comes from the industrialization of the mountain salt. It was hundreds of years ago the salt came from the spring located in the mountain where villager noticed that there are animals drinking water from the source [9]. But, even before the discovery of the salt springs, their economy is focused mainly on agriculture.

Meanwhile, in Long Lamai, the Penan people in majority. They are the people who in past are practicing nomadic lifestyle. Nowadays, they have their settlements while some are still practicing semi-nomadic lifestyle [18]. In the case of the Penans, their livelihood is very dependent on the jungle in terms of sources of food and shelter. Nowadays, they are still practising handicraft and slowly adopting agriculture in their livelihood which will be their new economic strength.

### 1.3 Indigenous Stories into Story-maps

The stories from the indigenous communities are often documented by visiting researchers and curious visitors in the form of digital prints or other multimedia formats.

Collecting stories in story-maps format is fairly a new concept in the hearts of Borneo, though a tremendous potential has been observed in the cultural heritage and rich bio-diversities. In terms of the contents, the story-map is often depicted in the perspective of the story-map authors instead of the related communities. Thus, the emphasis on local capacities for value-creation in the tourism industry harnessing on local knowledge and traditions is explored.

## 2 Story-map as a Tool for Virtual Tourism

### 2.1 Virtual Tourism

In recent days, COVID-19 has impacted the tourism sector the most, but there are still ways to recover from this with the help of current technologies [1]. To move forward in this tourism industry, we are seeing the tourism sectors are adapting to technology [16].

According to Kayumovich [8], virtual tourism is a method of digitalizing the tourism industry by implementing information technologies that are used by mobile technologies, internet, or even 3-dimensional methods.

Since the impact of a pandemic to the tourism industry is already known to be susceptible to the economy, this is where virtual tourism takes its next step to be adapted by tourism industry and travel agencies to stay sustainable in the coming years.

### 2.2 Related works in employing Story-map in the area of Tourism

A storymap is a web-platform tool used to represent the stand-alone resources, created with deep thoughts in the purpose of showing information in the form of text, image, video and it also provides the functionality such as map markers to show the reader the geographical information of a story [3].

The use of geospatial technology is has helped to obtain the characteristics of the surrounding area [12]. Furthermore, the use of storymaps will increase the promotional growth of the tourism industry while providing visualization of the potential tourism sites [11].

Other than that, the combination of visual and narrative methods is used to showcase the everyday life of the local community [10]. It is an effective method to show outsiders the degree of their sustainability which leaves an impact to the outsider's opinion the community. The process also is also supported using web-based GIS technology which are very useful to the rural community because it is inexpensive to implement with supports from stakeholders [14],[3].

Therefore, the use of storymaps in tourism will shape the future of the industry and will help struggling tourism sites to attract more potential tourist.

### 2.3 StorymapJS by Knightlab

The first alpha release of the StorymapJS was around 2013 and it was marked as a new tool for storytelling [7].

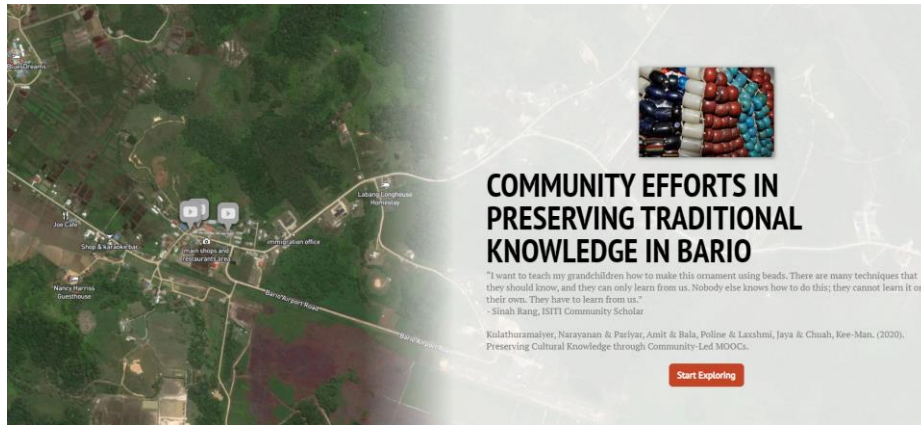


Fig 1. Snapshot of the Community Culture Preservation site in Bario

One of the main reasons why we chose StorymapJS instead of ArcGIS Storymap is because it is open-sourced, highly manageable and have third-party extensions for the multimedia contents. Other than that, the map is highly customizable with the use of third-party services.

## 3 Co-creating Storymaps powered by a TRIZ Approach

### 3.1 Integrating TRIZ with Storymaps

The integration of TRIZ with the problem faced in the co-designing of storymap requires an elaborate planning with the structural story-telling while helping to preserve the community values and way of life. TRIZ tools were initially adopted in problem modelling to identify the key problems for a abstract storytelling tasks.

This chapter will cover the use of *Cause-and-effect chain analysis* to find the key problems. Then, we will perform *Component Analysis* to form a *Function Analysis* to see the relationship of the components and the use of *39 Parameters* to extract the possible principles used in *40 Principles*.

### 3.2 Co-creation and Participatory Practices in a Community

In a study done with the full involvement and participation of a community, careful steps are required as a way to put the community members and organizers in charge of the content creation and in the purpose driven site management .

By adapting the co-creation practices in [5], we start by building connections for connectivity and collaborative customs. A collaborative project design is adopted together with locals, and it goes down to the community consultations, oral history interviews and storytelling.

Through the participatory practices, we can start by performing several participatory methods which are the informal description practices, preservation practices, post-custodial practices and using social media as a forum for community participation. Meanwhile, we conducted targeted interviews with community leads to collect multiple narratives.

### 3.3 Cause and Effect Chain Analysis

In adopting TRIZ at a problem modeling stage the cause-and-effect chain analysis was applied to acquire the characteristics and requirements in the design of story-maps as a potential virtual tourism and as a business enabler tool for these communities (see Fig.2).

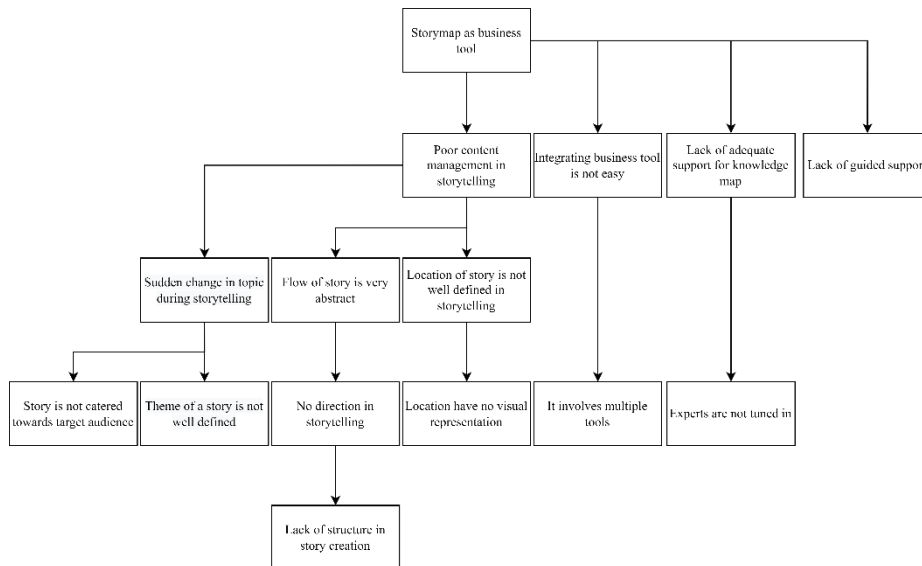
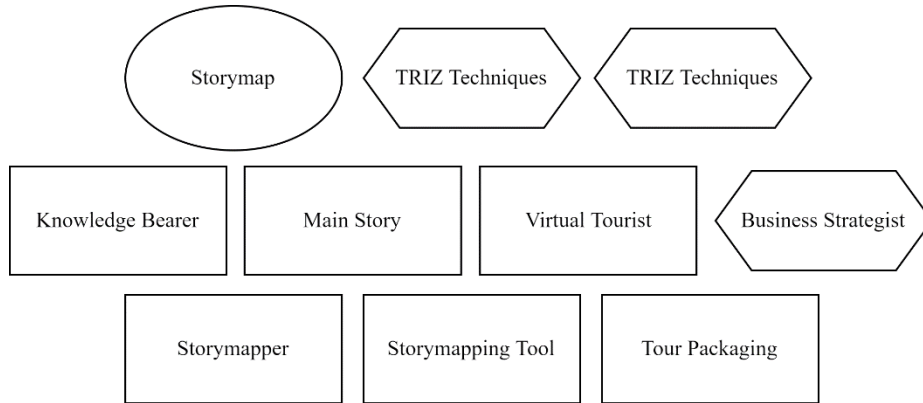


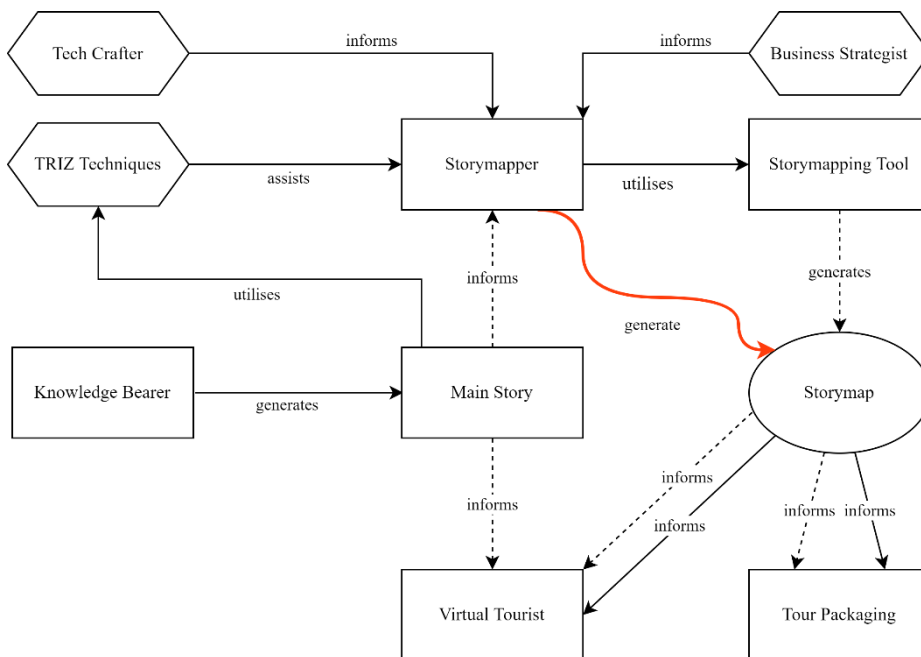
Fig. 2. Cause and Effect Chain Analysis

### 3.4 Component Analysis and Function Analysis

Component Analysis is then performed to acquire all the possible entities within a system design. The relationship between the entities will be connected during the function modelling. After performing the function model, function analysis was performed to determine the strength of each connection with the entities (see Fig. 4). The outcomes of the function analysis have provided linkage to formulate the design model [13].



**Fig. 3.** Component Analysis



**Fig. 4.** Function Analysis for story mapping scenario

### 3.5 Engineering Contradictions

This model uses the condition with improving and worsening parameters where it mimics the engineering contradiction. The use of engineering contradiction enhances the understanding and logical model involving the key parameters [15]

The next step would be us to determine the 39 parameters based on the given condition. Lastly, we can see the suggested 40 principles as our pivot point to solving a particular contradiction. The table below are the collection of generated If-then-buts based on the previous analysis (see **Table 1**).

**Table 1:** Generation of following engineering contradictions

<b>Engineering Contradiction #1</b>		
<b>IF</b>	Storymap is used as a way of capturing and preserving communities' traditional knowledge	<b>Parameter</b>
<b>THEN</b>	The interaction between knowledge capture will be instantaneous	<b>39. Productivity</b>
<b>BUT</b>	Story is limited to audience's attention span	<b>35. Adaptability or Versatility</b>
Suggested Principles	26. Instead of reading the text, audio aid is added 17. Adding another dimension of the business process as additional layer 19. Include short dialogues periodically between the long ones 1. Divide contents into sections of the main story	
<b>Engineering Contradiction #2</b>		
<b>IF</b>	Story is catered towards target audience,	<b>Parameter</b>
<b>THEN</b>	the content will appear to be useful towards the audience	<b>18. Illumination Intensity</b>
<b>BUT</b>	it leads to slower story generation	<b>9. Speed</b>
Suggested Principles	10. Storymaker generate rough story outline for target audience 13. Determine what target audience wants instead of creating stories on the fly 19. Create scenarios where during periodic changes in activities can be captured by using templates	
<b>Engineering Contradiction #3</b>		
<b>IF</b>	Theme of the story is well defined	<b>Parameter</b>
<b>THEN</b>	the content of the story will be concise	<b>13. Stability of the object</b>
<b>BUT</b>	storytelling will show less expression	<b>18. Illumination intensity</b>
Suggested Principles	32. Apply chromatic storytelling during sessions with kindergarten children 3. Engage with community inputs when highlighting indigenous flavor in stories 27. Use of cheap objects as props and backdrops to maximize immersion 16. Use a platform where exaggeration in storytelling is encouraged	
<b>Engineering Contradiction #4</b>		
<b>IF</b>	A story is created with a solid structure	<b>Parameter</b>
<b>THEN</b>	the flow of a story will be organized	<b>39. Productivity</b>

<b>BUT</b>	knowledge bearer will have to follow the structure	<b>35. Adaptability or Versatility</b>
Suggested Principles	1. Divide the structure into different sections 35. Make the story to be more flexible for knowledge bearer by allowing free flow	
<b>Engineering Contradiction #5</b>		
<b>IF</b>	Tourist is fully involved in designing the story-map	<b>Parameter</b>
<b>THEN</b>	We can see what other tourists want to see	<b>29. Manufacturing Precision</b>
<b>BUT</b>	The suggestions from tourist could disrupt the flow of story	<b>31. Object Generated Harmful Effect</b>
Suggested Principles	17. Rather than asking what tourist wants to see, put tourist in the perspective of the storyteller 34. Use only acceptable opinions from tourist while preserving all ideas	
<b>Engineering Contradiction #6</b>		
<b>IF</b>	Business strategist is involved in storymap development	<b>Parameter</b>
<b>THEN</b>	Storymapper can create a richer story	<b>29. Manufacturing Precision</b>
<b>BUT</b>	Creating content together is not always easy	<b>39. Productivity</b>
Suggested Principles	10. Expose the information to the business strategist 32. Story-mapper and business must always be transparent in knowledge exchange	

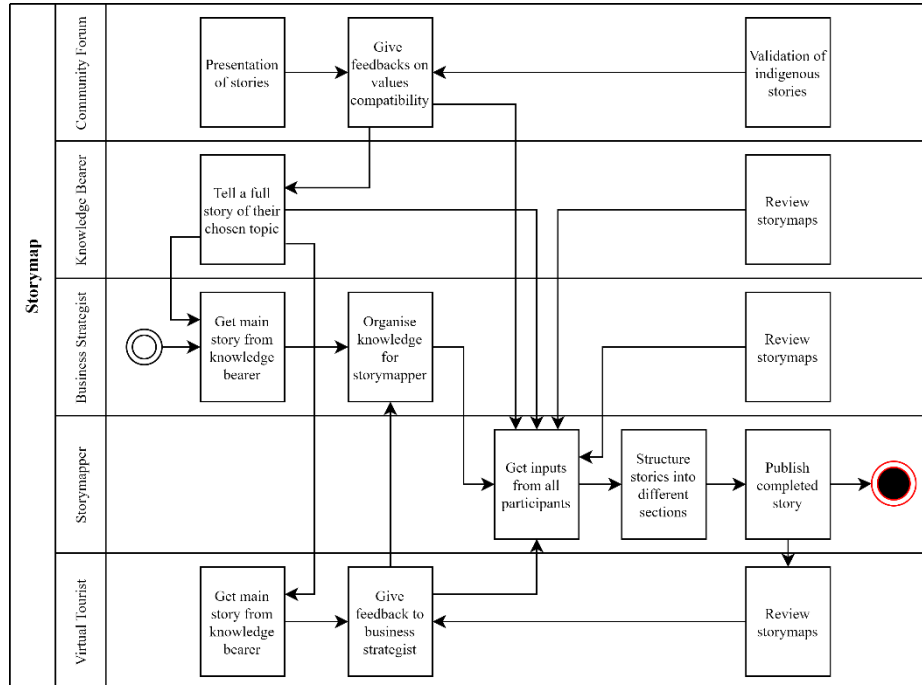
The use of functional models and TRIZ modelling tools have provided insights into the core modelling of systemic elements relating to the software design steps. As we started the process of building pilot models of story-maps highlighting various tourism products and services, the guidance in an insightful modelling has been instrumental.

## 4 Discussions and Future Works

### 4.1 Implementation of TRIZ in Indigenous Community

In the effort of simplifying the methods, we have subsequently produced a model that is easier for the community to visually understand our aim and concepts. As the goal was to translate the TRIZ modeling outcomes to serve as requirement specification and design descriptors for a high-level software design process.





**Figure 5.** Community story-maps overview for virtual tourism.

The results of our initial co-creation, co-design and interactive co-development has demonstrated the value of TRIZ modelling tools in the area of software and content development. The need to learn from experiences of TRIZ knowledgebases in guiding the interactions and component formulation has insightful in the initial models.

#### 4.2 TRIZ Components in Generating Storymaps

In generating storymaps, several TRIZ tools such were used from the beginning until the end of the procedure. In the table below, the importance of each TRIZ tools usage are justified for it is very crucial for each step of the process.

**Table 2. Importance of TRIZ Tools in storymapping**

TRIZ Tools	Importance in Storymapping
<b>Cause-and-effect Chain Analysis</b>	In Chapter 3.3, we made storymap as a business tool for the paper. By performing CECA on this point, we can see some underlying problems that relates to the flow and structure of the storymap.
<b>Component Analysis</b>	Next, in Chapter 3.4, component analysis is done to lay out all possible components (component, supersystem) that affects the buildup of the storymap.

<b>Function Analysis</b>	Subsequently, in Chapter 3.4, all possible functions of the components are defined in a way whether it has a degree of relationship (excessive, useful, harmful or insufficient).
<b>Engineering Contradiction</b>	Engineering contradictions are represented as If-Then-But. Based on function analysis in Chapter 3.4, we can identify the improving and worsening parameter as a sentence of 'If-Then-But'. For example,  IF – represents the problem model element (story-teller, story structure, business value) based on function analysis THEN – Improving parameter for the focused targeted systems design BUT – Worsening parameter for the focused targeted systems design
<b>39 Parameters</b>	The improving and worsening parameters will be mapped to a selected engineering 39 Parameters.
<b>Original Engineering Contradiction Matrix</b>	After the Parameters has been identified, then a quick reference to the contradiction matrix will lead to the set of recommended partial solutions with selected Inventive Principles as triggers.
<b>40 Principles</b>	40 Inventive Principles serves as triggers to solve the problems that arise from our function analysis phase.

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