Aalto University
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Managing Outsourced Image Content Production in an Image-Oriented Web Project

Master's Thesis
Helsinki, August 16, 2015

Supervisor: Professor Petri Vuorimaa
Advisor: Kiril Jovchev M.Sc. (Tech.)

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ABSTRACT OF
MASTER'S THESIS

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Title:
Managing Outsourced Image Content Production in an Image-Oriented Web Project

Date: August 16, 2015 **Pages:** viii + 73

Major: Media Technology **Code:** IL3011

Supervisor: Professor Petri Vuorimaa

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The objective of this thesis was to examine how outsourced image content can be managed in an image-oriented Web project. The research was conducted as a single-case study that involved developing tools and processes for integrating outsourced image content into an international construction company's Web platform. The results of the project were evaluated by analyzing log files and conducting interviews with people involved in the project. Furthermore, the results of the project were compared to the insights gained from a literature review.

The management of outsourced image content production is a unique process that depends on the characteristics of each individual Web project. Prior to engaging in an outsourcing relationship, the organization must have a profound understanding of the functional, visual, and technical requirements of the project. The organization must also make a plan for integrating images into the website and monitoring their quality.

Integration and quality monitoring are the two major challenges in outsourced image production. The integration process should be automated, where possible, but manual work is needed for tasks that require decision-making based on visual content. Quality monitoring should be conducted as a part of the integration process, and it should cover both the technical and visual properties of images as well as the integration data.

Keywords: image, image content, outsourcing, web, management, integration, validation, quality monitoring

Language: English

Aalto-yliopisto
Perustieteiden korkeakoulu
Tietotekniikan koulutusohjelma

DIPLOMITYÖN TIIVISTELMÄ

Tekijä:	Hanne Aho		
Työn nimi:	Ulkoistetun kuvien tuotannon hallinta kuviin painottuvassa Web-projektissa		
Päiväys:	16. elokuuta 2015	**Sivumäärä:**	viii + 73
Pääaine:	Mediatekniikka	**Koodi:**	IL3011
Valvoja:	Professori Petri Vuorimaa		
Ohjaaja:	Diplomi-insinööri Kiril Jovchev		

Tämän diplomityön tarkoituksena oli selvittää, miten ulkoistetusti tuotettua kuvasisältöä voidaan hallita kuvamateriaaliin painottuvassa Web-projektissa. Tutkimus suoritettiin yhden organisaation case-tutkimuksena, joka kohdistui kansainvälisen rakennusalan yrityksen Web-projektiin. Tutkimuksen yhteydessä kehitettiin tarvittavat työkalut ja prosessit, joiden avulla ulkoistetusti tuotettu kuvasisältö voidaan integroida yrityksen Web-järjestelmään. Projektin onnistumista arvioitiin analysoimalla lokitiedostoja ja haastattelemalla projektissa eri tavoin mukana olleita henkilöitä. Lisäksi projektin tuloksia verrattiin kirjallisuuskatsauksen avulla kerättyyn aineistoon.

Ulkoistetusti tuotetun kuvasisällön hallinta on yksilöllinen prosessi, joka muotoutuu kunkin Web-projektin ominaispiirteiden pohjalta. Ennen ulkoistamishankkeeseen ryhtymistä yrityksen on selvitettävä, millaisia toiminnallisia, visuaalisia ja teknisiä vaatimuksia projektiin liittyy. Lisäksi on laadittava suunnitelma siitä, miten kuvat integroidaan Web-sivustolle ja miten niiden laatua valvotaan.

Kuvasisällön integrointi ja laadunvalvonta ovat ulkoistetun kuvien tuotannon suurimpia haasteita. Kuvien integrointi voidaan teknisten ominaisuuksien osalta automatisoida, mutta manuaalista työtä tarvitaan silloin kun päätöksenteko tapahtuu kuvan visuaalisen sisällön perusteella. Laadunvalvonta on hyvä sisällyttää osaksi integrointiprosessia, ja sen yhteydessä on otettava huomioon kuvien tekniset ja visuaaliset ominaisuudet sekä mahdollinen integrointia varten tarvittava metatieto.

Asiasanat:	kuva, kuvasisältö, ulkoistaminen, web, hallinta, integrointi, validointi, laadunvalvonta
Kieli:	Englanti

Acknowledgements

I would like to thank my instructor, Kiril Jovchev, for making this Master's thesis possible. For quite some time, I was worried that combining my thesis with the interests of Siili Solutions will be a difficult, if not impossible, task. Thank you for taking the time to help me find a topic and kick-start this project.

I wish to thank Samuel Salmenlinna for giving me the opportunity and the official support to write my thesis for Siili Solutions. I also want to thank Matti Kiviluoto for all the small acts of encouragement during this project. Thank you for giving me the feeling that the company has my back on my efforts to graduate.

I want to express my gratitude to my supervisor, professor Petri Vuorimaa, who has given me valuable feedback and advice for the writing process. Thank you for the patience and the supportive words even when my thesis turned out to be quite a lot longer process than I expected.

I want to thank all my friends, coworkers, and relatives that have given me their support during this project. A very special thank you to my lovely friend and workmate, Vikki, who has lived through the ups and downs of my thesis with me. Another special thank you to my grandmother who made me the woolly socks that have kept my feet warm during the long days and nights that I have spent writing this thesis.

Finally, I want to thank my family: my brother Mika, my sister Joanna, my brother Jukka, mom and dad. Words cannot describe how much you mean to me. Thank you for always being there for me when I needed it.

Helsinki, August 16, 2015

Hanne Aho

Abbreviations and Acronyms

CAD	Computer-Aided Design
CEE	Central Eastern Europe
CSS	Cascading Style Sheets
GIF	Graphics Interchange Format
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
JPEG	Joint Photographic Experts Group
JSON	JavaScript Object Notation
PNG	Portable Network Graphics
RFP	Request for Proposal
SEO	Search Engine Optimization
SOW	Statement of Work
SVG	Scalable Vector Graphics
UAT	User Acceptance Testing
URL	Uniform Resource Locator
WCAG	Web Content Accessibility Guidelines
XML	Extensible Markup Language

Contents

Chapter 1

Introduction

As a result of the ongoing digital and mobile revolution, a massive oversupply of content has become available to consumers anytime and anywhere. In the World Wide Web – the Web, for short – the competition for consumers' attention has become so intense that consumers have gained a significant power to determine demand for different types of contents. This has put companies all over the world under pressure as ever more creativity and investments are required from the marketing departments in order to be noticed.

Over the last few years, the focus of marketing has been rapidly shifting from traditional advertising of products towards *content marketing*. Content marketing is a marketing strategy that aims at producing valuable, relevant and engaging content that serves the informational needs of the target customers. [43] One of the most commonly used and effective content marketing tactics is the use of illustrations and photos [8].

Illustrations and photos have become a prominent part of the Web, as 65 % of the transferred bytes on an average Web page consist of images (Figure 1.1). Images have a great potential for creating engaging content because they can be used to effectively guide and capture attention [71]. At best, an image may captivate the user, convey information, and enhance the overall experience of the site. At worst, however, an image is merely a waste of space that is either confusing or simply ignored by the users. [36] Thus, the impact of visual and technical quality of images on the user's behavior must not be underestimated.

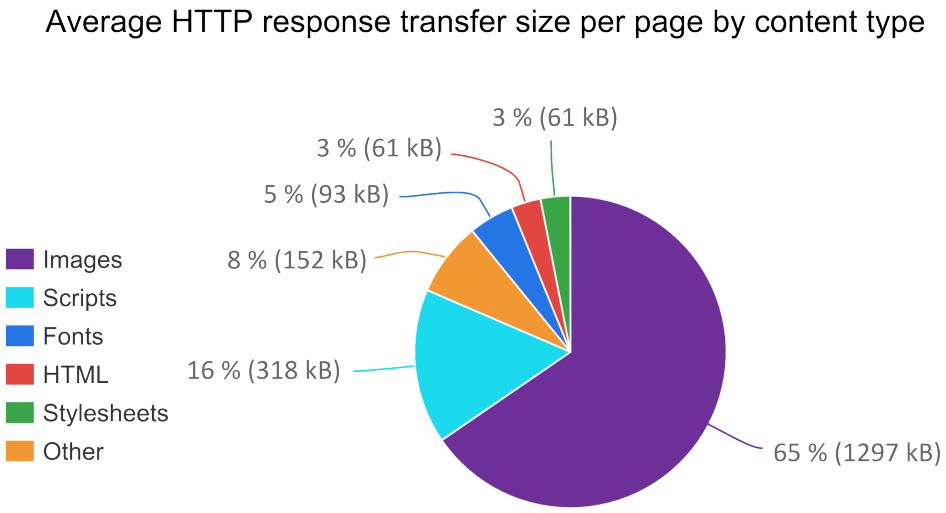

Figure 1.1: Images consume 65 % of the transferred bytes on an average Web page. [25]

A lot of companies do not possess the in-house knowledge or the resources for producing high-quality content for the Web. The in-house resources are commonly supplemented with outsourcing [2] which has become an increasingly common business strategy. In 2014, more than 70 % of the companies that participated in a global survey by KPGM and HfS Research reported that they are planning to increase their reliance on outsourcing over the next two years. Companies are also ever more willing to get advisory services that help them manage their outsourcing engagements better. [11]

1.1 Objectives and research questions

Image production is a common and frequently outsourced task in Web projects, but little to no research has been conducted on the topic. This Master's thesis attempts to bridge this gap by examining how outsourced image production can be managed in the Web project of an international construction company. The research is conducted as an exploratory single-case study that is complemented by a literature review. The research questions are:

RQ 1. How to manage outsourced image production as a part of a Web project?

RQ 2. How to integrate outsourced image content into a website?

RQ 3. How to monitor the quality of outsourced image content that is produced for a website?

The three research questions take slightly different perspectives on the research topic. The first question examines the topic from an overall project management perspective: the management of both the Web project and the image production process as well as orchestrating the two. The second question focuses on image integration: the steps that need to be taken in order to bring the outsourced image content available to the end-users. Finally, the third research question approaches the topic from the quality perspective: the different actions and steps throughout the process that contribute to quality assurance.

The thesis was sponsored by Siili Solutions (Siili), a Finnish IT company. Siili works in close cooperation with the case organization as a Web development and support partner. A development team from Siili was responsible for the technical design and implementations that were done as a part of this case study.

1.2 Structure of this study

This thesis is structured into eight chapters. After the first introductory chapter, chapters two and three focus on gaining familiarity with the two essential concepts of this thesis: outsourcing and image production for the Web. After that, we move on to the actual research: the research methods are introduced in chapter four, and chapter five describes the different phases of the case study. The results of the case study are evaluated in chapter six, the main findings of the research are discussed in chapter seven, and, finally, the conclusions are presented in chapter eight.

Chapter 2

Outsourcing

Outsourcing i.e. *outside resource using* is the practice of obtaining goods or services by contract from an external vendor [38]. The earliest known use of the term dates back to 1979 [37], when an automobile executive described the challenging situation in the British motor industry:

> *We are so short of professional engineers in the motor industry that we are having to outsource design work to Germany.*

This quote is a typical example of outsourcing: an outside resource, in this case German engineers, must be hired to do the work that the organization either cannot or chooses not to do due to some prevailing circumstances. This chapter begins by examining the motivation behind the outsourcing decision. After that, the life cycle of an outsourcing process is described.

2.1 Motivation

According to a global outsourcing survey conducted in 2014 [11], the most important business benefits that organizations expect to achieve include:

1. **Changing the way the organization runs the business**

   Organizations expect vendors to support them in transforming, automating, and standardizing their processes and the way they operate [11].

2. **Significantly lower operating costs**

   One of the most typically cited reasons for outsourcing is to gain lower operating costs. Outsourcing may entail cost savings, because an external vendor can often provide the same service at a lower price than the buying organization could do using the internal resources [3]. Vendors can achieve this kind of cost advantage by specializing in one activity and streamlining all its aspects [4].

3. **Greater flexibility to scale operations**

   Outsourcing may create flexibility, because the organization can increase and decrease its resources based on the changes in the business needs [9].

These are commonly cited motivations throughout the outsourcing literature. Other common motivations include improved quality and performance, focus on core competencies, access to needed skills, increased innovation, and turning fixed costs into variable costs [21, 26, 35].

However, the list of top motivations driving an outsourcing decision varies considerably depending on the survey and the organizations or individuals taking the survey. The results are highly subjective and, thus, it is impossible to gather a definitive and generally applicable list of motivations. [21]

2.2 Outsourcing life cycle

There is no one standard and commonly used model for describing the different stages of the outsourcing process, but several authors have attempted to formalize the process with a life cycle model. This section takes a brief look into three of these models. After that, the different stages of the outsourcing life cycle are introduced in more detail.

Willcocks et al. present a comprehensive, high-level overview of the outsourcing life cycle. This life cycle model groups the different stages of the outsourcing process under four high-level stages: (1) Architect, (2) Engage, (3) Operate, and (4) Regenerate (Figure 2.1). The Architect stage is where the groundwork for outsourcing is done, and it consists of four building blocks: investigate, strategize, target, and design. This is followed by the Engage stage where the vendor is selected and deal is negotiated. The Operate stage puts the deal in place with its two building blocks: transition and manage. Finally, the Regenerate stage involves evaluating the next generation options and starting the outsourcing life cycle anew. [64]

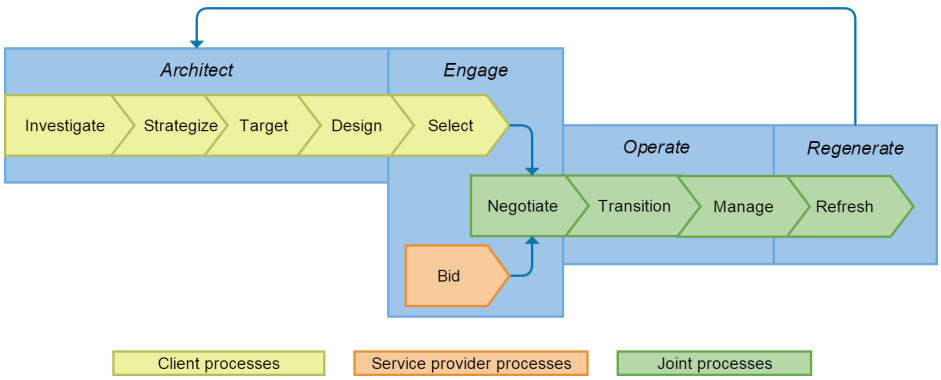

Figure 2.1: Outsourcing life cycle model by Willcocks et al. [64]

Brown and Wilson describe outsourcing as a cyclic process that consists of six stages: (1) Strategy, (2) Scope, (3) Negotiation, (4) Implementation, (5) Management, and (6) Completion or Termination (Figure 2.2). This model is well in-line with the model by Willcocks et al. as it presents all the corresponding stages in a similar order. [5]

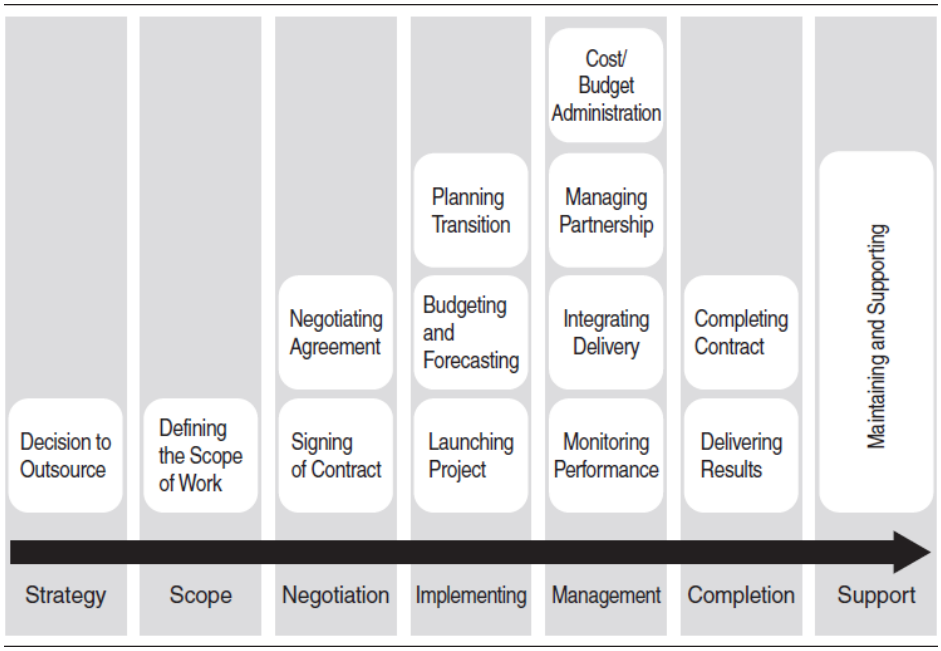

Figure 2.2: Outsourcing life cycle model by Brown and Wilson [5]

Power's [41] life cycle model depicts outsourcing as a continuous process that is gradually improved and sophisticated over time. This process consists of seven stages (Figure 2.3): (1) Strategic assessment, (2) Needs analysis, (3) Vendor assessment, (4) Contract and negotiation management, (5) Project initiation and transition, (6) Relationship management, and (7) Continuance modification or exit strategies. The following sections discuss the different stages of the outsourcing life cycle in more detail. The life cycle is divided into stages based on Power's model.

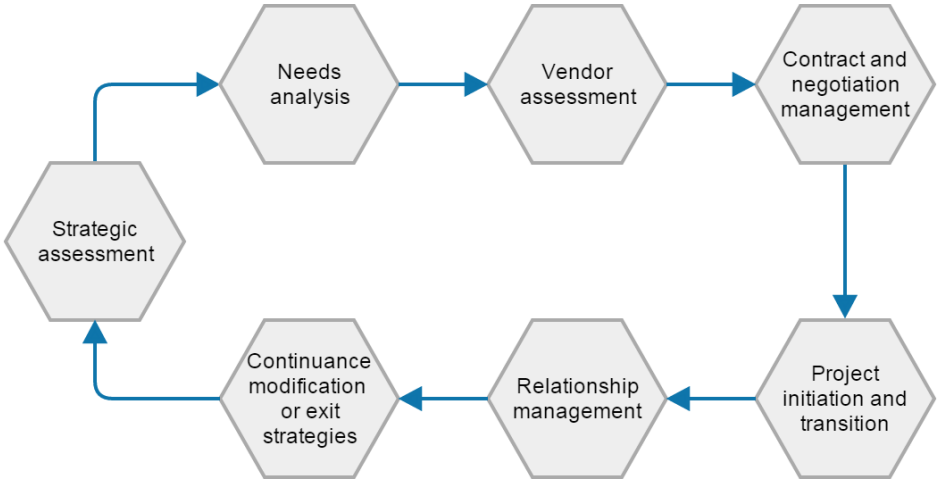

Figure 2.3: Outsourcing life cycle model by Power [41]

2.2.1 Strategic assessment

The first stage of the outsourcing life cycle is strategic assessment. During strategic assessment, the organization determines what it needs in order to utilize outsourcing as a strategic tool and what kind of benefits it expects to achieve as a result. Strategic assessment consists of four steps: business-value assessment, operational assessment, financial assessment, and risk assessment. [41]

Business-value assessment focuses on determining how outsourcing fits into the organization's overall business strategy. First, the organization must analyze its core competencies and identify areas that are suitable for outsourcing. Second, an executive team is set up to oversee the project. Finally, the organization outlines its current business strategy and analyzes how it may change in the future. [41]

Operational assessment focuses on evaluating the organization's process capabilities. This involves mapping the current processes and analyzing their maturity, i.e., how structured they are. The purpose of operational assessment is to uncover weaknesses, limitations, and performance issues in the current processes and set expectations for the future. [41]

Financial assessment focuses on evaluating the costs that will be tied to the processes that the organization is going to outsource. The different types of costs include fixed and variable costs, direct and indirect costs, current and expected future costs, and hidden costs. [41]

Risk assessment focuses on evaluating the risks that are associated with the outsourcing decision. These risks may be related to the operational or financial aspects of the relationship, or the delivered business value. The executive team must gather a list of risks, assign each risk a probability of occurrence, and estimate the costs that incur when the risk materializes. Finally, the organization must determine how much risk it is willing to bear. The information that is gathered through risk assessment may be used to select appropriate strategies for managing and mitigating risks. [41]

2.2.2 Needs analysis

Needs analysis is the process of defining the business needs for one or more outsourcing projects. It is important that vendors do not influence the needs analysis process, because the organization will later use the results of the analysis for evaluating the vendors. [41]

First, the organization must conduct in-depth operational assessment on each process that it plans to outsource. This involves gathering both objective and subjective data about the processes, benchmarking the processes, and comparing the process performance to the industry best practices. [41]

Second, the organization must make strategic choices regarding the outsourcing project. This involves deciding the number of vendors and projects, and the scope of the project. At this point, the organization must also examine whether outsourcing will be the best choice of strategy. [41]

Finally, the organization must define the project requirements in the same manner as in any normal project. The needs analysis should result in two important deliverables: the statement of work (SOW) and the request for proposals (RFP). The SOW specifies the scope of the project, details of the work assignment, and roles and responsibilities of both the organization and the vendor. The RFP which, in turn, specifies the sourcing requirements, ideal vendor, and any process or quality issues. A high-level description of the SOW is also included in the RFP. [41]

2.2.3 Vendor assessment

Vendor assessment is the process of evaluating vendor proposals with the target of finding the right business partner for further negotiation and discussion. [41] Throughout the process, the vendors should be evaluated in terms of their demonstrated competences, overall capabilities, and the relationship dynamics between the two organizations. [9]

First, the organization must prepare for the vendor assessment process by setting up a vendor evaluation team and ensuring that there is a standardized, fair and documented vendor evaluation process in place. Provided that there are a lot of responses to the RFP, the pool of potential vendors may be reduced by applying high-level criteria on them. The criteria defined in the needs analysis may be utilized, at this point. [41]

Second, the organization must evaluate each vendor's capabilities and strengths. This is done by asking questions from the vendor and talking to the vendor's customers. The vendor's customers can share their experiences about the vendor's performance, give insight to the vendor's reputation, and validate that the vendor has provided accurate information. Ideally, the vendor has proven experience of successful outsourcing efforts with customers similar to the organization. [41]

Third, the vendor proposals must be evaluated. At this point, the details of the proposal, such as pricing, should be carefully inspected in order to further narrow down the vendor pool. [41]

Finally, the organization must conduct an in-depth evaluation on the remaining vendors. After this step, the initial collection of vendors has been narrowed down to the candidates who are selected to the negotiation. [41]

2.2.4 Negotiation and contract management

After the vendor assessment is done, it is time to start negotiations with the selected vendor candidates. In order to negotiate well, the organization must have a competent negotiation team and a solid understanding of its own requirements, the vendor, and the marketplace. [41]

The terms of an outsourcing agreement are typically captured in a formal contract that is created between the organization and the vendor [9]. The nature of outsourcing contracts is bound to change as the relationship matures and business conditions evolve. Hence, a good contract should define a flexible working framework for the relationship rather than a rigid set of agreements that attempt to capture all aspects of the relationship. [9, 32]

Prior to signing the contract, the organization must perform a detailed due diligence process to ensure the vendor's capability and competence. The negotiation should strive towards a sustainable relationship rather than the best financial deal. [41] A flexible and reasonable contract that benefits both parties is the basis of any successful and long-term business relationship [9].

2.2.5 Project initiation and transition

Immediately after the outsourcing contract is signed, the organization must start making preparations to put the outsourcing relationship in motion. This stage is called the project initiation and transition. [41]

The purpose of project initiation is to make the outsourcing relationship operational and so stabile that the project can be handed over to the vendor. The initiation process tends to involve some amount of chaos and friction, but this is normal in the beginning of the relationship. Not all the issues that come up can be addressed during the project initiation stage, but it is important to provide temporary solutions to anything that could halt the relationship. [41]

After the project initiation is done, the organization must start training the vendor's employees and transferring knowledge to them. The target of the transition process is that, eventually, the vendor's employees can start conducting the work efficiently and independently. [41]

2.2.6 Relationship management

After the project has been transitioned to the vendor, the outsourcing relationship reaches a stabile stage where the vendor works independently. [41] However, the organization still needs to actively govern, supervise and develop the relationship in order to detect and resolve issues early on [18, 41].

Relationship management differs from the project initiation and transition stage in that it targets at governing the project by routines and automated processes rather than direct human intervention [41]. Relationship management can be divided into five focus areas: work administration, communication management, knowledge management, personnel management, and financial management. [41]

Work administration is the process of ensuring that the work gets done by tracking work assignments, deliverables, resource consumption, and overall progress. Three matters require particularly careful monitoring: the vendor should not be relying too much on the client organization's resources, the quality of deliverables should meet the accepted standards, and the work process should follow the agreed procedures and policies. [41]

Communication management is the process of ensuring that there is continuous information exchange between the organization and the vendor [41]. Regular, goal-oriented meetings between the vendor and the organization form the basis of communication management and serve as an important method of resolving issues. Furthermore, face-to-face meetings may be complemented with a variety of technical tools, such as the Internet, voice mail, teleconferencing, e-mail, discussion groups, instant messaging, and online collaboration tools. [9]

Knowledge management is the principle of sharing ideas, innovations, and best practices with the vendor in order to improve the work processes [41]. Knowledge management involves creating knowledge, storing it for future use, making it available for retrieval, and, finally, making the use of past knowledge a part of the culture [42].

Personnel management focuses on ensuring that the people involved in the outsourcing project are working in concert and have segmented, clearly defined roles and responsibilities. These responsibilities should cover monitoring the following matters: strategic planning and development, day-to-day functions and performance, critical issues, and various aspects of the project, such as quality or financial matters. [41]

Financial management is the process of ensuring that routine and periodic payments to the vendor are handled appropriately. The organization must monitor the budget of the outsourcing project, request for financial information from the vendor, and ensure that the vendor has met the set milestones. [41]

2.2.7 Continuance modification or exit strategies

At the end of the contract period, the organization must evaluate the current outsourcing arrangement and make a decision to either continue, modify, or terminate the relationship. The need for evaluating the state of the relationship may also rise from internal or external events that affect the organization's business either directly or through the vendor. [41]

Internal events include changes to the organization's core competencies, service and product offerings, organizational structure, or stakeholder expectations. External events refer to changes in the environment, such as political turmoil in the country where the vendor operates. Furthermore, there may be changes in the vendor's business. [41]

Finding and acquainting a new vendor is a costly process that may cause disruptions to the work processes and customers. For this reason, it is beneficial to continue the existing relationship given that the vendor delivers at agreed levels and there are no drastic changes in the business or environment. However, even when the organization decides to continue the relationship, it must evaluate whether the current agreement corresponds to its future plans. [41]

Chapter 3

Image production for the Web

This chapter discusses the fundamental choices and decisions that need to be made when image content is produced for the Web. An overview is done on Web-compatible image formats, images on Web pages, and various optimization methods.

3.1 Image formats

Digital images can be roughly categorized into two types:

1. **Raster images** consist of tiny coloured blocks (pixels) that are arranged in a rectangular grid [46]. Raster images are commonly used for storing all kinds of images, but they are particularly powerful with photographic images that have subtle colour changes and tonal differences. Raster images are resolution-dependent, and they cannot be enlarged without quality loss. This is demonstrated in Figure 3.1.

2. **Vector images** are composed of mathematically defined geometrical objects, such as lines, curves and polygons [27]. Vector images suit particularly well for typography, line art and illustrations [17]. Unlike raster images, they can be scaled to any size without quality loss.

A variety of image formats have been designed on these two concepts, but only four of them have gained native support in all the major Web browsers. This standard set of image formats includes three raster-based formats: Graphics Interchange Format (GIF), Joint Photographic Experts Group (JPEG) and Portable Network Graphics (PNG). In addition, one vector-based format, Scalable Vector Graphics (SVG), has got standard browser support. [13, 62]

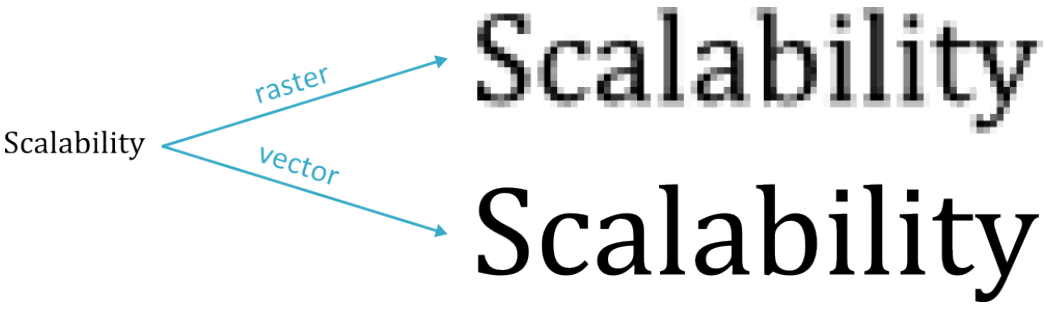

Figure 3.1: Raster and vector image enlarged by 400 percent

3.1.1 GIF

GIF is a lossless image format that was developed to transfer colour images efficiently between computers [50]. It is an appropriate format for storing graphical images that have large areas of flat, solid colour, such as logos, icons and charts [44]. In addition, it supports animation and the fully transparent colour. It is not ideal for photographic images, however, because the GIF format was designed to store a limited 256 colours. [54]

GIF was the first graphic file type that the early Web browsers were able to display and, as such, it is supported by virtually all graphical browsers [34, 44]. Nevertheless, it is gradually being replaced with another lossless image format, PNG, which has been the official W3C recommendation since 1996 [68]. PNG outperforms GIF in most aspects [40], but GIF still remains the only available option for animated images [44].

3.1.2 JPEG

JPEG is a lossy compression method that targets at minimizing file sizes by discarding information that the human eye does not perceive [54]. The JPEG format is ideal for storing complex photographic images, because it supports millions of colours and can obtain high compression ratios with good quality for any kind of continuous-tone images [50]. It is not adequate for graphics, however, because the lossy compression tends to leave artifacts in images that have sharp edges, typography or large areas of solid colours [44].

Along with GIF, JPEG was one of the first image formats supported by the early Web browsers [28], and it has gained the status of the de facto standard for storing photographic images on the Web [54]. In some cases, however, photographic images must be stored as GIF or PNG, because the JPEG format does not support animation or transparency [28].

3.1.3 PNG

PNG is a lossless compression method that was developed specifically for Web use [34] with the purpose of addressing the shortcomings of GIF [54]. Apart from animation support, the PNG format offers all the same features as GIF [44], but it also supports variable transparency and compresses images more efficiently. Furthermore, the PNG format is capable of storing photographic images in a losslessly compressed truecolor format [54].

Nowadays, PNG is very well supported by all major browsers [28] and, in most cases, it is the recommended substitute to GIF. However, PNG should not be used as a common substitute to JPEG [44], unless the image requires transparency or artifacts are unacceptable [54]. This is because losslessly compressed photographic images tend to have larger file sizes than the equivalent lossy files [44].

3.1.4 SVG

SVG is a vector image format that uses XML to describe mathematical instructions for drawing the image [14]. Like all vector formats, SVG is suitable for graphical images but not for photographic images. The instruction-based XML format makes SVG images easily editable and scalable without quality loss. [23, 45] In addition, SVG supports millions of colours, variable transparency, and animation [63].

SVG support in Web browsers is not yet complete, but the basic functionality is already available in all major browsers. It is not supported at all by some of the old browsers, including Android Browser 2.x series and Internet Explorer 8 or lower [6]. Nevertheless, SVG is a reasonable vector-based alternative for displaying graphical images. One promising use-case is responsive Web design where SVG's resolution-independent nature removes the need to have separate images for different resolutions [39]. The differences between the four image formats are summarized in Table 3.1.

3.2 Images on Web pages

The two core technologies of the Web are Hypertext Markup Language (HTML) and Cascading Style Sheets (CSS). HTML is a markup language that describes the Web page content and structure. CSS, in turn, is a style sheet language that describes the Web page layout and presentation. [65] These two languages provide several standard methods for including images on Web pages:

	JPEG	GIF	PNG	SVG
Type	raster	raster	raster	vector
Compression	lossy	lossless	lossless	none
Colour resolution	16.7M	256	16.7M	16.7M
Useful for photos	yes	no	yes	no
Useful for graphics	no	yes	yes	yes
Animation support	no	yes	no	yes
Transparency support	no	yes	yes	yes
Old browser support	yes	yes	yes	no

Table 3.1: Comparison of Web image formats

1. The HTML `a` element can be used for creating a link that opens a standalone image on an external page [62]. This method is suitable for including, for instance, images that are intentionally stored in nonstandard formats or very large resolutions. The Uniform Resource Locator (URL) of the image is specified using the `href` attribute [66]. In the following example, a link to an image called `example.jpg` is added:

```
<a href="example.jpg">Link to an example image</a>
```

2. The HTML `img` element is used for embedding images within the page together with other content [62]. This method is the most common way to include inline image content on Web pages. The `img` element has two important attributes: `src` and `alt`. The `src` attribute defines the URL of the image resource, and the `alt` attribute defines a textual description that is displayed when the image is not available. [66] In the following example, an inline image called `example.jpg` is added:

```
<img src="example.jpg" alt="This is an example image" />
```

3. The HTML `map` element, together with an `img` element and any descendant `area` elements, is used to define an image map. The image map is an image that contains several geometrically defined, clickable areas that are links. [62, 66] This method is commonly used for including image-based navigations on Web pages. In the following example, an image map is created with four clickable and differently-shaped areas:

```
<img src="example.jpg" usemap="#examples" alt="Example image map" />

<map name="examples">
   <area shape="rect" coords="0,0,100,150" href="rect.html"
      alt="Rectangle" />
    <area shape="poly" coords="0,0,10,32,98,200" href="poly.html"
       alt="Polygon" />
    <area shape="circle" coords="0,0,100" href="circle.html"
       alt="Circle" />
    <area shape="default" href="default.html" alt="Rest of image" />
</map>
```

4. The CSS `background-image` property is used for placing an image as the background of an HTML element [12]. This method should primarily be used for decorative background images and not for any essential image content [48]. In the following example, a background image is set for the HTML `body` element:

```
body
{
   background-image: url(example.jpg);
}
```

5. The HTML `object` element can be used for including SVG images that need fallback behavior when the browser does not support SVG. The `object` element requires two attributes: `data` for the image URL and `type` for a valid Internet media type. [14] In the following example, an SVG image is included with a fallback to PNG image:

```
<object type="image/svg+xml" data="example.svg">
  <img src="fallback-image.png" alt="Fallback image" />
</object>
```

6. The HTML `svg` element is used for including inline SVG images by inserting SVG markup directly in the Web page [62]. An inline SVG image can be styled with CSS [14] and scripted with JavaScript [62]. In the following example, inline SVG is used for displaying a blue circle:

```
<svg height="100" width="100">
   <circle cx="50" cy="50" r="25" stroke="black" stroke-width="1"
      fill="blue" />
</svg>
```

7. The HTML `canvas` element is used for including a two-dimensional area on the screen for the purpose of rendering 2D shapes and raster images dynamically with JavaScript [16]. The major use cases of this method are different kinds of games and photo manipulation [51]. In the following example, a simple JPEG image is rendered on the `canvas`:

```
<canvas id="exampleCanvas" width="400" height="400">
</canvas>

<script>
   window.onload = function() {
      var canvas = document.getElementById("exampleCanvas");
      var ctx = canvas.getContext("2d");
      var img = new Image();
      img.src = "example_image.jpg";
      ctx.drawImage(img, 0, 0);
   }
</script>
```

The previously discussed methods are not the only ways to include images on Web pages, but they are commonly used and well-supported by the major browsers. For instance, SVG images can also be included using the `iframe` or `embed` elements, but these methods cannot be recommended due to unreliable browser and device support [1, 31].

3.3 Image optimization

Image optimization can be approached either from the perspective of accessibility, Search Engine Optimization (SEO), or performance optimization. These three optimization methods are driven by distinct motivations, but they share a common goal of improving the availability of the Web content.

3.3.1 Accessibility optimization

Accessibility optimization is the principle of designing website content and functionality to be available for anyone regardless of any physical, sensory, or cognitive disabilities [10, 52]. Accessible Web design is particularly beneficial for people with disabilities, but, at the same time, it makes the Web more available for everybody [49].

The use of images is a major accessibility issue for visually impaired users, such as the blind or people with low vision [55]. Images are a visual medium that conveys information, but this information may be lost if the user is browsing the Web using assistive technology, such as a screen reader [10].

The de facto standard of accessible Web development is known as the Web Content Accessibility Guidelines (WCAG) 2.0 [55]. The WCAG 2.0 standard consists of 12 guidelines that are structured under four principles: perceivable, operable, understandable, and robust [69]. Based on these guidelines, the most important aspects of accessible image design include:

1. WCAG 2.0, Guideline 1.1 Text alternatives:

   > *Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language.* [69]

   This guideline concerns every image that conveys meaningful information to the user. As a basic principle, a brief description of the image or its purpose should *always* be included using the `alt` attribute and, if there is a need for a longer description, it can be added using the `longdesc` attribute. The text alternatives should convey the same information as the visual image. The only exception is the purely decorative images which should have empty `alt` text. [70]

   Another special case is inline SVG that has its own syntax and cannot utilize the `alt` attribute. However, a text alternative can be added by including `title` element within the SVG image and referring to it with the `aria-labelledby` attribute [70]:

   ```
   <svg aria-labelledby="alt-text">
     <title id="alt-text">Example text alternative</title>
      [other svg code]
   </svg>
   ```

2. WCAG 2.0, Guideline 1.4 Distinguishable:

   > *Make it easier for users to see and hear content including separating foreground from background.* [69]

   This guideline concerns images of text. In general, text should be used rather than images of text, if the same visual presentation is possible to be achieved with the technologies being used. There are two exceptions two this rule: cases where the image of text can be visually customized to the user's requirements and cases where a particular presentation of text is essential to convey the information. [69]

Images of text should have a contrast ratio of at least 4.5:1, or for large-scale text at least 3:1. However, the minimum contrast requirement does not concern images where the text is purely decorative or a part of a logo or brand name. [69]

3. WCAG 2.0, Guideline 2.3 Seizures:

   > *Do not design content in a way that is known to cause seizures.* [69]

   This guideline concerns animated, flashing images that may trigger a seizure in people with epilepsy. Based on the general flash and red flash thresholds, an image should not flash more than three times in any one second period [69].

3.3.2 Search Engine Optimization

Search Engine Optimization (SEO) is the practice of improving the availability of website content from the search engines' perspective with the goal of enhancing website ranking and attracting more visitors. [15] Search engines use automated software programs, *Web crawlers*, to traverse the Web and collect information for indexing Web pages and files [29, 33]. Based on the collected and analyzed data, search engines determine a ranking for each search result when a user enters a search query [15].

Images are non-textual content that is basically ignored by Web crawlers [33]. Web crawlers are able to detect the presence of an image, but they have a limited ability to understand and analyze its actual visual content [15]. For this reason, search engines are obliged to look for any textual clues that are somehow connected to the image in order to determine its relevancy. The most important aspects of SEO friendly image optimization include:

1. **Relevant file names**

   Search engines look for keywords in the image file names. A good file name is short and describes the content of the image [15, 20]. Words should be separated by hyphens or periods rather than underscores, because the underscore is interpreted as a separate character by the search engines [7].

2. **Text alternatives**

   Another place where search engines look for keywords is the `alt` attribute of the HTML `img` element. A good `alt` text is a brief, keyword-focused description of the content of the image. Images that are also links should have keywords relevant to the target page. [15, 20] However, any SEO optimization for the `alt` text should be done understanding that its primary purpose is to ensure accessibility for humans [47].

3. **Anchor texts**

   Images that are included on the page with links should have relevant keywords in the link anchor text. Anchor text is one of the most important factors that search engines use for ranking the search results [33].

4. **Nearby textual content**

   Search engines utilize any textual content that is placed nearby images or anchor texts to further analyze the relevancy of an image [7]. The website gets more credibility in the search engine logic if the surrounding text includes the same keywords as the image [33].

It is important to select the keywords carefully, because they have a considerable role in determining the ranking in search results [33]. However, too many keywords or repeated use of the same keyword may be considered as spam and result in lower ranking [59].

3.3.3 Performance optimization

Performance optimization is the practice of improving website speed by optimizing its content and servers for the fastest possible delivery [30]. The website speed has a major impact on user experience, and fast websites tend to lead to better user engagement and higher conversions [22, 54].

Image content is one of the most beneficial targets of optimization [54]. Optimizing images for the ideal performance is basically a matter of reducing the image file sizes. The most important methods include:

1. **Dimensions**

   The physical dimensions of an image is one of the most important factors affecting the file size [34]. To avoid transferring unnecessarily large files, it is important to resize the image to its intended dimensions before it is served to the client [54].

2. **Image format**

   The choice of image format has a significant impact on the image file size, because the different image formats are designed for different purposes [22]. As a general rule, JPEG should be used for photographic images, GIF for animations, and PNG for everything else [54].

3. **Parameter optimization**

   Specialized image optimization tools provide additional compression to different types of images. The compression is done based on a set of optimization parameters that can be experimented with in order to find the optimal combination of quality and file size. [19, 23, 53]

4. **Metadata**

   Raster images may contain unnecessary metadata, such as camera settings or geographical location. Stripping this data reduces the file size. [19]

5. **Alternative technologies**

   In some cases, the most efficient option is to not use images at all. Alternative technologies, such as CSS effects and Web fonts, are often capable of producing the desired results in a fraction of the bytes required by an image file. [19]

The above performance optimization methods concern raster formats and are not applicable to SVG, because its file size is based on image complexity rather than pixels [53]. SVG optimization targets at reducing the image complexity by stripping unnecessary metadata. In addition, SVG code can be minified and compressed to reduce the transfer size. [19]

Chapter 4

Research methodology

This chapter discusses the methodological choices of this study and the related decision-making process. The chapter begins with an introduction to the two central research methods of this study: exploratory single-case study approach and literature review. After that, the data collection methods are examined in in detail.

4.1 Exploratory single-case study

This study was conducted as an exploratory single-case study. The exploratory research strategy aims at finding out what is happening, seeking new insights, and generating ideas and hypotheses for new research [24]. This was a natural approach, because existing research regarding outsourced image production and its effects on Web projects is extremely limited. Definitive research questions could not be formulated before the data collection was started and, thus, the focus was directed towards gaining general familiarity with the topic.

4.2 Literature review

Literature review was conducted after the case study project was launched, interviews collected, and technical data gathered. The purpose of the literature review was to identify the current state-of-the-art best practices in the two subject areas of the study: outsourcing and image production for the Web. This information was used as a part of the case study evaluation in order to get further insight into the successes and failures of the project.

4.3 Data collection

Data collection was done in the form of research interviews, Web server logs, and image importer logs. Moreover, information about the technical qualities of images was gathered for further inspection.

4.3.1 Research interviews

As a part of the case study, a total of six semi-structured interviews were conducted. The interviewees were selected from the people who participated in the case study project in different roles: three case organization representatives, two Web development team representatives, and one design agency representative.

Three different question sets were prepared for gathering information from three different perspectives: business, technical implementation, and image production. The first question set (Appendix A) consists of business-oriented questions that were discussed with the case organization representatives. The second question set (Appendix B) includes technical questions, and it was aimed at the development team that was responsible for the technical implementation of the case project. The third question set (Appendix C) was prepared for the design agency that produced the image content.

The question sets were used as the basic structure for the interviews, but the actual interviews covered also follow-up questions and discussion. Three of the interviews were conducted by e-mail, because the interviewer was located in Finland whereas the interviewees were located in Lithuania. The rest of the interviews were conducted face-to-face, audio recorded, and transcribed into an *intelligent verbatim* format for further analysis.

4.3.2 Web server logs

Web server logs were collected of all the Hypertext Transfer Protocol (HTTP) transactions occurring on the case organization's website during a one month period after the case project was launched. The Web server used was Internet Information Services (IIS) which logs data using the W3C Extended Log File Format. The purpose of collecting the log files was to later analyze the HTTP Requests and Responses and detect any errors with retrieving the image content.

The log files were analyzed by filtering transactions by the directory path where the outsourced image content was stored in the file system. After that, the data was transferred into the Excel format. The number of occurrences of unique status codes were then calculated with Excel.

4.3.3 Image importer logs

Image importer, which was built as a part of the case study project, uses the Apache log4net library to log the successful and failed attempts to upload images. Importer tool logs were collected for a one month period after the pilot project was launched. The purpose of collecting the log files was to analyze the usability of the importer, and the human errors that occur when creating image packages against the specification.

The log files contain detailed information about the entire import process, including the user information, date and time, informative messages about each step of the import process, and, finally, a success or error message. The log files were analyzed by manually examining the user behavior and the success and error messages.

4.3.4 Technical qualities of images

Technical qualities of images were examined by collecting various data about the images produced for the case project. The data collection was done in three steps:

1. The vendor-produced image files were manually examined and data was gathered about the image naming conventions, dimensions, file formats and file sizes.

2. The HTML and CSS of the case project was examined with Google Chrome Developer Tools and data was gathered about the text alternatives and the different methods that are used for including each image on the website.

3. Data was gathered about the current performance of images by examining how stripping metadata and applying file format specific optimizations affect the image file sizes. The JPEG images were compressed with TinyJPG [60] and PNG images with TinyPNG [61] compression method.

Chapter 5

Case study

This chapter describes a case study about a real-world Web project carrying the name Visual Navigation. First, the background of the project is explained, then we have a look at the image production workflow, and finally, the image integration process is described.

5.1 Background

This section introduces the case organization and the project concept. After that, the project team structure and Web platform are discussed.

5.1.1 Company introduction

The case organization is an international construction company that employs about 6,000 people in seven different countries. The organization offers a wide range of construction services, including housing, business premises, infrastructure, and entire areas. The case organization is divided into several business units that operate in different countries.

The case organization's Web presence consists of 23 websites, 16 of which are focused on showcasing the products, i.e., apartments that are for sale in different countries. The content on each website is managed by a local business unit that is operating in that country.

During the past few years, the case organization has been standardizing their local websites by moving them on a common Web platform. The common platform brings numerous advantages in terms of centralized development and management; however, some of the existing functionality from the old websites was lost in the standardization process. As a result, some of the business units started to express discontent towards the new platform, because their business needs were not met anymore.

The Central Eastern European (CEE) business units were particularly concerned about the fact that the new Web platform was primarily serving the needs of large business units that have very different business needs compared to the smaller units. For instance, having a diverse search functionality is vital for the large business units, but completely irrelevant for the CEE units that only have a few areas, buildings, and apartments to showcase on their websites. Instead, it is much more important for the small units to invest in the browsing experience and the visual presentation of apartments. The CEE business units urgently needed to get the lost functionality back.

This was the starting point of the Visual Navigation project. The project had two different business goals: short-term and long-term. The short-term goal was to restore the positive attitude towards the new Web platform by quickly developing the much-needed functionality. The long-term goal was to create a set of tools and processes that can later be extended for the needs of any other business unit. In the scope of this case study, the functionality was piloted with the Lithuanian business unit. The existing concept was taken, revised, and adapted specifically for their needs.

5.1.2 Concept

The case organization had a strategic and visionary goal that can be described with the phrase *celebrate the product*. The *product*, in this context, refers not only to the apartment itself, but also to the building that has been built and the area where it has been built. The purpose of the Visual Navigation project was to give the website visitors, i.e., potential customers the possibility to visually explore the entire product as a package of the living area, building, and apartment.

The Visual Navigation concept is based on four different views: area, building, floor, and apartment (Figure 5.1), each visualizing the corresponding part of the product. Each view is an image map containing clickable areas through which the user can navigate deeper in the product.

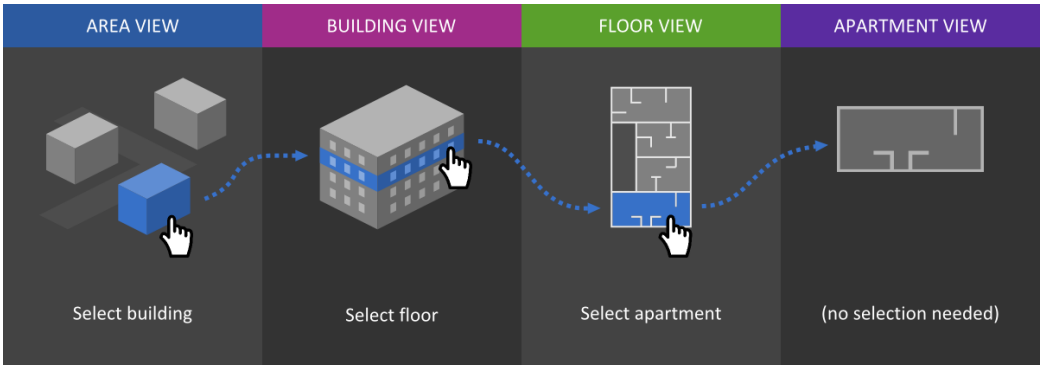

Figure 5.1: The concept of Visual Navigation

The navigation between the different views begins from the area view. The area view is an illustration of an area with several clickable buildings that take the user to the building view. Correspondingly, the building view is an illustration of the building facade with clickable floors that take the user to the floor view, and the floor view is a floor plan of that floor with clickable apartments that take the user to the apartment view. Finally, the apartment view is the last step in the navigation chain, and it presents the floor plan of the apartment. Each view also contains textual information that is relevant to that view.

5.1.3 Team structure

The Visual Navigation project was done as a joint effort of three different organizations: the case organization, Web development partner, and design agency (Figure 5.2). The case organization was the customer of the project and, thus, responsible for defining the business requirements and orchestrating the work among the vendors.

The project can be divided into two concurrently progressing tracks: development and image production. The development track focused on implementing the required functionality on the case organization's Web platform. The image production track, in turn, aimed at producing the required image content for one Lithuanian area that was used for piloting the functionality.

The development work was done in Finland by the case organization's Web development partner. Their contact person in the case organization was the project's proxy product owner who coordinated the work in Finland and handled the communication with the image production track.

The image production work was done in Lithuania by a local design agency. Their contact person in the case organization was the project's business owner who coordinated the work in Lithuania and handled the communication with the development track.

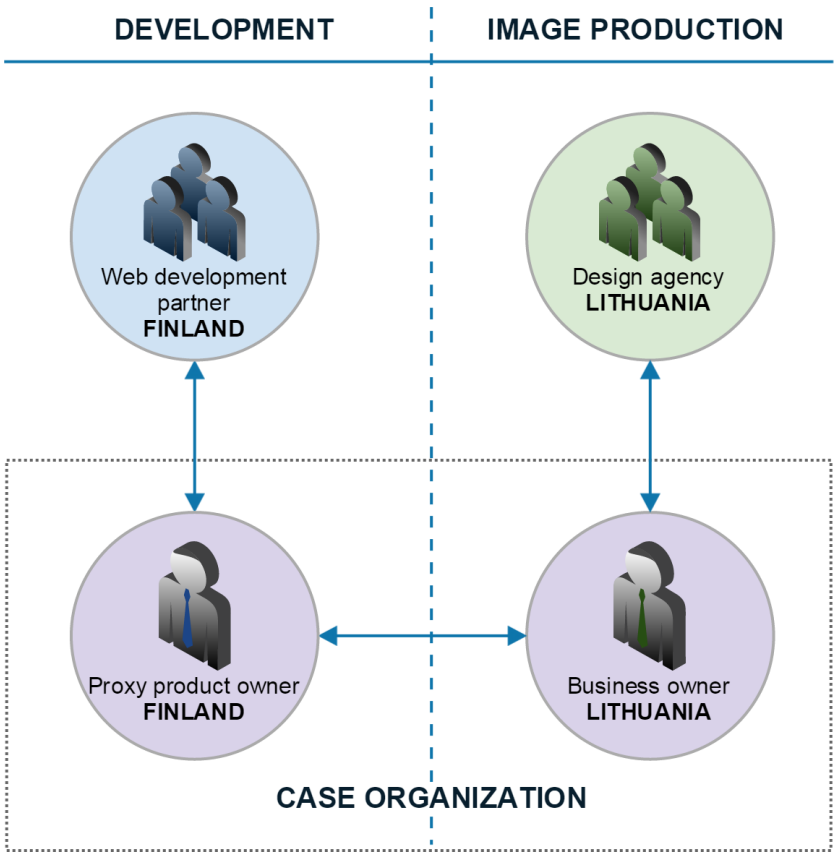

Figure 5.2: Team structure

5.1.4 Web platform

The case organization's websites are built on Sitefinity Web Content Management System (Sitefinity). Sitefinity is an ASP.NET based content management and customer analytics platform that uses widgets as the basic building blocks for Web pages. Widgets are drag-and-drop controls that can be arranged on Web pages in order to display content to the end-users. [56, 57]

Content may be managed in Sitefinity by using either built-in or custom content types [58]. In the case organization's websites, information about areas, buildings, floors, and apartments is presented with two different content types:

1. **Housing estate project**

   Housing estate project is a content type that is used to present data for one or more buildings that belong to that housing estate.

2. **Apartment**

   Apartment represents an apartment that belongs to a specific housing estate. An apartment is always connected to some housing estate project.

From the technical perspective, an *area* and *floor* are merely abstract concepts that do not have their own content types. However, the area name can be configured in the housing estate project data, and the floor number can be configured in the apartment data.

5.2 Image production workflow

Constructing new areas, buildings, and apartments is a regular process in the case organization. Therefore, updating the websites with the most recent information about these housing estate projects is a regular operation as well. In the scope of this case study, images were produced only for one Lithuanian area, but the image production work does not end there. As new areas are built, new images will be needed.

The navigation functionality is very heavily based on images. In addition to the illustrative images and floor plans, overlay images are needed to highlight the clickable areas. Theoretically, the simplest possible area would have only one single-floor building that has one apartment. Yet, even for this minimal case, nine image files are required (Figure 5.3).

In reality, areas have several buildings with several floors and several apartments in each floor. The number of required images grows quickly and geometrically, and it cannot be controlled without a properly designed workflow.

This section discusses the workflow, tools, and specifications that were designed and implemented for controlling the image production workflow. The section begins with an overview of the workflow. After that, the image content specification, image package creation, and importer tool are introduced in more detail.

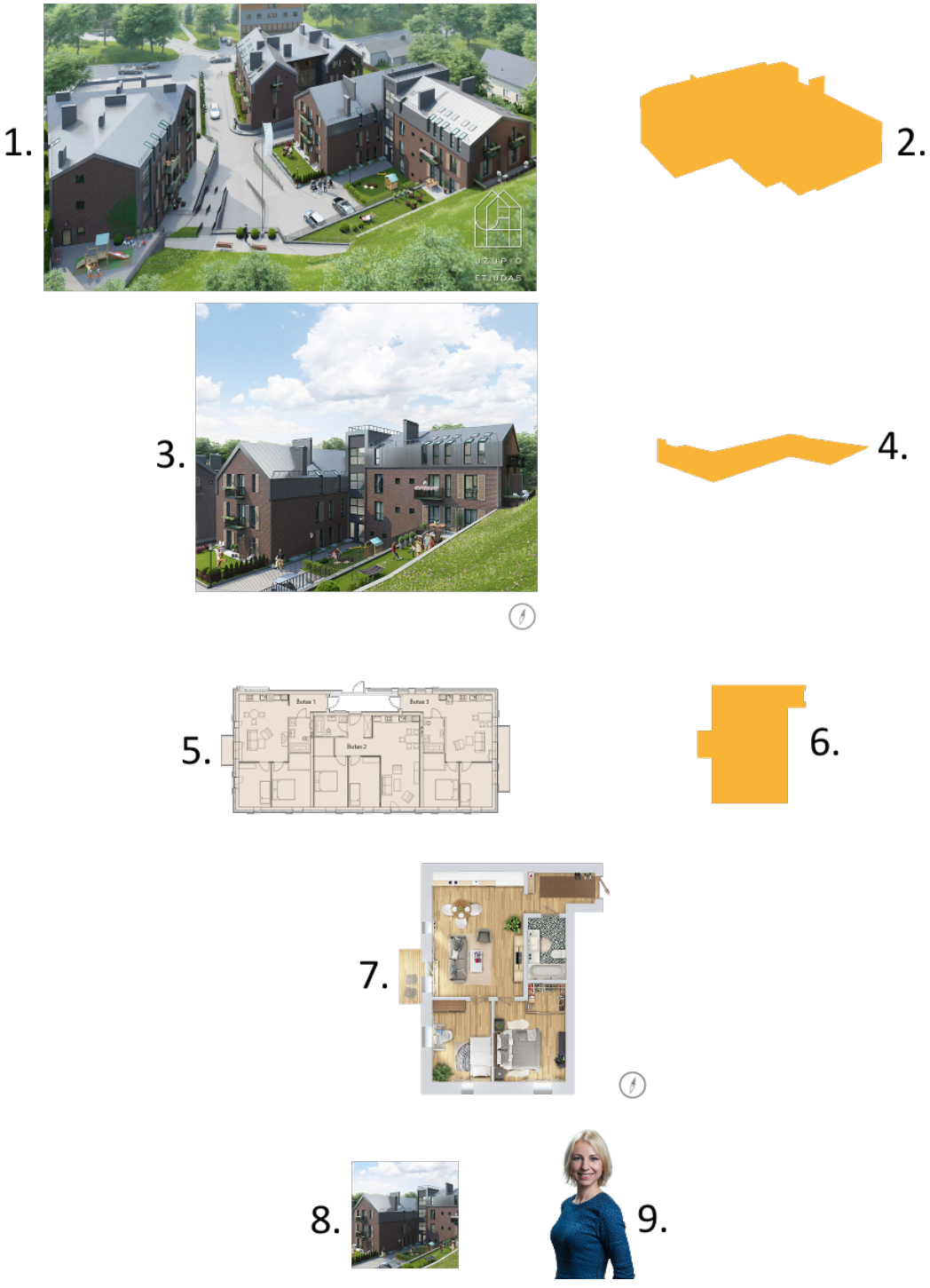

Figure 5.3: The nine different types of Visual Navigation images: (1) Area image, (2) Building overlay, (3) Building image, (4) Floor overlay, (5) Floor image, (6) Apartment overlay, (7) Apartment image, (8) Building icon and (9) Contact image.

5.2.1 Overview

The image production workflow involves the case company, design agency, architect office, and importer tool. The workflow, as illustrated in Figure 5.4, consists of the following steps:

1. **Case organization prepares the XML files**

   The case organization prepares an XML file (see Section 5.2.3) for each housing estate project in the area.

2. **Case organization contacts a local design agency**

   The case organization contacts a local design agency and requests them to produce images for each housing estate project in the area. At the same time, the case organization delivers the XML files and the image content specification (see Section 5.2.2) to the design agency.

3. **Design agency contacts the architect office**

   The design agency contacts the architect office that is responsible for the architectural design of the area and its buildings. The design agency requests for the original architectural visualizations and floor plans.

4. **Architect office delivers the source materials**

   The architect office delivers the original architectural visualizations to the design agency. This source material may consist of, for example, Computer-Aided Design (CAD) files or already rendered image files.

5. **Design agency produces images**

   The design agency uses the architectural visualizations as the source material and creates a set of images according to the image production instructions. This may involve exporting images from a CAD software and cropping, resizing, renaming, or otherwise editing them. Furthermore, the overlay images must be created from scratch.

6. **Design agency creates and delivers ZIP files**

   The design agency generates a ZIP file (see Section 5.2.3) for each housing estate project. Each ZIP file contains an XML file and a set of appropriately named images in an appropriate file structure. The design agency delivers the ZIP files to the case organization.

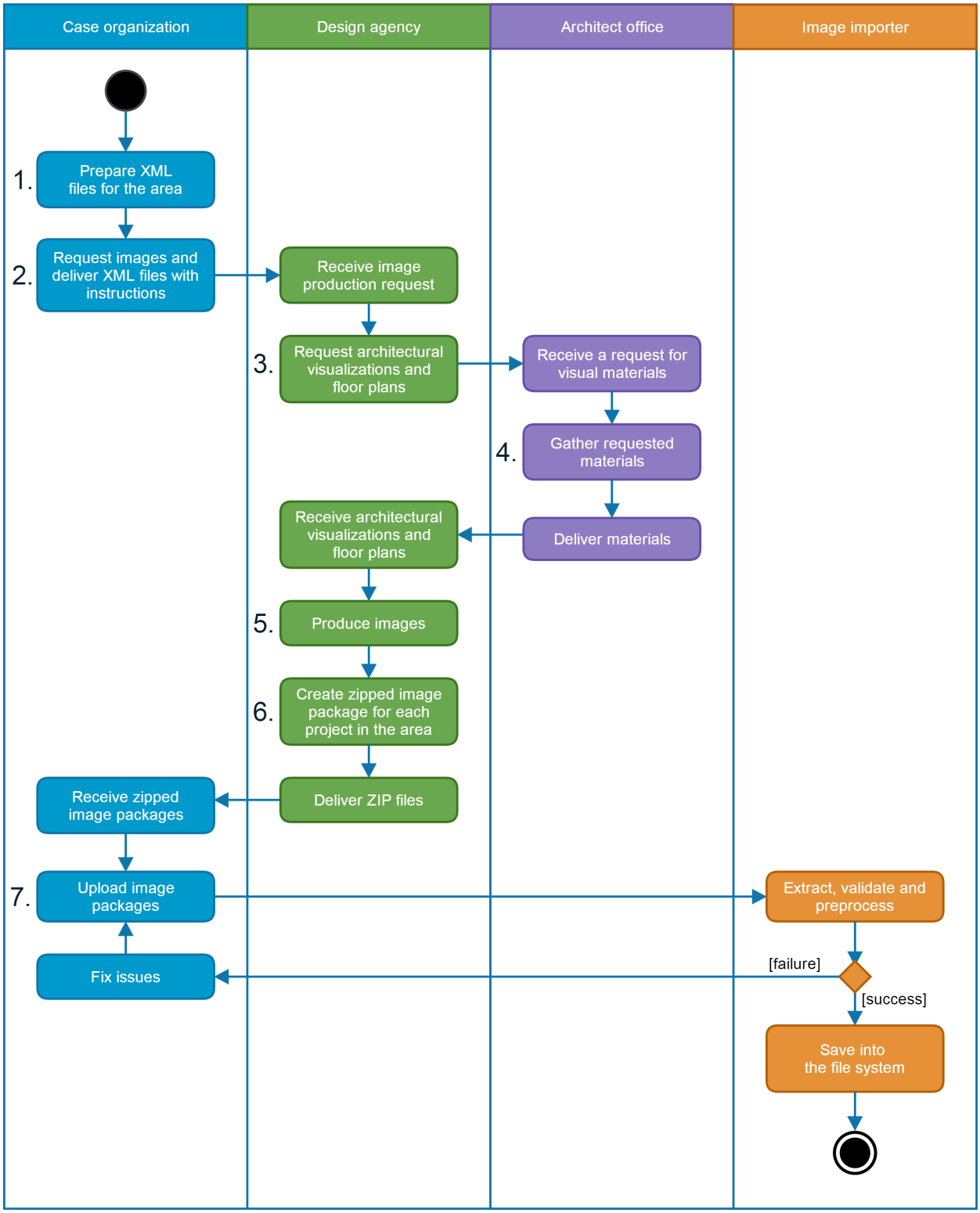

Figure 5.4: Image production workflow

7. **Case organization uploads ZIP files**

   The case organization uploads the ZIP files using the image importer tool (see Section 5.2.4). If the upload fails, the case organization takes the necessary actions and repeats the step until the upload succeeds and the data is saved into the file system.

5.2.2 Image content specification

Image content specification is a PDF file containing instructions for producing different types of Visual Navigation images. The specification was created for the design agencies as a detailed guideline that defines the expected dimensions, file formats, naming conventions, and visual content of images.

The most important part of the specification is the creation of overlay images. The overlay images are produced as raster images, but when the images are uploaded to the case organization's system, they are run through an image recognition service that translates them into image map coordinates. It is essential that the overlay images are produced strictly against the specification, because the coordinate generation may fail with improperly created images.

The specification defines three important factors that must be taken into account when creating overlay images (Figure 5.5). First, the highlighted area must be presented on a transparent background with a single color that is not black. This is because the image recognition service uses the black color to denote the transparent color. Second, the image must have at least two pixels of empty space on each edge, because the image recognition service cannot correctly detect coordinates for areas that touch the edges of the image. Finally, the overlay image must have the same dimensions as the main image.

5.2.3 Image package creation

Image package creation is the process of organizing images into an appropriate file structure and compressing them to ZIP files that can be uploaded to the case organization's Web system. Each ZIP file must contain a full set of images for one housing estate project, its buildings, floors, and apartments. Moreover, each package must contain an XML file that maps each image file to the corresponding building, floor, and apartment. The XML file (Code snippet 5.1) has three functions:

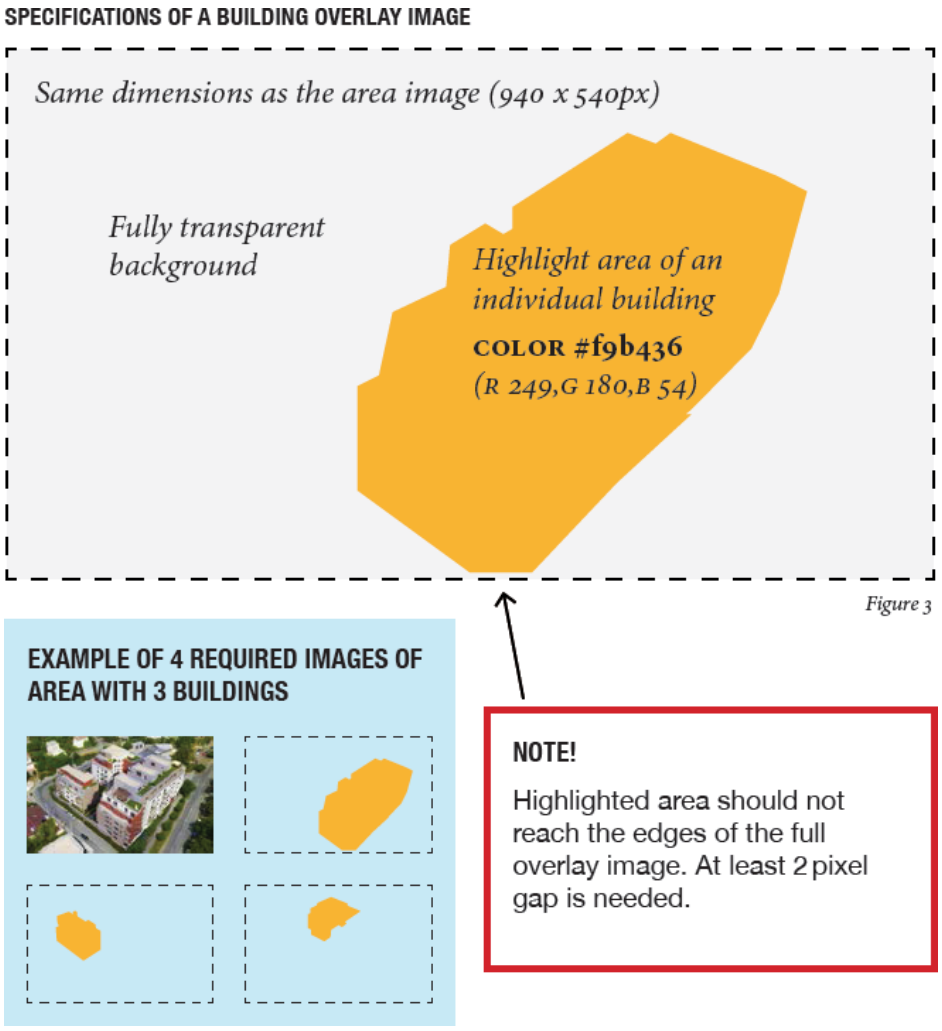

Figure 5.5: Instructions for creating building overlay images, as presented in the image content specification PDF

1. It connects a set of images to a specific housing estate project or apartment in the database with a unique identifier.
2. It gives a machine-readable meaning to each image file.
3. It may be used for including other information that does not exist in the database but is needed by the navigation functionality.

5.2.4 Image importer

Image importer is a tool that was developed for uploading images to the case organization's system. The importer not only saves the images into the file system but also validates and preprocesses them. The importer was designed to give feedback about each step of the upload process in order to help the user to understand what has to be fixed if the upload fails. A successful and a failed upload are shown in Figure 5.6.

The import process is illustrated in Figure 5.7. First of all, the importer verifies that the file being uploaded is in the ZIP format. If so, the importer extracts the ZIP file and validates its contents based on a set of validation rules. After that, the overlay images are sent to an image recognition service that generates coordinates for the highlight areas. These coordinates are then added in the XML file. Finally, the image package is saved into the file system. If any errors are encountered while extracting, validating, preprocessing or saving the image package, all the extracted data is deleted.

```
<?xml version="1.0" encoding="utf-16"?>
<Project CRMId="1-ABCDEF">
   <Image Uri="zip:1-abcdef.area.jpg" />

   <Contacts>
   <Contact>
      <Name>Contact Person</Name>
      <PhoneNumber>+358501234567</PhoneNumber>
      <Email>contact.person@company.com</Email>
      <Image Uri="zip:1-abcdef.contact.jpg" />
   </Contact>
   </Contacts>

   <Buildings>
   <Building>
      <Overlay Uri="zip:1-abcdef.overlay.png" />
      <Image Uri="zip:1-abcdef.jpg" />
      <Icon Uri="zip:1-abcdef.icon.jpg" />

      <Floors>
      <Floor FloorNumber="1">
         <Overlay Uri="zip:floors/1/1-abcdef.1.overlay.png" />
         <Image Uri="zip:floors/1/1-abcdef.1.floorplan.png" />

         <Apartments>
         <Apartment CRMId="1-GHIJKL">
            <Overlay Uri="zip:1-abcdef.1-ghijkl.overlay.png" />
         </Apartment>
         </Apartments>
      </Floor>
      </Floors>
   </Building>
   </Buildings>
</Project>
```

Code snippet 5.1: The simplest possible, valid XML

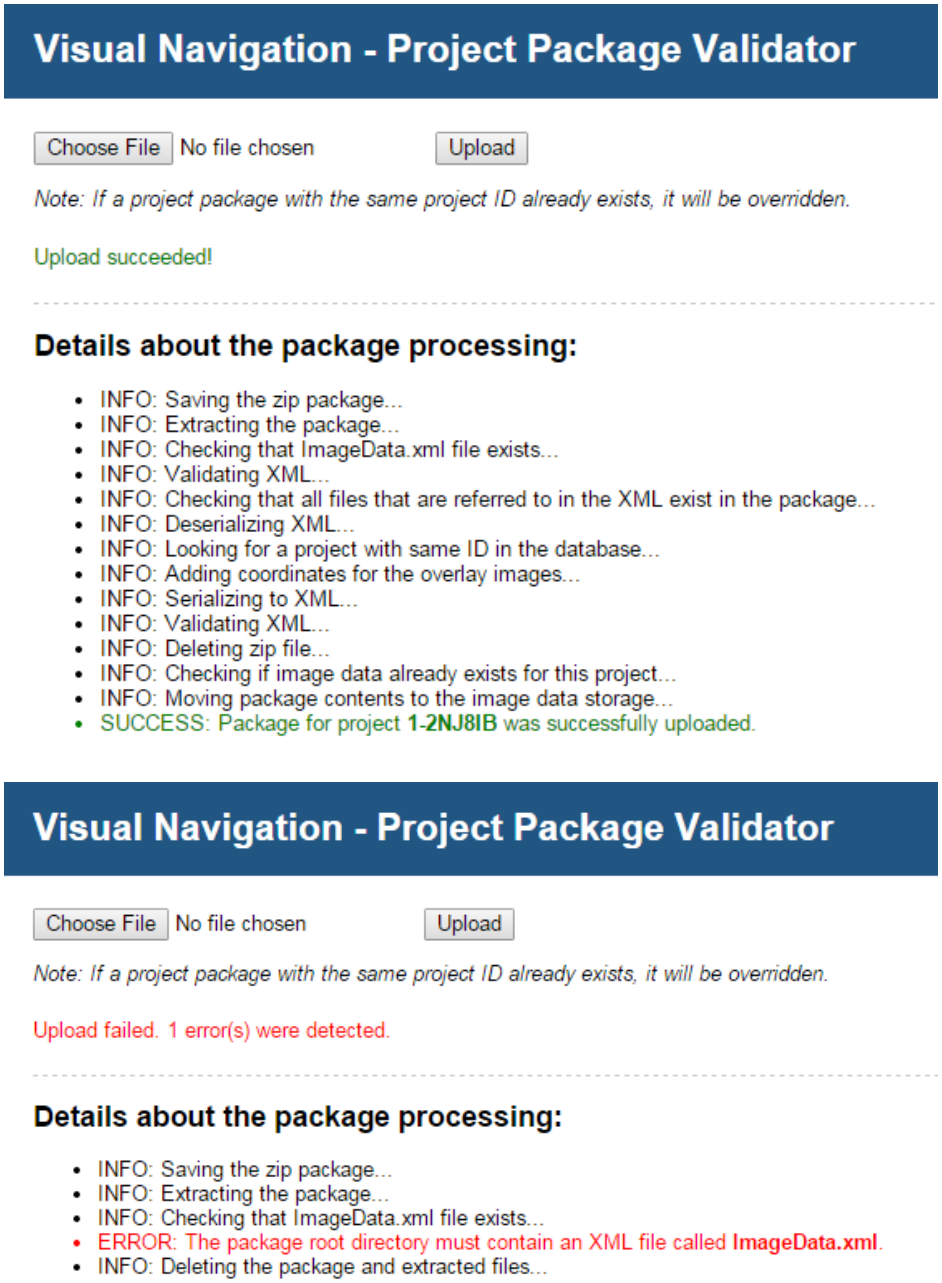

Figure 5.6: Successful and failed import

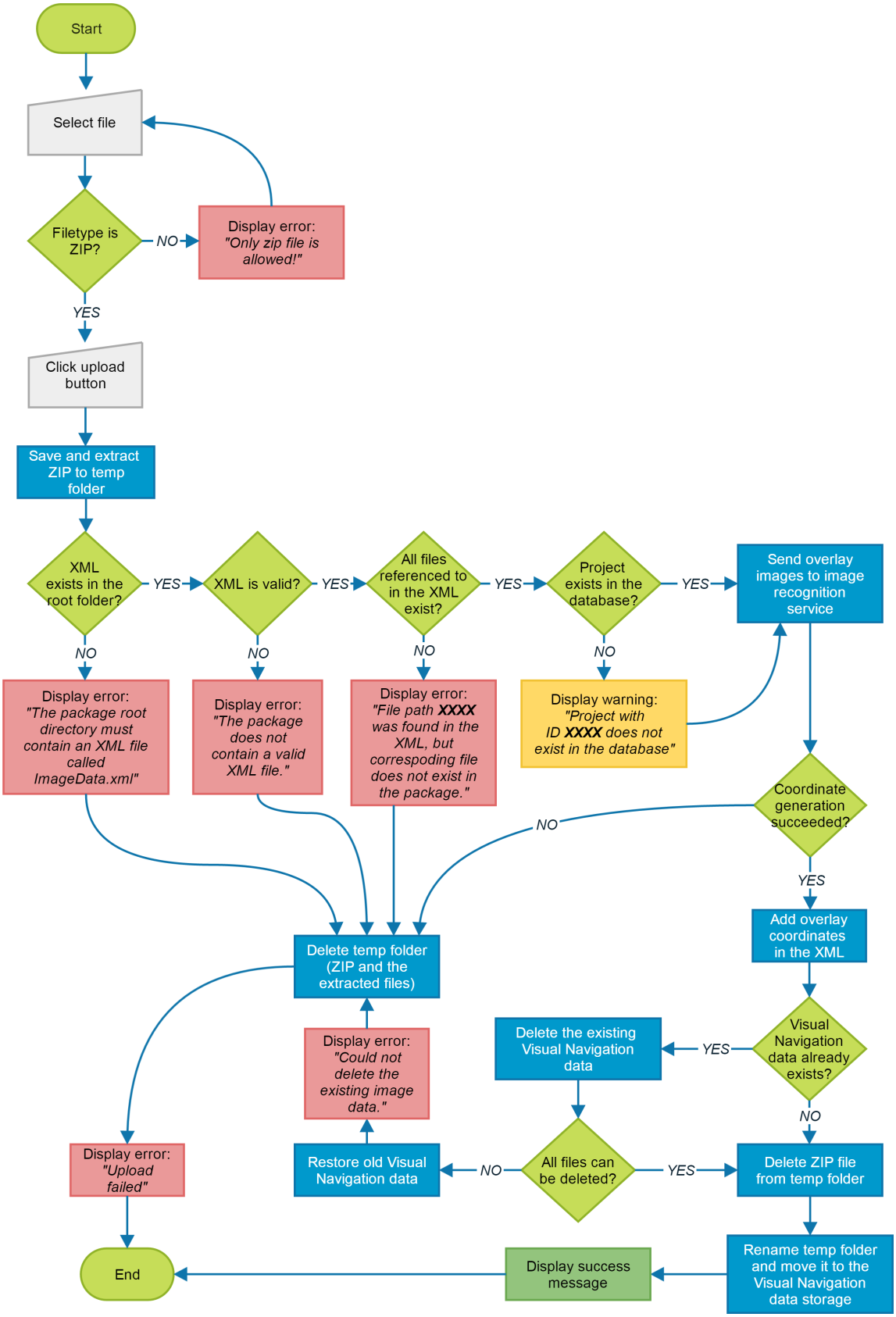

Figure 5.7: Image package validation process

5.3 Image integration

Image integration is the process of bringing the outsourced image content available to the end-users, i.e., the visitors of the case organization's website. The mandatory first step of the integration process is to produce images in such way that they can be integrated. Thus, the purpose of the entire image production process is to prepare images for integration. The actual integration to the website is then handled by a widget and a Web service.

5.3.1 Widget

The navigation functionality was implemented as a custom Sitefinity widget that consists of four distinct front-end views: area (Figure 5.8), building (Figure 5.9), floor (Figure 5.10), and apartment (Figure 5.11).

The widget was designed to visualize and display information for one geographical area at a time. In order to fetch the data for the correct area, the area name needs to be configured in the widget settings (Figure 5.12). The widget sends the area name to a backend service which, in turn, returns the data in the JavaScript Object Notation (JSON) format. This JSON data is then mapped to the widget's HTML with JavaScript.

Figure 5.8: Area view

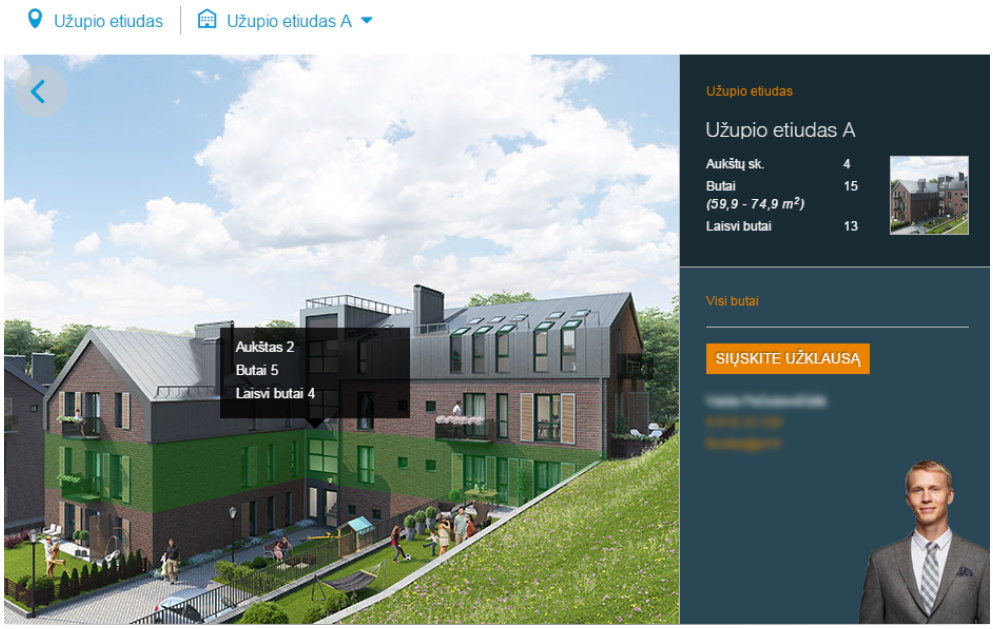

Figure 5.9: Building view

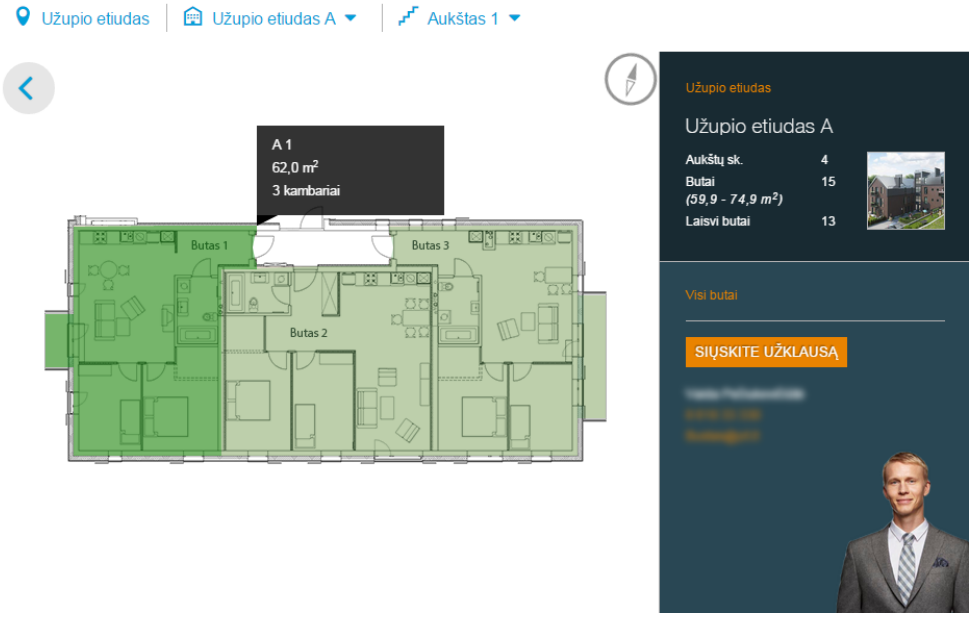

Figure 5.10: Floor view

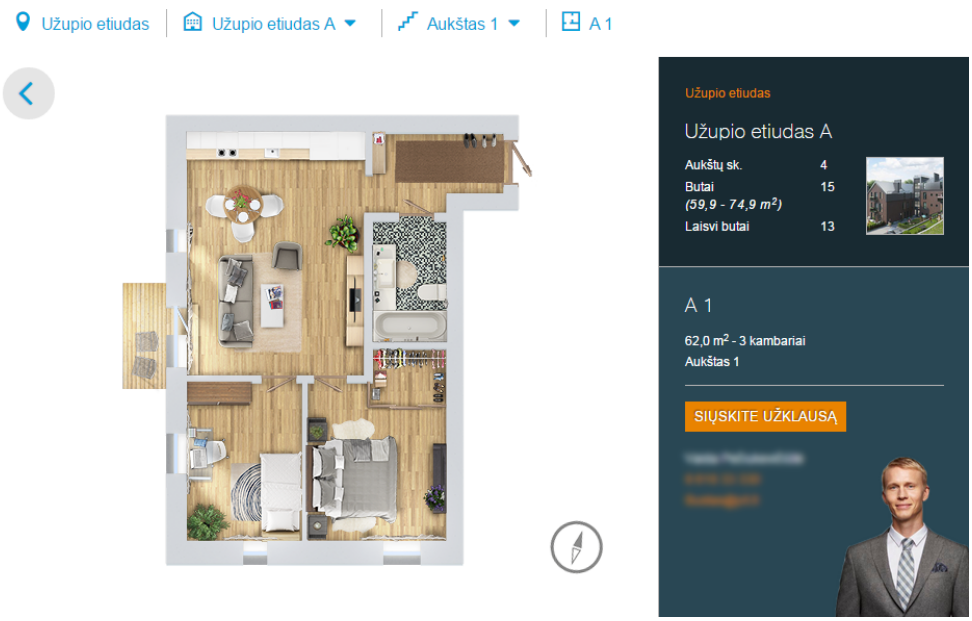

Figure 5.11: Apartment view

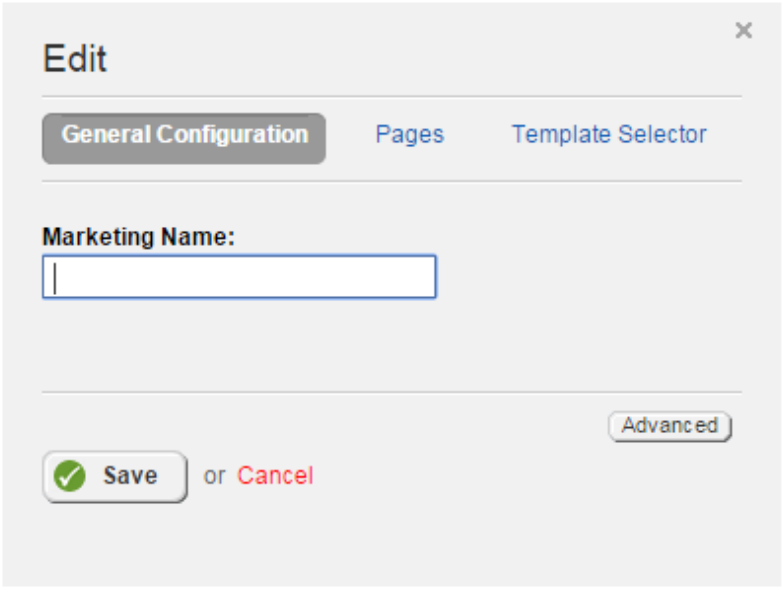

Figure 5.12: Area name, i.e., *Marketing Name* must be configured in the widget settings.

5.3.2 Web service

The navigation widget requires a corresponding backend service which provides it with image and navigation data. Communication between these components – the widget running in the browser and the service running on the web server – was realized as JSON requests and responses (Figure 5.13).

Each housing estate project has a unique identifier that is used both in the XML file and in the database. The user will typically browse projects in the navigation widget by geographical area. The widget will relay the query to the backend service, the backend service will query the database and return a list of projects that are located in the selected area. The unique identifiers of these projects will then be used to fetch the corresponding XML files. Finally, the service combines data from these two sources into a single JSON response.

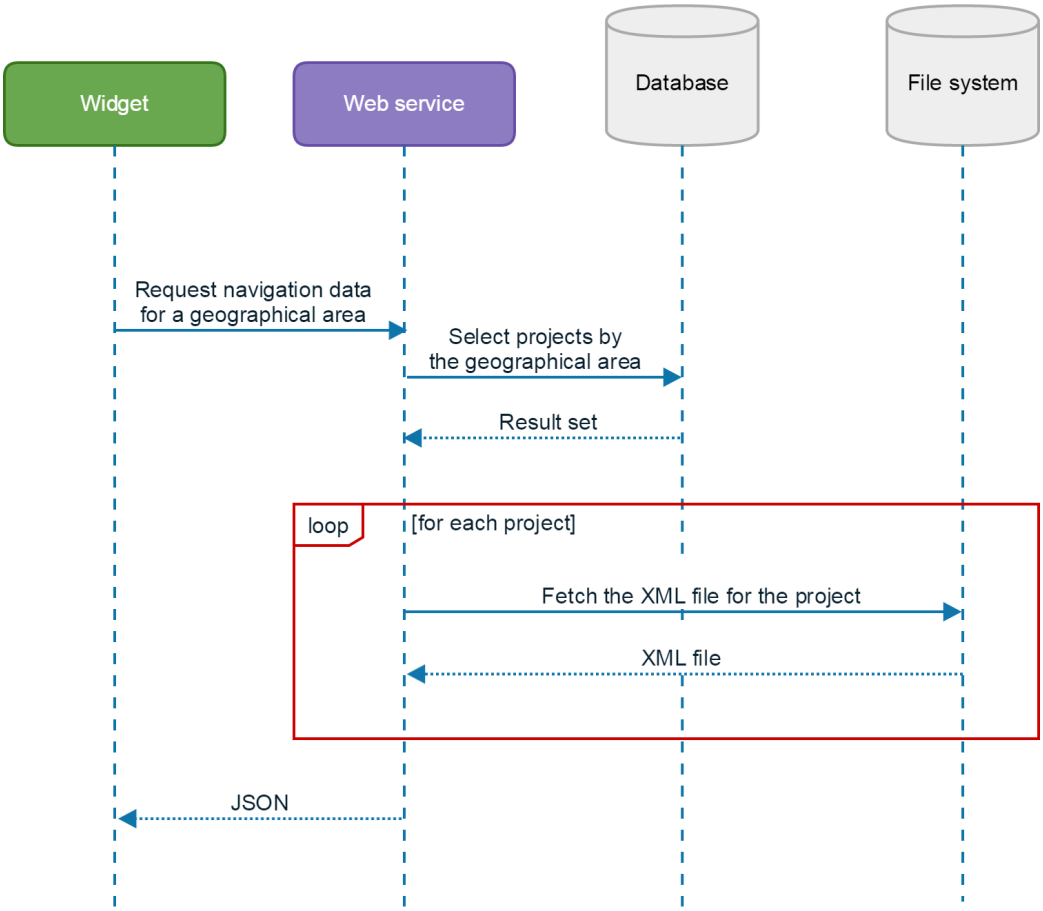

Figure 5.13: Generating JSON for a geographical area

Chapter 6

Evaluation

This chapter evaluates the results of the case study. The case project is examined from five different perspectives: communication management, quality monitoring, image integration, immediate results, and image optimization.

6.1 Communication management

The case project was divided into two concurrently progressing tracks: development and image production. All the communication between the two tracks happened through the case organization. This turned out to be a non-ideal arrangement, because the direct information exchange was missing between the developers and the image producers. The development team recognized this as one of the possible factors that delayed the project and caused issues with the quality.

> *Actually,* [direct communication with the agency] *could have helped. At least, it might have made the process quite a lot faster and more straightforward. Now we had the customer in between handling everything related to the materials. Being in direct contact with the people who produced the images might have been the solution that would have also saved time.*
>
> — Developer, Siili Solutions (translation by the author)

> *It would have been nice if the* [design agency] *that provided the images had worked in close cooperation with the* [development] *team. Sometimes, they cannot work in one place, that's understandable, but checking points daily or once in two days would have been nice.* — Scrum master and QA, Siili Solutions

6.2 Quality monitoring

During the case project, quality monitoring was primarily done by automated validation and manual User Acceptance Testing (UAT). The project demonstrated that there is a need for both types of validation, but the current process has room for improvement.

Automated validation was used in the case project for ensuring that an image package contains a valid XML file and all the required images in an appropriate file structure. However, the validation does not verify that each image follows the technical specification, such as appropriate image dimensions and file formats. This leaves open the possibility of human error.

> *If there is not an automation process to verify the quality, there is always the human error.* [...] *I'm completely sure that, at some point, someone is going to save* [the image] *in the wrong format. That is just an example of the verification.*
>
> — Scrum master and QA, Siili Solutions

> *They sent a couple of faulty packages* [of images] *that were, for example, in wrong proportions.*
>
> — Proxy product owner (translation by the author)

Manual validation is needed, because automated validation is not suitable for monitoring the visual content of the images, such as perspectives or the use of brand-specific imagery. The case project was mostly based on technical specification of images, but there were no strict guidelines for the visual content.

> *Even though we delivered quite a clear documentation about producing the images, they had done some decisions on their own, for example, the position of the compass icon. It does not look so good without marginals, in my opinion.*
>
> — Developer, Siili Solutions (translation by the author)

> *There needs to be always manual UAT done by local unit to check the behavior, as different parties are involved in creation.*
>
> — Business owner

> *If we want to comment on* [the visual appearance] *more, the specification should be extended into a visual guideline. After that we could comment that "hey, you cannot do this because the business and the brand are specifying it like this".*
>
> — Proxy product owner (translation by the author)

6.3 Image integration

Integrating a set of outsourced images into a Web project is a straightforward process, but it requires some manual work and technical confidence. In the case project, the tricky part of the process turned out to be the creation of a valid image package and XML file.

> *The business often expects that things like creating a ZIP file or an XML structure are automated.* [...] *It might be a good idea to invest in* [automation] *in order to ensure that the creation of packages is a reliable and fluent process.* [...] *It is not the easiest thing in the world to do and, that's why, people who are not technically confident may not be comfortable with it.*
>
> — Proxy product owner (translation by the author)

The image packages are uploaded using the image importer tool. The importer tool is primarily needed when the Visual Navigation functionality is launched for a new area, or the images for the existing areas must be changed. Analysis of the image importer logs reveals that the importer tool has not been in very active use after the case project was launched. This designates that new areas were not launched during the tracking period, and the pilot area did not have any major issues shortly after it was launched.

The collected log files contain only four subsequent attempts by the same user to upload an image package for a new area. Each of the four attempts failed, because the XML file was not valid. Three times, the problem was with incorrect encoding, and, the fourth time, the XML file was incorrectly structured. Due to the limited amount of logged data, any generalizations regarding the usability of the importer tool cannot be made. However, the log files show that creating valid XML files is not a trivial task for all users. This may be a sign of too ambiguous instructions or a need for automated XML generation.

6.4 Immediate results

The case organization was very pleased with the results of the pilot project. There were a few quality issues throughout the project, but this was recognized as a normal part of the learning process when working with a new vendor. However, it is beneficial to standardize the relationships and strive for a long-term collaboration.

> *Everything depends on how professional the agency is. We knew what result should be achieved, so agency had to work hard to give it to us. Yes, there were some disagreements in what we wanted and the result they gave to us. But I wouldn't name as a problem. It was a normal part of all process.* — Site Manager

> *I would advice to invest time and effort in the first time and try to standardize the partnerships so that there is some kind of continuity. I would also walk the design agency through the process and show how to do it, even by sitting next to them, if there are any problems. The amount of manual supervision and guidance should not be underestimated during the first times when you are doing something like this and trying to standardize it. It is really important.*
>
> — Proxy product owner (translation by the author)

> *When agencies will get used to the process we can have visual navigations really easily and fast without a need to use the* [case organization's IT team] *resources.* — Business owner

The technical analysis of Web server logs reveals that during the 30-day tracking period, there were no issues with serving the Visual Navigation images. Images were requested a total of 21,087 times. The server responded with the status codes 200, 203, and 304, none of them being errors. Thus, all the requested image files existed on the server, and, from that perspective, the integration was successful in the pilot project. The meanings of the different statuses [67] and the number of responses by status are presented in Table 6.1.

Status	**Description**	**Count**
200	The request succeeded.	16,903
203	The request succeeded, but the information is gathered from a local or a third-party copy.	9
304	The document was not modified.	4,175
Total		21,087

Table 6.1: HTTP Responses for Visual Navigation images by Status Code

6.5 Image optimization

This section analyzes the optimization of images in the case project. Image optimization was not one of the primary goals of the project, but it may have a role in the future improvements of the process. The data used as the basis of the analysis is presented in Appendix D.

6.5.1 Accessibility

The accessibility was analyzed based on the three WCAG 2.0 guidelines that were presented in Section 3.3.1:

1. WCAG 2.0, Guideline 1.1 Text alternatives:

   > *Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language.* [69]

   The main images that illustrate each view – area, building, floor, and apartment – either have an empty `alt` text or the entire `alt` attribute is missing. As stated in Section 3.3.1, a text alternative should always be provided. The empty `alt` text, in turn, is reserved for purely decorative images which these images are not.

   The overlay images – building, floor, and apartment – function as a link to the corresponding building's, floor's or apartment's view. Thus, the `alt` text should describe where the link leads to. The `alt` texts for building and apartment overlays correctly describe the link content, because for the building overlays it is the building name and for the apartment overlays it is the apartment's number. At the same time, however, these kinds of `alt` texts are slightly ambiguous, because they do not explicitly state that the names and numbers actually stand for specific buildings and apartments. Furthermore, the `alt` texts for floor overlays are empty.

   The rest of the images – building icons and contact images – have text alternatives. Even though the text alternatives are relevant, they are slightly ambiguous and describe the image in a very generic way, such as "Project Image" and "Contact Person". Furthermore, these `alt` texts are not localized and are displayed in English on a Lithuanian website.

2. WCAG 2.0, Guideline 1.4 Distinguishable:

   > *Make it easier for users to see and hear content including separating foreground from background.* [69]

   The Guideline 1.4 concerns images of text. Only two types of images in the case project contain text: the area image and the floor images. As for the area image, the text appears as a part of a logo. As for the floor images, the text is used to mark each individual apartment in the floor plan.

   The Guideline 1.4 is not violated. The text in the area image is not an issue, because the minimum contrast ratio does not concern logotypes. The text in the floor images, in turn, meets the contrast requirement. Furthermore, the use of images of text instead of plain text is justified, in these two cases, because achieving the same visual presentation would be much more complex process if the text was not part of the image.

3. WCAG 2.0, Guideline 2.3 Seizures:

   > *Do not design content in a way that is known to cause seizures.* [69]

   The Guideline 2.3 is not violated, because Visual Navigation does not contain any animated or flickering images.

6.5.2 Search Engine Optimization

The SEO capabilities of Visual Navigation images were analyzed by examining the four aspects of SEO friendly image design that were discussed in Section 3.3.2:

1. **Relevant file names**

   The case project follows a systematic naming convention where periods are correctly used as separators between the words instead of underscores. The naming convention is not, however, particularly keyword-centered. Most of the files are named with project and apartment identifiers that cannot be considered as meaningful keywords.

2. **Text alternatives**

   The text alternatives are mostly missing, empty or slightly ambiguous. The only images that have `alt` texts with some relevant keywords in a relevant language are the project and apartment overlays.

3. **Anchor texts**

   There were no images included in the case project using the anchor element. Thus, anchor texts do not affect the SEO capabilities of the navigation functionality.

4. **Nearby textual content**

   The textual content nearby the images consists of area, building, floor and apartment names, numbers and contact details. Using these as the keywords in the file names and `alt` texts might increase the SEO ranking of the site.

6.5.3 Performance

The performance capabilities of Visual Navigation images were analyzed by examining the four aspects of image performance optimization that were discussed in Section 3.3.3:

1. **Dimensions**

   Majority of the images are served in the same dimensions that are used for displaying the image. Two types of images, however, are consistently served in a larger size than necessary: building icon and contact image.

2. **Image format**

   The choice of image formats is justified. JPEG is consistently used for photographic images and PNG is used for graphical images or when transparency is needed.

3. **Parameter optimization**

   The file sizes can be further optimized with file format specific optimizations. The most considerable savings in the tests were achieved for apartment image sizes – the average image size reduced from 223.3 kB to 60.3 kB (-73 %).

4. **Metadata**

   All the image files are carrying some metadata that could be stripped with metadata removal tools. In most cases, however, the reduction of the file size by this method is negligible. The most considerable savings were achieved for apartment image sizes – the average image size reduced from 223.3 kB to 203.3 kB (-9 %).

Chapter 7

Discussion

This chapter revisits the research questions and presents the main findings of this thesis. In addition, the limitations of this study are discussed and recommendations are given for further research.

7.1 Main findings

The research objectives of this study were broken down into three research questions:

RQ 1. How to manage outsourced image production as a part of a Web project?

RQ 2. How to integrate outsourced image content into a website?

RQ 3. How to monitor the quality of outsourced image content that is produced for a website?

In the earlier chapters of this thesis, the above topics were discussed from two perspectives: literature review and a case study. This section presents a synthesis of the findings by answering to each research question.

7.1.1 RQ 1. How to manage outsourced image production as a part of a Web project?

The first step of outsourced image production is to gather a profound understanding of the functional, visual, and technical requirements that the Web project sets for image content. In the literature review, an equivalent step was recognized as a part of the outsourcing life cycle: needs analysis.

Images may be optimized from the accessibility perspective, search engine perspective, or performance perspective, as described in Chapter 3. Each of these optimizations has immediate effects on the image production process. For instance, in order to make the image accessible, it must have a text alternative. In order to make the image SEO friendly, it must have a keyword-centered file name. In order to optimize the image performance, it must be saved in a specific file format. These aspects must be considered when the image production process is designed. Furthermore, the organization must consider how the outsourced image content is going to be integrated into the website, because the integration process may affect the material and instructions that must be given to the vendor, or even the deliverables that the vendor must produce.

The case project did not follow any of the optimizations in an ideal way. Moreover, some steps of the image production process, such as the XML generation, could have been designed in a more user-friendly way. To some extent, these design decisions were conscious choices that were steered by the tight schedule: the case organization was happy with the results despite of the deficiencies, because the developed functionality responded to a major business need. Nevertheless, some of the quality and usability issues could have been tackled by incorporating more careful planning in the beginning of the project.

The second step of outsourced image production is vendor selection, which is followed by project initiation and transition – also these are standard stages of the outsourcing life cycle. As the vendor starts to work on the images, a sufficient amount of guidance, training, and support must be provided to them. It is essential that a continuous information exchange and feedback process is established between the people who produce the images and the people who understand the functional, visual, and technical requirements of the project. This did not succeed in the case project described in this thesis, because the lack of direct communication between the vendor and the development team was recognized as one of the major reasons for schedule and quality problems.

Finally, outsourced image production is a specialized process that involves training and transferring knowledge to the vendor. It is beneficial to strive for long-term relationships, because starting a relationship with a new vendor is a learning process that requires time and effort. As the relationship normalizes, it is also important to standardize and automate the integration and quality monitoring processes, where possible. In this case project, automation was recognized as a means of preventing human error and simplifying the integration process.

7.1.2 RQ 2. How to integrate outsourced image content into a website?

Image integration is a unique process that must be carefully designed for each individual Web project. Due to the unique nature of the process, it is very likely that a custom integration tool must be developed – unless the integration work is done completely manually.

First, the organization must decide which parts of the image production work will be automated and which parts will be done by the vendor. Automation may be a reasonable choice for purely technical tasks, such as compressing or resizing images, but it is not suitable for tasks that require decision-making based on visual input. In this case project, automation could have been utilized, for instance, for auto-generating SEO friendly file names and text alternatives.

Second, the vendor must produce the images in such way that they can be integrated into the website. In this case project, it was essential that the vendor-generated image file names and file structures matched to the corresponding file paths in the XML file.

Finally, the integration process must be designed so that it minimizes the risk of publishing images that do not meet the set technical or aesthetical requirements. The case project proved that human error and misunderstandings are not uncommon problems in outsourcing efforts. Thus, it is reasonable to incorporate quality monitoring in the integration process.

7.1.3 RQ 3. How to monitor the quality of outsourced image content that is produced for a website?

Quality monitoring for outsourced image content must be designed considering both visual and technical qualities of images, and the validity of integration data. Visual qualities refer to the visual content of images, such as colors and composition. Technical qualities, in turn, include dimensions, file format, file size, file name, and other technically measurable data. Finally, integration data consists of any metadata or other additional data that is needed in order to integrate the images into the website.

In this case project, integration data consisted of XML files that were used to map each image to the corresponding area, building, floor, or apartment. The image content was validated solely based on the integration data, which successfully prevented the users from uploading packages with faulty XML files, but ignored the visual and technical qualities of each individual image. As a result, a few visually or technically defective images passed the validation.

Quality monitoring process must be automated, where possible. Technical qualities of images and integration data are likely targets for automated validation, but many visual qualities of images cannot be reliably validated by automation. Thus, a routine manual process should be established for validating the visual qualities.

These findings are well-aligned with the literature review. The literature review suggested that quality monitoring should be a standard part of work administration when the outsourcing relationship reaches the relationship management stage. The literature review also suggested that the organization should start governing the project with routines and automated processes rather than direct human intervention after the relationship is standardized.

7.2 Limitations

This thesis had several limitations. First of all, the study was conducted as a single-case study, and the results of this research are a particularization of an individual case. Thus, they may not be externally valid or generally applicable to other similar settings.

Another limitation is that a half of the interviewees, including the people associated with the image production track, were located in a different country and interviewed through e-mail. This resulted in considerably reduced input from the interviewees compared to the face-to-face interviews. Thus, most of the information was gathered from the Web development perspective rather than the image production perspective. The Web development perspective may be even further emphasized, because the study was conducted in Finland, and the author was a part of the development team.

A third limitation was that the study covered only the pilot project where one vendor produced images for one area. This did not produce enough data and knowledge to evaluate the developed tools and work processes properly. For instance, there was not much importer and validation data to analyze, because the importer tool was used extremely rarely during the one month tracking period after the pilot project was launched.

7.3 Further research

This thesis has provided a general overview of managing outsourced image production in an image-oriented Web project. Further research is required, however, to gather generalizable information on the topic with a larger sample of cases. Little to no previous research has previously been conducted on the topic, even though image production is a common and frequently outsourced task in Web projects.

Image integration is the most complicated and vital part of the process, because the success of the entire project is dependent on the success of the integration. Further research is recommended to gain more comprehensive understanding on the challenges and best practices of image integration.

Another recommended research topic is to investigate what kind of quality monitoring process can be applied on the visual qualities of images. This is an especially relevant problem in projects that involve handling large sets of images that are difficult to validate manually.

Finally, image integration and validation are challenges that must be tackled in every Web project with outsourced image production. In this case study, these challenges were handled with a completely custom tool. Further research is suggested to examine whether it is feasible to develop a general integration tool that can be customized to serve different kinds of integration needs.

Chapter 8

Conclusions

This thesis has studied the management of outsourced image content production in an image-oriented Web project. The research was conducted as an exploratory single-case study that was complemented by literature review. The study serves as the groundwork for further research on outsourced image production for the Web.

The case study examined outsourced image content production as a part of a Web project that was done for an international construction company. The target of the project was to develop a new functionality to the case organization's Web platform in order to provide home buyers a possibility to visually explore the entire product as a package of the living area, building, and apartment. The functionality requires a lot of image content that is produced by local design agencies in different countries.

The project was piloted by bringing the functionality for one Lithuanian area. This involved designing an image production workflow and guidelines for the design agencies, and implementing tools for validating and integrating images into the case organization's website. The images were produced by a Lithuanian design agency.

In order to evaluate the results of the project, a total of six semi-structured interviews were conducted with people who participated in the case study project in different roles. Furthermore, Web server logs and image importer logs were gathered for analyzing the success of image validation and integration. Finally, various data was collected about the produced image content and compared to the state-of-the-art best practices of image production.

The findings of the study suggest that outsourced image production can be managed with a standard life cycle model for outsourcing. Prior to engaging in a business relationship with the vendor, it is important to gather a profound understanding of the functional, visual, and technical requirements that the Web project sets for image content. This involves making a plan for integrating images into the website, monitoring their quality, and determining what kind of accessibility, SEO, and performance optimizations must be applied on the images.

As the project is initiated, it is essential to ensure that the vendor receives a sufficient amount of guidance, training, and support. Scheduling and quality issues may rise, if a continuous information exchange is not established between the people who produce the images and the people who understand the functional, visual, and technical requirements of the project. After the relationship normalizes, it is important to strive for standardizing the relationships and automating the integration and quality monitoring processes.

The integration process must be designed so that there is a thorough understanding of which parts of the work will be automated and which will be done by the vendor. Automation may be utilized for purely technical tasks, but tasks that require decision-making based on visual content must be done by the vendor. Quality monitoring should be incorporated in the integration process in order to prevent deficient images from being integrated into the website.

Monitoring the quality of outsourced image content requires validating the technical and visual properties of images, and the integration data. Quality monitoring must be automated, where possible, and routine manual processes must be established for monitoring the visual quality of images.

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Appendix A

Interview questions for the case organization

General questions

1. What was/is your role in the Visual Navigation project?
2. Visual Navigation is almost completely based on a large set of images that are produced by outsourcing.
    - How did this affect your work?
    - What was the biggest challenge from your point of view?
    - Do you think something should have been done differently?

Business perspective

1. What kind of business value does the Visual Navigation project bring to you?
2. How did you select the first area that gets Visual Navigation?
3. We have another widget with a very similar idea (AFP). Why to create a new one?
4. Why did you decide to outsource the image content production?

Image Production process for new areas

1. Describe the image production/integration workflow that was used in the pilot project (what was the step-by-step process?)
2. Would you change something in this process in the future?

Working with outsourced image content producer

1. What kind of instructions and materials were given to the design agency?
2. Are the current instructions sufficient or should they be improved somehow? How?
3. Were there any problems with the image content quality? How could that kind of problems be avoided?
4. How is the image content quality verified?
   (a) **Automatic validation** - Are the current validations enough? Should something be added?
   (b) **Manual validation** - Was there any manual validation? Do you think it's necessary?

Results and future

1. How did the Visual Navigation turn out? Are you happy with the results?
2. Did it bring you the business value that you were expecting?
3. Are you happy with the image content quality?
4. Is the outsourced image content looking good in the widget?
5. Are there any plans to take Visual Navigation into use for other areas?
6. Are there any plans to take Visual Navigation into use on other websites?
7. Based on this experience, what kind of advice would you give to other business units willing to have Visual Navigation on their website?

Appendix B

Interview questions for the Web development team

General questions

1. What was/is your role in the Visual Navigation project?
2. Visual Navigation is almost completely based on a large set of images that are produced by outsourcing.
   (a) How did this affect your work?
   (b) What was the biggest challenge from your point of view?
   (c) Do you think something should have been done differently?

Technical requirements

1. What kind of limitations does the web environment set for image content?
2. In general, what kind of actions are needed to make sure that
   (a) outsourced image content can be integrated to the website?
   (b) the quality of the development team's work is not compromised because of possibly bad content?

Development team work

1. In this project, the design agency and development team did not communicate directly with each other. How did that work out?
2. Were there any problems with the image content quality? How could that kind of problems be avoided?
3. Do you think outsourced image content quality can ever be trusted? Is validation always necessary?

Results and future

1. How did the Visual Navigation turn out? Are you happy with the results?
2. Based on this experience, what kind of advice would you give to other development teams working with outsourced image content?

Appendix C

Interview questions for the design agency

General questions

1. What was your role in this project?
2. What kind of other people/roles were working on this project?

Instructions

1. What kind of instructions did you receive?
2. How did you get the instructions?
3. Was there any problems with the instructions?
4. How would you improve the instructions in the future?

Materials

1. What kind of visual materials did you receive?
2. Where did you get the materials?
3. Were there any problems with the materials?
4. Would you have needed something else?

Communication

1. How did you communicate with the customer?
2. Were there any problems with the communication?
3. How would you improve the communication in the future?

Processes & Deliverables

1. How was your internal work process (starting from receiving materials to delivering them)?
2. This project required a large set of images and manual work. How do you cope with the risk of human error (e.g. wrong file types etc.)?
3. Were there any problems with the deliverables? How could that kind of problems be avoided?

Results and future

1. Are you happy with how the images eventually turned out?
2. What was the biggest challenge from your point of view?
3. Would you do something differently in future?
4. What kind of advice would you give to a new team creating similar image assets for another area?

Appendix D

Data for technical analysis

Accessibility					
	Purpose	**Inclusion in HTML**	**Text alternative**	**Animated or flickering image**	***Contains text (contrast ratio)***
Area image	Illustrates the area where the building is.	**`img`** element	*empty*	*no*	*yes, but is logo*
Building image	Illustrates the building where the apartment is.	**`img`** element	*empty*	*no*	*no*
Floor image	Illustrates the floorplan of the floor where the apartment is.	**`img`** element	*missing*	*no*	*yes (16.31:1)*
Apartment image	Illustrates the floorplan of the apartment.	**`img`** element	*missing*	*no*	*no*
Building overlay	Link to the building view. Clickable area that highlights a building In the area image.	**`area`** coordinates	**Format:** project title **For example:** Užupio etiudas A	*no*	*no*
Floor overlay	Link to the floor view. Clickable area that highlights a floor in the building.	**`area`** coordinates	*empty*	*no*	*no*
Apartment overlay	Link to the apartment view. Clickable area that highlights an apartment in the floor view.	**`area`** coordinates	**Format:** apartment number **For example:** A 1	*no*	*no*
Building icon	Illustrates the current building that is being explored.	**`img`** element	Project Image	*no*	*no*
Contact image	Photograph of the contact person who is responsible for the currently explored building.	**`img`** element	Contact Person	*no*	*no*

Search Engine Optimization					
	Purpose	File name	Text alternative	Inclusion in HTML	Wrapped by Anchor
Area image	Illustrates the area where the building is.	all-houses.jpg	*empty*	**`img`** element	*no*
Building image	Illustrates the building where the apartment is.	**Format:** projectID.jpg **For example:** D070A.jpg	*empty*	**`img`** element	*no*
Floor image	Illustrates the floorplan of the floor where the apartment is.	**Format:** projectID.floorID.floorplan.png **For example:** D070A.1.floorplan.png	*missing*	**`img`** element	*no*
Apartment image	Illustrates the floorplan of the apartment.	*Naming convention varies.* *CDN removes the name from the URL..*	*missing*	**`img`** element	*no*
Building overlay	Link to the building view. Clickable area that highlights a building In the area image.	**Format:** projectID.overlay.png **For example:** D070A.overlay.png	**Format:** project title **For example:** Užupio etiudas A	**`area`** coordinates	*no*
Floor overlay	Link to the floor view. Clickable area that highlights a floor in the building.	**Format:** projectID.floorID.overlay.png **For example:** D070A.1.overlay.png	*empty*	**`area`** coordinates	*no*
Apartment overlay	Link to the apartment view. Clickable area that highlights an apartment in the floor view.	**Format:** projectID.apartmentID.overlay.png **For example:** D070A.1-2p8gnh.overlay.png	**Format:** apartment number **For example:** A 1	**`area`** coordinates	*no*
Building icon	Illustrates the current building that is being explored.	**Format:** projectID.icon.jpg **For example:** D070A.icon.jpg	Project Image	**`img`** element	*no*
Contact image	Photograph of the contact person who is responsible for the currently explored building.	**Has two contact images:** saleswoman1.png saleswoman2.png	Contact Person	**`img`** element	*no*

Performance								
	Original dimensions (width x height)	Display dimensions (width x height)	File format	Contains transparency?	Avg. size (KB)	Reduce size with parameter optimization?	Reduce size by stripping metadata?	Alternative technologies used?
Area image	940 x 540	940 x 540	JPG	*no*	157.0	~22 KB / image	< 1 KB / image	*no*
Building image	640 x 540	640 x 540	JPG	*no*	96.3	~16 KB / image	< 1 KB / image	*no*
Floor image	640 x 540	640 x 540	PNG	*no*	91.8	~58.8 KB / image	< 1 KB / image	*no*
Apartment image	640 x 540	640 x 540	PNG	*no*	223.3	~163 KB / image	~ 20 KB / image	*no*
Building overlay	640 x 540	*Not displayed in the front-end as a raster image*	PNG	*yes*	7.5	~4.7 KB / image	< 1 KB / image	*The original raster image turned Into coordinates and displayed with CSS*
Floor overlay	640 x 540	*Not displayed in the front-end as a raster image*	PNG	*yes*	5.8	~3.9 KB / image	< 1 KB / image	*The original raster image turned Into coordinates and displayed with CSS*
Apartment overlay	640 x 540	*Not displayed in the front-end as a raster image*	PNG	*yes*	4.8	~3.2 KB / image	< 1 KB / image	*The original raster image turned Into coordinates and displayed with CSS*
Building icon	200 x 200	73 x 73	JPG	*no*	13.2	< 1 KB / image	< 1 KB / image	*no*
Contact image	260 x 293	155 x 175	PNG	*yes*	82.5	~48 KB / image	< 1 KB / image	*no*