# Development of a general maturity model for Smart Tourism Destinations

Conceptual Framework

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ABSTRACT

With this thesis, a new maturity model for Smart Tourism Destination is developed. So far there has been no such a model in the literature.

Tourism service providers do not always work closely with the tourism organisation. The maturity model shows how cooperation can be improved and intensified. Every stakeholder wants a slice of the tourists' expenses.

By a literature study, the knowledge necessary for the development of the model is built up. On the other hand, this study serves as a basis for the development of the new model.

The tourism sector is continually changing. Tourists behave differently or have changed their needs, for example since the advent of social media. New technologies such as social media have a more significant impact on the tourism sector. Experiences that a tourist makes at a destination can thus be disseminated quickly. The power of marketing departments is dwindling because they can no longer control what is written about a destination. The maturity model describes how a tourism organisation can adapt to new circumstances, how it deals with the changes and reacts to them. Furthermore, the maturity model describes how a tourism organisation cooperates with tourism service providers. The model goes one step further in how data is exchanged.

The maturity model can only be successfully implemented if the necessary processes and regulations are adopted. All partners involved are committed to entertaining tourists.

**Keywords** Smart Tourism Destination, Smart Tourism, Internet of Things, social media, maturity model

**Pages** 66 pages

# TERMINOLOGY

Table 1: Abbreviations

| Abbreviation | Description |
|---|---|
| API | Application Programming Interface |
| CMM | Capability Maturity Model |
| DMO | Destination Marketing Organisation<br>Destination Management Organisation |
| GPS | Global Positioning System |
| HTML | Hypertext Markup Language |
| ICT | Information and Communications Technology |
| IoT | Internet of Things |
| IT | Information Technology |
| KDD | Knowledge Discovery from Data |
| JSON | JavaScript Object Notation |
| NFC | Near Field Communication |
| RC | Residential Consumer/Customer |
| RFID | Radio-frequency identification |
| SMA | Social Media Analysis |
| SNS | Social Network Service/Social Network Site |
| STE | Smart Tourism Ecosystem |
| STT | Smart Tourism Technologies |
| TC | Tourist Consumer/Customer |
| TS | Tourist Supplier |
| UGC | User-generated content |
| UN | United Nations |
| UNWTO | UN World Tourist Organisation |
| XML | Extensible Markup Language |

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# 1 INTRODUCTION

Smartphones and especially social media have changed a tourist's life. Both empower tourists to share pictures or videos with their friends immediately and let them report about their experiences. The rapid exchange of experience does not leave the tourism organisations unaffected. They have to adapt to new technologies.

The development of Smart City brings not only new opportunities and services for residents and tourists but also generates new data that is publicly accessible. The generated data can also be used in the tourism industry. As a result, smart tourism is emerging, and it allows the tourist organisation to create new services and products based on the data. As a consequence of Smart City, another step is the Smart Tourism Destination, which brings together not only the tourism organisations but also the stakeholders involved. Smart Tourism Destination uses state-of-the-art technologies and provides a platform for stakeholders to enhance the tourist experience with new apps and products.

Tourists have their needs and preferences. A tourism organisation must be able to meet these needs. It follows that a maturity model can help to develop a tourism organisation and adapt them to new needs and technologies. However, when this thesis was written, there was no maturity model for Smart Tourism Destination. Therefore, a new maturity model for Smart Tourism Destination is being developed.

This thesis intends to address the following research questions: (1) Which influence has the use of open data and social media in the tourism industry? (2) What kind of information is needed to create a maturity model for the Smart Tourism Destination? (3) How can social media data be integrated into the model? (4) How can an app reflect on the levels of the maturity model? (5) Are there any problems, errors, incompleteness or other difficulties that may arise in connection with the model and therefore the reliability of the model? In order to be able to answer the research questions, a literature study was carried out which build the knowledge base.

The first part of the work deals with the development of the necessary knowledge for the maturity model. The second chapter describes what maturity models are and how they are developed. The tourism destination defines the next chapter. The following chapter continues with smart in tourism and destinations. The fifth chapter deals with the collection of data on Social Media, Open Data and the Internet of Things. Chapters six and seven describe the influence of large amounts of data and social media on tourism. The structure of the maturity model is described in chapter nine, which is also the second part of the thesis.

# 2 LITERATURE REVIEW FOR MATURITY MODEL

This chapter explains and describes the maturity model in the literature. In order to develop a maturity model, corresponding steps are necessary. In the literature, there are different ways to develop a model. Every author has their theories and ideas, which are described in this chapter.

## 2.1 Definition of the maturity model

"As organisations continually face pressures to gain and retain competitive advantage, identifying ways of cutting costs, improving quality, reducing time to market, and so on, become increasingly important" (de Bruin, Rosemann, Freeze, & Kulkarni, 2005, p. 1). The claim is also supported by Mettler (2009). According to Mettler (2009), Simpson & Weiner (1989) described the term maturity model as "the state of being complete, perfect, or ready". In addition to him, Mylopoulos (1992) argues that "models generally represent a formal description of some aspects of the physical or social reality for the purpose of understanding and communicating" (Mettler, 2009).

A maturity model is also called a stage growth model or stage continuous level models (Lasrado, Vatrapu, & Andersen, 2015). Further to them, Röglinger et al. (2012) and Pöppelbus et al. (2011) state that all stages have a relationship between each of them. The basic concept of the maturity model emerged in the 1970s by Gibson & Nolan (1974). Since then several maturity models have been created. One of the reasons was "the introduction of the Capability Maturity Model (CMM) in the 1980s" (Mettler, 2009).

Many models have been created through projects that have produced positive results. Information from these projects flows into the new model as best practices or success factors. As a result, there is no guarantee that a company will achieve significant success through the maturity model. However, some maturity models are based on the CMM. (Mettler, 2009) Lasrado et al. (2015) support the statement regarding CMM that it is widespread and has become a quasi-standard. Further maturity models adapted CMM over a wide range of problem areas. CMM has led to the establishment of a stronger certified culture. As a result, consulting firms have increasingly adopted them or developed new maturity models. This, in turn, increased the popularity of the models among users. (Lasrado et al., 2015)

The main purpose of the maturity model is to identify gaps and close them through improvement measures. However, many models do not describe how to close these gaps, even if management knows what to do. (Mettler, 2009)

Moreover, Lasrado et al. (2015) characterised five crucial components for a maturity model which are listed in Table 2.

Table 2: Definition of the components by Lasrado et al. (2015)

| No | Component | Description |
|---|---|---|
| 1 | Maturity levels or stages | They define the level of abstraction from the lowest to the highest level |
| 2 | Dimensions | These are critical success factors, benchmark variables, or how to measure |
| 3 | Sub-categories | Define the domain into smaller parts which can be measured better |
| 4 | The path to maturity | Is the way of maturity as a linear, unidirectional path from bottom to the top |
| 5 | Assessment questions | Are linked to the sub-categories and are mostly visualised or as a graphical representation |

The five components of Table 2 are used to explain the design structure of the model, but there are hierarchical relations between them. However, there are four challenges in a maturity model, as they are, (1) how are the distances between each level measured or how to achieve the next level, (2) which scale is used in the model, (3) how does a company achieve the overall maturity by linear combination of several activities, and (4) which is the source of the dimensions. (Lasrado et al., 2015) Mettler (2009) conclude that the progression in the maturity model is not linear; it is more an s-curve.

## 2.2 Criticism of maturity models

From the papers analysed there were some criticisms about maturity models. There are three significant criticisms as described in Table 3.

Table 3: Major criticism about maturity modes stated by Lasrado et al. (2015)

| No | Criticism | Description |
|---|---|---|
| 1 | Lack of theoretical foundations | Which means that most maturity models are created out of best practice instead of a literature review. |
| 2 | Lack of strong empirical validation | Which means that variables and dimension are not enough validated through questionnaires. |
| 3 | Lack of operationalising maturity measurements | Which means that most maturity models are a conceptual framework and missing empirical evidence. |

Mettler (2009) state that many organisations stuck in CMM Level 1 because requirements to reach the next level were far too hard to meet. Further according to Lasdrado et al. (2015), King et al. (1984) stress that most maturity models are not useful or are too merely as well as they lack empirical validation as mentioned above. Corresponding to Damsgaard & Scheepers (2000, p. 136), King et al. (1984) criticise Nolan's model as too evolutionist theory because one stage in the maturity model is the prerequisite for reaching the next stage. As long as the previous stage is not reached, it is not possible to reach the next ones. Hence, maturity models have a predefined direction typically as a succession of states. (Damsgaard & Scheepers, 2000, p. 136)

All in all, the importance of maturity models emerged since the introduction of the stage model by Nolan & Gibson in the 1970s. Numerous maturity models use CMM as a basis. However, most criticisms are that most maturity models are not validated, or the stages are hard to reach.

## 2.3 **Development of the maturity model**

"The importance of a standard framework is emphasised when considering the purpose for which a model may be applied" (de Bruin et al., 2005). As identified by Lasrado et al. (2016, pp. 2–5) there is not a progression through a linear sequence of stages; it is more of configurations with multiple complex conditions. According to them, Pöppelbuss et al. (2011) describe the purpose of maturity models as a path to organisational maturation by defining stages and the relationship between them. However, Lasrado et al. (2016, p. 5) state that a maturity model should have underlying core components and they can be characterised as maturity stage, conditions, boundary conditions, and the path to maturity. Maturity stage is an archetypal stage of maturity of the entity. The entity is referred to as an organisation or company. (Lasrado et al., 2016, pp. 2–5)

Each stage has a set of testable characteristics. Conditions, in this case, are for example critical success factors, dimensions, benchmark variables, or enablers. The conditions decide the maturity stage and are defined as multi-dimensional factors. Each factor could have sub-factors, but all of them have their characteristics. Boundary conditions are referred to as conditions which have to be satisfied to progress from one stage to another. Boundary conditions are necessary conditions. (Lasrado et al., 2015) Numerous authors (Jussila, Kärkkäinen, & Lyytikkä, 2011, p. 4; Lasrado et al., 2015, 2016, p. 17) state that most models use four to five stages.

Several authors (de Bruin et al., 2005; Lasrado et al., 2015, 2016, pp. 7–16; Mettler, 2009) describe how to develop a maturity model. Each developer then must go through several steps. First the steps of Mettler (2009) are described, which serve as a basis to compare the steps of the other authors. Mettler (2009) proposes four phases to develop a maturity model that is shown in Table 4.

Table 4: Four phases maturity model development steps defined by Mettler (2009)

| No | Phase | Description |
|---|---|---|
| 1 | Define Scope | The maturity model could be a more generalistic or more specific object. Every audience has its needs for the model. It could be a more management-oriented, technology-oriented or both. |
| 2 | Design Model | Every model has a way of maturity. This can be theory-driven, practice-oriented or a combination of both. The interest of the audience has a significant influence. |
| 3 | Evaluate Design | During the evaluation phase, the defined maturity model is verified and validated. The model should be an accurate representation of the real world so that the audience can use it. |
| 4 | Reflect Evaluation | In this phase, the maturity model must be maintained, so it reflects future demands or new requirements. |

Mettler (2009) describes the development of a maturity model as a cycle. The cycle is usually triggered by a need or an intention. The cycle contains the steps described in Table 4. Once all the steps have been completed, the cycle starts again from the beginning, if it is necessary to adjust the model. This may require the scope, design, or other adjustments.

The following models in the Table 5 and Table 6 are compared against the model of Mettler in the Table 4. For this reason, only the differences compared to the Mettler model are described in the individual tables.

De Bruin et al. (2005) propose six phases to develop a maturity model, as shown in Table 5.

Table 5: Six phases maturity model development defined by De Bruin et al. (2005)

| No | Phase | Description |
|---|---|---|
| 1 | Scope | The scope can also be used to determine the associated stakeholders. |
| 2 | Design or architecture | It also describes what the model represents and how it is validated. The result is a maturity model with its stages. Each level should have an explicit name to distinguish it from the others. |
| 3 | Populate | Each model defines how and what is measured. Each stage has a set of criteria to meet. For each step, the measurement method and the corresponding scale are defined. For complex domains, it is necessary to divide them into subcomponents in order to make |

| No | Phase | Description |
|---|---|---|
| | | them more measurable. For example, Delphi, focus group, Likert scale and others can be used as measurement techniques. |
| 4 | Test | Every model must be tested. This allows the validity, generalizability and reliability to be tested. A pilot test is conducted to determine whether the objectives of the model have been achieved. For this purpose, a pilot group is created, which is composed of the later users of the model. |
| 5 | Deploy | The larger the audience of the model, the more widely it will be accepted and standardised. |
| 6 | Maintain | By using the model more widely, the authors receive feedback from the users. External influences can also lead to the model having to be further developed. |

It turns out that the steps populate and trest are new in contrast to Mettler. De Bruin et al. (2005) describe the development of a maturity model as a lifecycle. The lifecycle is comparable to that of Mettler (2009). In contrast to Mettler, de Bruin et al. mention that each cycle is executed like a waterfall model. This means that if erroneous decisions are discovered during the process, the respective step must be returned to. The development process begins again at that point. Since this is a lifecycle, the model will continue to be maintained after publication.

Lasrado (2016, pp. 7–9) propose a six-step procedure to develop a maturity model as shown in Table 6.

Table 6: Six-phase procedure maturity model development defined by Lasrado et al. (2016, pp. 7–9)

| No | Phase | Description |
|---|---|---|
| 1 | Problem definition | Necessary and sufficient conditions must be defined so that each level can be reached. |
| 2 | Necessary condition analysis and identify boundary conditions | The necessary conditions analysis is used to find the boundary conditions for each maturity stage. |
| 3 | Formulation of maturity stages and boundary conditions | Based on the results of the necessary condition analysis, the number of maturity levels is defined. Each stage has boundary conditions that have to be fulfilled. Each should have four to five levels. |
| 4 | Qualitative comparative analysis and derive maturity configurations | Based on the qualitative comparative analysis are the calibration of the maturity stages and the necessary conditions. This is an iterative cycle, so there could be new macro |

| No | Phase | Description |
|---|---|---|
| | | conditions for a maturity stage and are formulated. |
| 5 | Transfer concept | This step visualises the results and outcomes. The visualisation helps for management better understand how to reach each maturity stage. |
| 6 | Operationalise quick version of maturity measurement | Each maturity measurement must be checked for accuracy or adjusted if necessary. This helps to create a diagnostic tool. It is essential to understand the needs of critical stakeholders. |

Lasrado et al. (2016, pp. 2–17) pursued a completely different model in order to develop a maturity model. They proceed with the development using theoretical methods. This is shown by the steps for Qualitative Comparative Analysis and Necessary Condition Analysis. These steps are used to define the necessary number of levels in the maturity model. You further write that the results of the last step will be presented to an academic-industry project consortium or its stakeholders. Unlike the other two authors, they do not mention what happens after the last step. It is not mentioned whether there is a lifecycle.

Because Lasrado et al. (2016, pp. 2–17) describe a different procedure for developing a maturity model, it does not have much in common with the steps mentioned by de Bruin et al. (2005). This although they refer to the steps of the latter.

In summary, it can be said that all defined steps have some similarities. However, each author describes his point of view and has defined a different approach. For the development of the maturity model in this thesis the ideas and thoughts of all three authors flow in. However, the literature shows that Mettler (2009) and Lasrado et al. (2016, pp. 2–17) are both based on the steps of de Bruin et al. (2005). Since the Mettler (2009) only defines four steps, it was easier to use them as a starting point and to compare the descriptions of the other two authors.

Based on Damsgaard & Scheepers (2000, p. 138), Pascale et al. (1981, p. 82) defined for a maturity stage the seven S. They have used the seven S model to address general organizational and management elements. This should help in the development process of a new maturity model to structure each level. It should give the management an overview to discuss the different aspects in management and implementation of the maturity model. For this reason, the seven S model is used for the development of the maturity model in this thesis.

Table 7: The seven S by Pascale et al. (1981) mentioned in Damsgaard & Scheepers (2000, p. 138)

| Element | Description by Pascale et al. (1981, p. 82) |
|---|---|
| Strategy | A plan or approach that over time leads to the allocation of a company's scarce resources to achieve its defined goals. |
| Structure | Characterisation of the organisation chart (i.e. functional, decentralised) |
| Systems | Proceduralised reports and routinised processes, such as meeting formats. |
| Staff | Demographics description of important personal categories within the firm (i.e. engineers, entrepreneurs, MBAs). Staff is not meant in line-staff terms. |
| Style | Characterisation of the behaviour of key managers in achieving the goals of the organisation including the cultural style of the organisation. |
| Skills | Distinctive capabilities of key personnel or the firm as a whole. |
| Superordinate goals | The significant meanings or guiding concepts that an organisation imbues in its members. |

## 2.4 **Assessment of a maturity model**

Many maturity models do not describe how the individual levels are evaluated. Furthermore, the methodology of how the levels are to be assessed is not specified. Using Pöppelbuss & Röglinger (2011), academics and practitioners have tried to classify and evaluate maturity models based on theoretical assumptions. However, it turns out that there is no general and universally accepted procedure how a level of a Matura model should be assessed, or which methodology should be applied. The assessment methodology is essential because it is responsible for what data needs to be collected. (Frick, Küttner, & Schubert, 2013, pp. 274–275)

Another problem is that researchers are struggling to find a true definition of what a good Maturity Model is. This leads to the fact that there is also no uniform procedure of how a level is to be evaluated in a maturity model. As a result, Fraser et al. (2002) divided the maturity models into different types. The types are maturity grids, Likert-like and hybrid of both forms. The maturity grid is a matrix which represents the criteria to be tested and the individual levels in a tabular form. The columns are the individual levels and the rows the corresponding criteria. Likert-like is a form in which a level is evaluated in the form of a survey. The hybrid form uses both types and combines them. (Frick et al., 2013, p. 276)

Based on Mettler et al. (2009), they define three dimensions which a maturity model should include for the assessment. (1) General model attributes describing the assessment criteria of the model. (2) Maturity Model Design deals with the conceptual problems of constructing and organising the Maturity Model. (3) Maturity model usage describes the development and proposals for the assessment of levels and practical applicability. Each of these three dimensions defines different attributes, which stand for the requirements of the Maturity Model. (Frick et al., 2013, p. 276)

When applying a maturity model, it is difficult to ensure that the assessment methods are not misused. This could result in no valid and verified results. Therefore, it is important that the methods are well orchestrated. There are three different types of assessment of the organisation against a maturity model. (1) Self-assessment, (2) third-party assessment and (3) Certified assessment. In self-assessment, data and information from own organisation are collected by internal members. One problem with self-assessment is that, by definition, there is bias because internal personnel are involved in the assessment. In the case of third-party evaluation, the evaluation is carried out by an external partner. The self-assessment is extended and carried out by the external partner. Internal specialists support the employees of the external partner. In the case of the certified evaluation, the evaluation of the organisation is carried out by certified practitioners. However, none of these types indicates the methodology used in the assessment. (Frick et al., 2013, p. 277)

Table 8: Assessment method matrix by Frick et al. (2013, p. 281)

| Model Complexity | Low | High |
|---|---|---|
| High | In-Depth Method | Multi-Method |
| Low | Limited Scope Method | Wide-Reach Method |

Subject Complexity

Frick et al. (2013, p. 281) describe that not every organisation is capable of performing any methodology for assessing a level in a maturity model. They have created a matrix that takes into account the complexity of the subject as well as the complexity of the model. For a better overview, Table 8 is helpful as support. An example is given to illustrate how the matrix can be applied. The quadrant at the top left as an example can be described as follows. An organisation with a low topic complexity and a high model complexity needs a project and draws on expert advice. A low complexity

model, on the other hand, can be done by self-assessment. Table 9 gives an overview of which quadrant from the matrix in Table 8 leads to which instrument. (Frick et al., 2013, p. 281)

Table 9: Assessment method, instruments, and execution defined by Frick et al. (2013, p. 281)

| Method Approach | Exemplary Instruments | Execution |
|---|---|---|
| Limited Scope | Interview, limited survey | Self-assessment |
| In-Depth | Case study, focus group, interviews, simulation | Third-party |
| Wide-Reach | Extensive survey | Self-assessment, Third-party |
| Multi-Method | Multiple, e.g. case study and survey | Third-party or Self-assessment |

Frick et al. (2013, p. 281) summarise that a model with a high complexity should be performed for an evaluation by a third party. However, this requires that the third party has the necessary knowledge about the model. On the other hand, a model with low complexity can be evaluated by a self-assessment.

# 3 DEFINITION OF TOURIST DESTINATION

According to Ammirato et al. (2018, p. 624) and Gretzel et al. (2015, p. 180), the UN World Tourism Organisation (UNWTO) defines a tourism destination as a physical place where the visitor can spend an overnight. There could be administrative and analytical boundaries. Furthermore, they stress that tourism is "a social-cultural and economic phenomenon" (Gretzel, Sigala, et al., 2015, p. 180).

## 3.1 Tourism Ecosystem

Based on Palmer & McCole (2000, p. 198), Gartrell et al. (1991) describe that the success of a tourist destination depends on a network of an independent and inter-dependent organisation and companies. In this context, Palmer & McCole (2000, pp. 198–200) state that some organisations are unwilling or unable to cope with the complexity of a tourist destination. Therefore, there is an organisation necessary which can compete in the global market. This organisation builds a network with all relevant partners also referred to as stakeholders. These partners can be restaurants, hotels, museums and other attractions. Each of them is independent, but in their totality they are interdependent. Each partner brings a part of its core competence to the organisation.

With the help of a tourist organisation, the result of this collaboration is a composite product that experiences tourism. Therefore, Palmer & McCole (2000, pp. 198–200) argue that bringing together all partners together with the tourism organisation creates a virtual organisation. In this context, Palmer & McCole (2000, p. 198) define the virtual organisation as a network of independent companies, suppliers, customers, and even rivals linked by Information Technology (IT) to share skills, cost, and access to one another's market. (Palmer & McCole, 2000, pp. 198–200)

Ammirato et al. (2018, p. 624) claim that along the tourism value chain there must be a cluster of products and services as well as activities and experiences. Those are possible if all involved stakeholders are united and form a network. By arguments from Palmer & McCole (2000, p. 198) and Ammirato et al. (2018, p. 624) Figure 1 could be the image of a virtual organisation. In detail, Brandt et al. (2017, p. 703) argue that the virtual organisation is forming a tourist ecosystem.

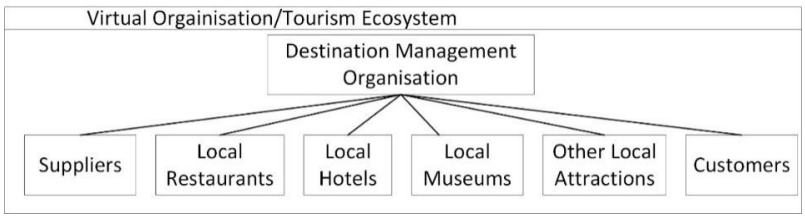


Figure 1: Virtual organisation or tourism ecosystem

## 3.2 **Destination Marketing Organisation**

Different researchers defined the term destination marketing organisation (DMO) or destination management organisation (DMO) (Ammirato et al., 2018, p. 623; Brandt et al., 2017, p. 704; Buhalis & Amaranggana, 2015, p. 381; Elbe, Hallén, & Axelsson, 2009, pp. 286–287; McCamley & Gilmore, 2018, p. 158). Both terms refer to the same; however, within this thesis, the term destination management organisation is used. Ammirato et al. (2018, p. 6264) claim that each DMO has not only the role in managing or advertising a destination, but they also reduce asymmetries in information among stakeholders. Ammirato et al. (2018, p. 624) support that a DMO ”calls for a coalition of different interests to work towards a common goal". Further, they state that DMOs needs to work closely with the government, local authorities, and businesses to be effective. This is supported by McCamley & Gilmore (2018, p. 158) that a DMO provides a link between government and private sector supplier. Therefore, DMOs are boundary spanner of a collaborative network of local services providers and tourists. Within the tourism value chain, the DMO acts as an intermediary between the various providers and the tourists. (Ammirato et al., 2018, pp. 624–628) According to Palmer & McCole (2000, p. 199), Sussman & Baker (1996) argue that DMOs have to go closer to actual and potential customers by providing greater customer satisfaction. Further to them, Pollock (1995) concluded that the role of a DMO is rarely to sell a product but to bring together buyers and sellers.

The success of a tourism destination and DMOs is strongly linked to the fact that it functions as a unique interface of the network. Buhalis & Ammaranggana (2015, p. 381) establish that a DMO is the central construct and promotes a positive tourism experience.

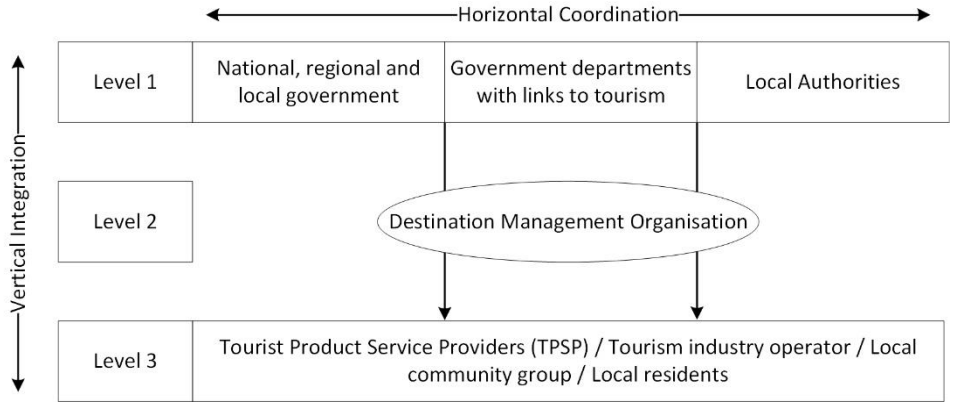


Figure 2: Stakeholder infrastructure by McCamley & Gilmore (2018, p. 162)

McCamley & Gilmore (2018, pp. 158–159) suggest that the infrastructure of stakeholders have three different levels, see Figure 2. Level 1 shows that government agencies are responsible for the strategic management and direction of tourism. This includes national, regional and local governments and authorities. Within the authority, dialogue and communication, as well

as cooperation between departments, are necessary, which is referred to as horizontal coordination. Level 2 shows the DMOs, which have a coordinating function between tourism product services and government agencies. Level 3 shows that tourism product service providers are the most consumer-oriented part of the infrastructure. This level also includes the residents and the community group. All three levels form a vertical integration.

Elbe et al. (2009, pp. 286–287) define that in a DMO the degree of cooperation between the participants can vary. This can range from limited to moderate to broad cooperation. All require a certain degree of commitment and adaptation by the stakeholders involved. In this way, stakeholders provide adequate resources. Smaller companies are not always in a position to provide these resources. Larger companies have more opportunities and also more personnel available so that they can contribute them to the DMO. (Elbe et al., 2009, pp. 286–287)

Zeng & Gerritsen (2014, pp. 29–30) argue that social media plays a significant role in the travellers planning process and sharing experience after the trip, moreover tourists can rely on others' experiences which help them to make proper decisions. Additionally, if a tourist shares their experience with pictures or videos on a hotel social media site this involvement has a positive impact to revisit the page. In contrast, business travellers have a different attitude and mostly follow their company's recommendation for accommodation. Moreover, they are more convinced to use search engines or online travel agents to get available hotels. Otherwise, leisure travellers often follow the recommendation from friends or colleagues before they use search engines or travel-related websites. (Zeng & Gerritsen, 2014, pp. 29–31)

As shown above, a DMO is not only a provider of information to tourists but also form a network of different businesses which are involved in the value chain of a tourist. The new form of cooperation all leads to a common goal: entertain the tourist and thus lead to a better experience.

# 4 EVERYTHING IS SMART

The term smart is used today in many areas. This also influences the tourism sector. This chapter deals with the topic smart and describes it in the areas Smart City, Smart Tourism and Smart Tourism Destination. These areas depend on each other.

## 4.1 Defining smart

"The term 'smart' represents a marketing word for all things that are embedded or enhanced by technology" (Boes, Buhalis, & Inversini, 2015, p. 391). These days the adjective smart is used in all kind of situation and combined with almost every noun. As Apple 2007 introduced the first smartphone, that was the ignition to use the adjective smart (Cocchia, 2014, p. 29). Gretzel et al. (2015, p. 180) additionally emphasise that smart describe technology-driven ways to connect and exchange information.

Further, it does not matter what kind of technology is used; it is more how everything is connected. That is one of the reasons while everything could be or is smart. Some authors tried to define what the meaning of smart is or what they call smartness (Nam & Pardo, 2011, p. 283). As explained by Nam & Pardo (2011, p. 283), Klein et al. (2008) state that smartness nowadays means that everything in daily life is centred on a user perspective. Further, they say "smart is more user-friendly than intelligent" (Nam & Pardo, 2011, p. 283), because smart could be replaced by the word intelligent. Li et al. (2017, p. 2) emphasise that the difference between smart and intelligence are two different aspects of wisdom. Moreover, they state that intelligence can change its state or action in response to varying situations in contrast smart "means to do the right thing in various circumstances" (Li et al., 2017, p. 2).

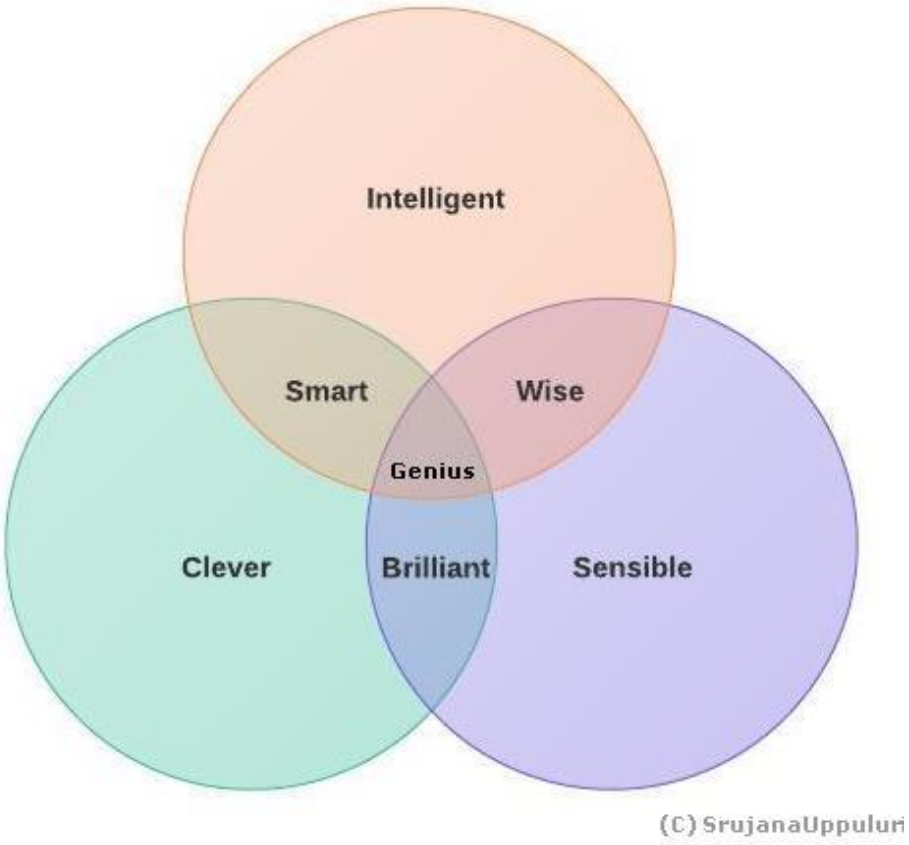


Figure 3: Shows the difference between smart and intelligent (Anoohya, 2011)

Based on the idea of Gretzel et al. (2015, pp. 179–180), Harrison et al. (2010) argue that the meaning of "smart is exploiting operational, near-real-time real-world data, integration and sharing data […] which helps to make better operational decisions" (Gretzel, Sigala, et al., 2015, p. 179). Even the buzzword smart has not a clear definition, suddenly everything is smart (Gretzel, Sigala, et al., 2015, pp. 179–180).

## 4.2 **Defining Smart City**

There are numerous definitions for Smart City depending on the meaning of the word smart (Cocchia, 2014, p. 13). Smart City is the foundation on which Smart Tourism and Smart Tourism Destination are built. For this reason, Smart City is described here in order to have a better understanding.

This led to each author having their definition of Smart City. However, for this thesis, the definitions from some authors were used (Buhalis & Amaranggana, 2013; Cocchia, 2014; Nam & Pardo, 2011). All agree that Information and communication technology (ICT) plays a significant role to become a Smart City. Cocchia (2014, p. 14) mentions that some authors used Digital City instead of Smart City. Furthermore, she also states that before the introduction of the first smartphone, most authors used the definition Digital City. After the introduction of the first smartphone, the

definition of Smart City became more and more common. One of the reason is that “Smart City is a political trend, driven by international institutions, to implement adequate initiatives to improve the environmental quality in cities” (Cocchia, 2014, p. 30).

According to Boes et al. (2015, p. 393), Kanter & Litow (2009) describe that “a Smart City can be perceived as an ‘organic whole’ and as a linked system where the people, visitors and citizens alike, are the most important aspect”. Further, they state that Smart City tries to increase the quality of life for citizens. In most European cities, however, tourism is part of their income. Therefore, Smart Cities should not focus only on citizens. (Boes et al., 2015, p. 393) A Smart City can adapt itself to the user needs and can provide personalised services to them. A significant characteristic of a Smart City is collaboration. Business, government, academics, non-profit and voluntary organisations, and others are part of the system and collaborate. For these reasons, the government become more transparent and accountable. It allows better to manage resources more effectively, and citizens have access to decisions that affect their lives. People are one of the success factors to become a Smart City. All relevant stakeholder, as well as residents, participate in collaborating, to cross-linking of knowledge and creating innovations. (Boes et al., 2015, p. 398)

All Stakeholder have their particular interests and have different goals to achieve. Especially citizens are the biggest group of stakeholders. However, Smart City should be still a citizen-centric or citizen-driven approach. Smart City’s goal is to create an environment of sharing information, collaboration, interoperability, and seamlessness. (Nam & Pardo, 2011, pp. 283–288)

Cocchia (2014, pp. 17, 29, 35–36) adds that Smart City is involved in many aspects of urban life. She also states that Smart City must be accessible and affordable. To be accessible means inclusion to all citizens. Moreover, a Smart City is mainly technology driven. “A smarter city infuses information into its physical infrastructure to improve conveniences, facilitate mobility, add efficiencies, conserve energy, improve the quality of air and water, identify problems and fix them quickly, recover rapidly from disasters, collect data to make better decisions, deploy resources effectively, and share data to enable collaboration across entities and domains” (Nam & Pardo, 2011, p. 284).

Smart City is mostly technology driven so that local organisations are interconnected through ICT and interactive services. Citizens have access to the services and can use them. It also facilitates to have access to value-added service and real-time information on public transport. Real-time interactions play an essential role in Smart City. This is done with the help of the Internet of Things (IoT), which collects the data. (Buhalis & Amaranggana, 2013, pp. 553–557)

Further, the real-time interactions are triggered by real objects which are connected to the internet. For tourists, the following six points are essential which are referred to as the six A's: attraction, accessibility, amenities, available packages, activities, and ancillary services. (Buhalis & Amaranggana, 2013, pp. 553–557)

Apparently, Smart City aims to ensure that every user has access to services from anywhere and at any time. Not only tourists but also citizen will benefit from this to improve their quality of life or stay.

## 4.3 **Defining Smart Tourism**

"The basic starting point of Smart Tourism is to fully satisfy the tourists' needs for food, accommodation, travel, shopping and entertainment" (Li et al., 2017, p. 4). They further remark that Smart Tourism means it can change its state or action based on the reaction in various situations. To do that, the previous faced experience will help and generate appropriate results. Tourist search for information for public transport, where to stay or to eat. They do it not only before but also during a trip. Yoo et al. (2017, p. 330) point out that Smart Tourism is more than to have a website. They explain that Smart Tourism supports a tourist throughout their lifecycle. Gretzel et al. (2015) further advocate that Smart Tourism provides more relevant information, greater mobility and better decision support. It is helpful to have a good DMO which provides the necessary information. Moreover, tourists wanted to have the information anywhere at any time and preferred through a smartphone application (Li et al., 2017, pp. 2, 4).

Gretzel et al. (2015, p. 181) define a Smart Tourism as tourism which integrates, collects and aggregates data. Data can come from physical infrastructure, government and organisational sources, and human bodies to combine them using state-of-the-art technology. Data is transformed into a local experience and creates entrepreneurial value creation potential. In the case of smart tourism, technology is seen as infrastructure and not as an information system. Li et al. (2017, p. 3) point out that Smart Tourism is based on new communication technology to meet the needs of the individual tourist. This leads to using tourism resources effectively while integrating social media. Smart Tourism uses technologies like cloud computing, networking and portable devices. All are connected via the internet to achieve information about tourism resources or activities on-site. Therefore, tourists can acquire information at the right time to arrange or adjust their travel plans by using all kind of tourism information. Smart Tourism convinces to a new development which is integrated, agile and interactive. It meets the demands of tourists and supports mobile devices for decisions. Tourists are informed accurately and timely by the use of IoT which will help to provide the necessary data in real-time. It is not only data-mining, or collection sensor data but also social media should be integrated into it. (Li et al., 2017, pp. 2–4)

Koo et al. (2013) illustrate a practical model for Smart Tourism which contains the three channels webpage, social media and smartphone application. Through all the channels a tourist can receive information or can interact with the tourism organisation. Further, they emphasise that tourist has already experience in using Google Maps or social media to receive the experience of other tourists. Therefore, there should be an integration into the IT system of the tourism organisation to answer questions of potential tourists. The reason for this is that tourists try to collect as much information as possible, so it does not matter which channel is used. Koo et al. (2013) conclude that demand, behaviour, and satisfaction are different and depends on which channel someone received the necessary information. (Koo et al., 2013)

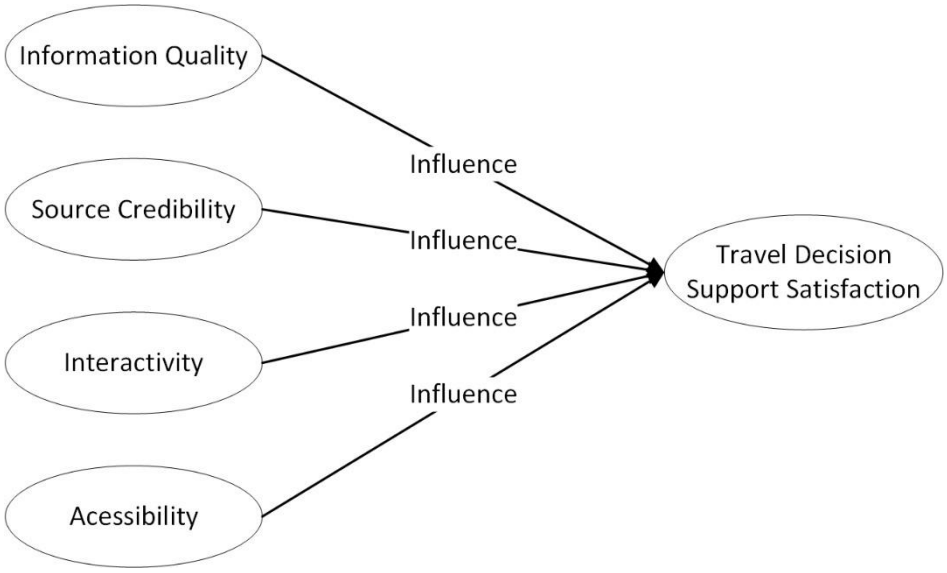


Figure 4: What influences in Smart Tourism a traveller by Yoo et al. (2017, p. 332)

Yoo et al. (2017, pp. 330–331) support the findings from Koo et al. (2013). Further, they defined the expression Smart Tourism Technologies (STT) which include all relevant IT system of a tourist organisation. This could be the webpage, social media, and smartphone apps. However, an STT should provide the information to a tourist in an interactive manner. According to Yoo et al. (2017, p. 331), Perdue (2002) argue that the travel quality for a tourist increase when the STT perceive accessibility, ease of navigation, and visual attractiveness. A good STT should have the four ellipses on the left side as seen in Figure 4 and what impact they have. Those four cornerstones influence travellers' decisions. The cornerstones are information quality, source credibility, interactivity, and accessibility. Information quality is described as information must be sufficient, accurate up-to-date, so that traveller is satisfied and have an influence on their planning. Despite, high-quality content is still a concern. Source credibility is explained how a tourist perceives a system as trustworthy, reliable, experienced, and professional. Information quality and source credibility go hand in hand because false or unsatisfied information makes the system untrustworthy

and unreliable. Interactivity is represented as users perceive a system as interactive when they are reciprocal, responsive and speedy in response. Responsive is the ability that a website or smartphone application adapt themselves to the devices' display resolution but also means that a tourist can classify the information as relevant or not. Reciprocal gives tourists opportunities to participate and communicate jointly with tourist organisations. Speed to response means that the system delivers the necessary information fast enough so that a tourist has not to wait too long. Accessibility is referred to how a website and its content is easily searchable and accessible to current and potential tourists. This is a significant factor that an application or in this case an STT is successful or not. As a result, information quality, source credibility, interactivity, accessibility has a positive influence on tourist and support their decisions. (Yoo et al., 2017, pp. 330–334)

Gretzel et al. (2015, pp. 560–561) define when DMO and stakeholders of tourism services are connected by using the digital environment; this form a Smart Tourism Ecosystem (STE). Therefore, an STE is an interaction space and involves various types of players, but each player can fulfil multiple roles. An STE does not evolve automatically the necessary technological, and regulatory conditions are met. Furthermore, they state that data is the primary food source for an STE. (Gretzel, Werthner, et al., 2015, pp. 560–561)

This section showed that the smartphone is very popular with tourists these days. Through smartphone application, a tourist can receive information anywhere at any time. When an application uses a global positioning system (GPS) signals, it could provide location-based services, and according to the position it can deliver better information tourists. Also, Smart Tourism makes it easier for tourists to search for information. It helps them to make decisions before, during and after the trip or to book certain services (Yoo et al., 2017, p. 337).

## 4.4 **Defining Smart Tourism Destination**

The basic principles of Smart Tourism remain valid in the Smart Tourism Destination. In this case, the tourist is more integrated. Smart Tourism was mainly limited to the tourism organisation and the stakeholders of the tourism services. Figure 5 shows how the Smart Tourism Destination depends on Smart Tourism and integrates the tourism destination.

Based on Gretzel et al. (2015, p. 180), Lopez de Vila et al. (2015) defines a Smart Tourism Destination that has sustainable development of tourist areas which is accessible to everyone. It increases tourists' experience and improves citizens' quality of life.

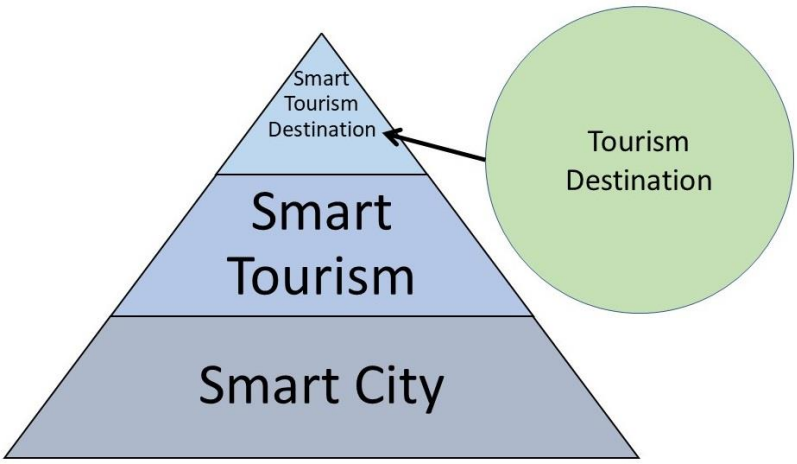


Figure 5: from Smart City to Smart Tourism Destination pyramid

Vecchio et al. (2018, pp. 848–850) emphasise that a smart tourism destination dynamically connects all community stakeholders via a single platform. Also, they confirm that it is a system that allows a communication flow and supports decisions. In reality, it arises that a Smart Tourism Destination will be a complex system of products and services where many stakeholders with their interests involved. (Vecchio et al., 2018, pp. 848–850)

In fact, a destination should be able to manage the stakeholders "to work towards a common goal to ensure the viability and integrity of destinations" (Ammirato et al., 2018, p. 624). Further, they advocate that stakeholders "can build a network to form larger destinations" (Ammirato et al., 2018, p. 624). Boes et al. (2015, pp. 392–399) stress, that competition between stakeholders should be eliminated. Buhalis & Ammaranggana (2013, p. 557) stress that a Smart Tourism Destination should take advantage of the following four points. "(1) Technology embedded environments; (2) Responsive processes at micro and macro levels; (3) End-user devices in multiple touch-points; (4) Engaged stakeholders that use the platform dynamically as a neural system" (Buhalis & Amaranggana, 2013, p. 557).

Boes et al. (2015, p. 392) comment that a Smart City is the foundation for Smart Tourism Destination because it also takes the advantages of ICT infrastructure and technological applications. Gretzel et al. (2015, p. 180) additionally describe the integration of ICT into physical infrastructure. Notably, the use of ICT allows Smart Tourism Destination to supply co-creation of value and experience for travellers. Gretzel et al. (2015, p. 180) argue that a Smart Destination is nothing more than a Smart City but aligned to residential and tourist equally. They show that most Smart Tourism initiatives in Europe were started of Smart City projects, but the focus is to bring together existing data combine and process them in a new way that tourism experience could be enriched.

Smart Tourism Destination aims to co-create and provide services for tourist to enhance their experience (Vecchio et al., 2018, p. 828). A destination

is only successful if the initiative is taken to develop the critical resources, which are known as the six A's. Also, those A's are amalgamated to adding value to the tourists' experience and rising profit and benefits out of a destination. Therefore, there is a need for human resources to collaborate and combinate incentives for innovation on a local and a regional level. (Boes et al., 2015, pp. 392–394) Ammirato et al. (2018, p. 624) illustrate that the tourist experience at a destination is affected by the quality of services and interactions. This could be public or private services like hospitality or interactions with communities and environments.

Ammirato et al. (2018, p. 627) establish the definition of tourist 2.0 and tourist 2.0 lifecycle. Based on the emerging of Web 2.0 and the new possibilities, they created the new definition of tourist 2.0. A tourist 2.0 uses the current state of art technologies and tools. New technology and the use of existing data a tourist could be assisted with routes, attractions and other recommendations. This could be done by location-based services which use GPS or cell-id signals to localise the current position. It can be all kinds of data or services provided to tourist like weather conditions, opening hours and more. A tourist 2.0 lifecycle contains a sequence of activities each tourist does before, during and after a trip. The stages are dreaming, planning and booking, experiencing, recollecting as described in Table 10. (Ammirato et al., 2018, p. 627)

Table 10: Tourist lifecycle phases by Ammirato et al. (2018, p. 627)

| No | Phase | Description |
|---|---|---|
| 1 | Dreaming Phase | Dreaming phase is when there is a desire to travel. |
| 2 | Planning and booking phase | Planning and booking phase is when a tourist composes their holiday and book flights, excursions, events and accommodations. |
| 3 | Experience phase | Experience phase is when the tourist is at the destination. |
| 4 | Recollection phase | Recollection phase is when the tourist is back home and share their experience and photos. |

Tourism operators and tourist can profit from ubiquitous technologies like Radio-Frequency Identification (RFID), near field communication (NFC), or IoT. They all enable data to be collected and passed on to tourists or are used by tourism operators to develop new services and products. Moreover, tourism organisation use the potential from the data to ease congestion or manage the tourist flows. (Ammirato et al., 2018, pp. 624–627) Buhalis & Ammaranggana (2013, p. 558) describe when tourism sites (for example, museums) would use sensors they could control visitor numbers regarding the capacity the site has.

Buhalis & Ammaranggana (2013, pp. 558–562) stress the transformation to Smart Tourism Destinations are having access to destination-wide real-time information. This is achievable by open access data through an integrated and public-controlled system that offer data to citizen and tourist. Also, the government should prevent providers from having data monopolies, since data should be publicly available. Data could come from sensors or existing open data. However, tourists have limited knowledge and low awareness of the destination they visit. With the use of open data, apps can be built which fulfil the different needs and characteristics of tourist. (Buhalis & Amaranggana, 2013, pp. 558–562)

Successful Smart Tourism Destinations are based on publicly available data. Data is collected by sensors or by state-of-the-art technology and made available. Apps use the data and help to simplify a tourist's trip when they are at the destination. It also shows that all stakeholders involved are working towards the goal to ensure that tourists have good experiences.

# 5 DATA GATHERING

Hashem et al. (2014, pp. 101–102) state that data can come from different sources such as web & social media, machines, sensing, transactions, and IoT. This chapter lists the ways which are essential for a tourism destination. In this case, it is about social media, open data and IoT. The literature showed that these forms of data collection should be integrated into a tourism destination (e. g. Vecchio et al., 2018).

## 5.1 Collecting data by open data

Big data and open data are buzzwords in this thesis. Data are generated everywhere and all the time, so that it can be processed or analysed. However, in this thesis, big data and open data are used simultaneously and referred to as open data. Big data is referred to as a term for data which is collected from different sources and stored. This chapter describes what open data is.

### 5.1.1 Definition of open data

According to Berrone et al. (2016, p. 39) describe that open data is referred to as data which can be freely used, reused, and redistributed. These data should not have any restriction of copyright or another control mechanism. Everyone can use the data about how they wish.

Moreover, Meijer & Potjer (2018, pp. 613–614) demonstrate that citizens can generate data, besides government. For example, if a government has set up interfaces for citizens, they can report a defective street lamp. This way, citizens generate data that can be evaluated and analysed by the local government. “Citizen-generated data are a specific form of user-generated data” (Meijer & Potjer, 2018, pp. 613–614).

For a user of open data, it is vital that they can obtain the data via a platform. Governments mostly provide open data, and therefore they have to create a platform for the users. However, that a government can provide such a platform, they need an open data strategy. They should know which data they want to provide or declare as open available. Furthermore, Meijer & Potjer (2018, p. 619) argue that ease of use of the data has great importance for the users and citizens. The result is that many governments fail with an open data platform because they lack the understanding of a generally open data framework and this leads to wrong decisions in the implementation and formulation of the strategy. However, existing companies also benefit from open data, because they can provide new or better services. As a result, a government should establish a culture of a data-driven economy. (Berrone et al., 2016, pp. 39–43)

According to Hashem et al. (2014, pp. 101–102) the nature of data can be structured, semi-structured or unstructured. Structured data are stored in a traditional database. Semi-structured data are in formats like HTML (Hypertext Markup Language), XML (Extensible Markup Language), or JSON (JavaScript Object Notation). Unstructured data are like videos, audios, and images. Structured and semi-structured data are in a manner that they have a pre-defined format and are readable by machines. (Hashem et al., 2014, pp. 101–102; Marjani et al., 2017, p. 5258) According to Vecchio et al. (2018, p. 849), Jin et al. (2015) show that there are two types of data: data from and about the physical world – for example, obtained from sensors, scientific observations – and data from human society – for example, obtained from social media, internet, and marketing. (Vecchio et al., 2018, p. 849)

One reason for governments to provide data that they have used at different levels is to create transparency and accountability. Open data goes further and motivate the public for more engagement and promoting citizen involvement in decision making. However, not all data can be made available through open data. There can be a restriction in confidentiality or law, and those data will not be available online. Moreover, some data are kept secret because they could be misused such as crime data. Also, some government used the mentioned restrictions that they have not to release data. (Berrone et al., 2016, pp. 41–45)

Berrone et al. (2016, pp. 51, 58–61) describe that in an open data strategy it is crucial to identify the critical stakeholders since such an initiative involves many stakeholders. For example, they could be municipality agencies or service providers. Such service providers could be private companies, and therefore they have to build a relationship with the project's leadership inside the government. In order to have a successful open data initiative, it is critical to be a joint enterprise for which collaboration is essential. Thus, it leads to sharing research and innovations resources and therefore co-create new applications out of the data. These applications can reach all economic and social sectors. (Berrone et al., 2016, pp. 51, 58–61)

Furthermore, stakeholders, users and government together form an innovative stakeholder in which everyone is involved in the development, provision and use of data. This collaboration only works when boundaries are crossed, regardless of whether this is within the government or with the service providers themselves. Everyone needs to go one step further to create innovation. Moreover, Meijer & Potjer (2018, p. 619) state that collaboration between third parties and public organisations requires an active search for solutions. (Berrone et al., 2016, pp. 51, 58–61)

Another essential point is that the generated data has to be stored somewhere. According to Hashem et al. (2014, p. 106), data growth may limit or exceed the performance of existing storage systems such as databases.

However, open data requires a storage architecture which allows access in a highly efficient manner for achieving availability and reliability. Moreover, Kaisler et al. (2013, p. 997) argue that everyone and everything creates data. According to them, there could be two solutions to reduce the traffic between data source and storage. First, data is processed in a place where the data is created, and only the result is transmitted to the storage. Second, do a triage of the data and send only data which are crucial for further analysis or processing. (Hashem et al., 2014, p. 106; Kaisler et al., 2013, p. 997) Data can help to solve real problems by developing new applications which help citizens and businesses (Berrone et al., 2016, pp. 60–62).

In summary, "a brilliant strategy is worthless without implementation" (Berrone et al., 2016, p. 64). However, a government is facing several barriers inside and outside its department levels. Private companies can create or enrich open data and make them available. The generated data must be saved. This requires a technology that is capable and has sufficient capacity to process large amounts of data.

### 5.1.2 Use open data

According to Meijer & Potjer (2018, pp. 614, 617–619), there is an intermediate from where all the data are provided to users. Thus, it can be a private organisation or a government. The aim of a central intermediate is that users have one contact point and can get the data from one source.

Berrone et al. (2016, p. 41) describe an example from San Francisco that the use of open data reduced the number of phone calls for information. The city provided real-time information for transit as open data, and therefore they were able to save money just by supplying data. Those data were available through a predefined format and a corresponding application programming interface (API). (Berrone et al., 2016, p. 41)

Berrone et al. (2016, pp. 60–62) emphasise that data from the municipality and other public agency are often not harmonised nor they use a standard format. It is crucial for users to have data in a standardised format. As a result, with standardised format data are readable by a machine and therefore users can better identify which data are valid and trustworthy. It reduces the potentiality of misinterpretation and misreading. Hence, this would lead to a broader acceptance by users and data could be shared between cities. (Berrone et al., 2016, pp. 60–62)

Based on Berrone et al. (2016, pp. 65–66) open data need a culture for feedback and controls. As soon as data are available, there could arise issues or other problems. Therefore, the government should get feedback from data users, but they should also install a control mechanism. A controlling is required to address potential deviations and continuous improvements. Moreover, it is vital that the data provider communicates appropriate and on time. (Berrone et al., 2016, pp. 65–66)

In conclusion, the using of open data allows new services and applications but also it could lead to that government can save money. Can use apps instead of calling the government to gain the required information.

## 5.2 **Collecting data with the IoT**

The IoT is playing an increasingly important role because Smart City is based on it in which things are measuring, and data is delivered. Data is collected and made available at a central location. The new technology is a link between the physical world and its counterpart in the virtual world. (Kaur & Kaur, 2016, pp. 357–360; Nitti, Pilloni, Giusto, & Popescu, 2017, pp. 1–2)

### 5.2.1 Definition of the IoT

"IoT is based on the integration of various processes such as identifying, sensing, networking, and computation" (Čolaković & Hadžialić, 2018, p. 17). According to Čolaković & Hadžialić (2018, pp. 17–24) and Atzori et al. (2010, pp. 2787–2804) there are several other terms for IoT such as IoE (Internet of Everything), WoT (Web of Things), CoT (Cloud of Things), M2M (Machine to Machine), and more. One of the reasons why the term IoT is so fuzzy is because it is composed of the terms internet and things. In this thesis, the term IoT is used. (Atzori et al., 2010, pp. 2787–2804; Čolaković & Hadžialić, 2018, pp. 17–24)

IoT enables a new type of seamless connection where the connection is available anytime, anywhere. Gretzel et al. (2015, p. 182) describe IoT as networked objects that can be identified, located, monitored and managed. Moreover, IoT "is defined as an infrastructure of interconnected objects, people, systems, and information resources together with intelligent services" (Čolaković & Hadžialić, 2018, p. 18). Each of the IoT can be addressed by a unique addressing schema. According to Marjani et al. (2017, p. 5248), Ciufo (2014) describe an IoT as a device can talk with each other and central controlling devices. However, IoT can put into several categories such as sensing technologies, identification and recognition technologies, hardware, software and cloud platforms, communication technologies and networks, software and algorithms, positioning technologies, data processing solutions, power and energy storage, and security mechanism. Based on the functionality the IoT can be grouped according to the domain of utilisation such as monitoring, control, optimisation, and autonomy. The number of connected objects is increasing. IoT is deployed in different areas and collecting various kinds of data such as geographical, astronomical, environmental, and logistical data. (Atzori et al., 2010, pp. 2787–2804; Čolaković & Hadžialić, 2018, pp. 17–24; Marjani et al., 2017, p. 5248)

IoT does not change the basic concept of the internet, but it makes things smarter. They get connected to the internet and collecting data from physical and the virtual world what is referred to as the digital world so that it can react by them. In the beginning, things were considered as RFID tags. Furthermore, this technology enables physical objects to see, hear, think, share information, coordinate decisions, and perform jobs. (Atzori et al., 2010, pp. 2787–2804; Čolaković & Hadžialić, 2018, pp. 17–24; Marjani et al., 2017, p. 5248)

Moreover, the purpose of such network and objects are to exchange information and communication with sensing devices through agreed protocols. The protocol is here referred to the internet and therefore network protocols or communication protocols as well as the format of how the data are exchanged. (Atzori et al., 2010, pp. 2787–2804; Čolaković & Hadžialić, 2018, pp. 17–24; Marjani et al., 2017, p. 5248)

It is also essential to ensure privacy and security. This can be done through mechanisms such as authentication, access control and cryptography. Some objects allow to trace objects and therefore surveillance all equipped objects. This could be not only physical objects but also people. People will resist as long as there are threats to privacy. One of the reasons is that IoT is vulnerable to attacks because they are unattended. Furthermore, they can also be physically attacked. Hacking technology allows hacking the IoT device. (Atzori et al., 2010, pp. 2787–2804; Čolaković & Hadžialić, 2018, pp. 17–24; Marjani et al., 2017, p. 5248)

Besides, an issue for IoT is that they do not have the capabilities for common cryptography algorithms because they are limited in terms of energy, communications and computation capabilities. (Atzori et al., 2010, pp. 2787–2804; Čolaković & Hadžialić, 2018, pp. 17–24; Marjani et al., 2017, p. 5248)

The privacy concern is always a part of our civilisations nowadays. Another essential point is that the ways how IoT is collecting, mining, and provisioning data are different from those that people know. Moreover, to protect the privacy there should be applied appropriate policies to guarantee that (1) when people are tracked they should not be linked to their identities, (2) provide people with the critical information how they are tracked, (3) collected data should be used for the defined purpose and deleted afterwards. However, this is not always possible. For example: when in an area camera for security reasons are installed, someone could only avoid them not entering the monitored area.

Further issues are related to how to represent, store, interconnect, search, and organise information generated by the objects becomes more and more challenging. Therefore, to integrate IoT devices into a system needs a good architecture and appropriate modelling solutions because they have to be integrated into business processes or workflows. (Atzori et al.,

2010, pp. 2787–2804; Čolaković & Hadžialić, 2018, pp. 17–24; Marjani et al., 2017, p. 5248)

As explained by Čolaković & Hadžialić (2018, pp. 24–30) another issue in IoT is that there are many standards and more are introduced to fit into the IoT world. However, standardisation is one of the critical factors for the successful deployment of IoT. Standards are available to the public and make it easier to integrate new sensors and other data mining IoT to their architecture. In the development of IoT architecture, it is important to use open standards because there is less chance of being limited to a specific vendor or technology. (Čolaković & Hadžialić, 2018, pp. 24–30)

Furthermore, IoT architecture is required to be scalability, interoperability, openness, and modularity in a heterogeneous environment. As a result, when the architecture integrates IoT very well into business models and value chains, it enables new business opportunities. Equally important is the availability and reliability of IoT. IoT applications should be available anywhere and anytime because the connected devices should be adaptive and intelligent enough to support seamless connectivity and desired availability. An open architecture based on a set of standards enables the integration of various technologies and gives full support of interoperability. (Čolaković & Hadžialić, 2018, pp. 24–30)

In conclusion, IoT allows a new kind of services and data collection. The sensor is recording activities and send the data in real-time to storage. However, there are some concerns about security and privacy which should be considered seriously. Moreover, it is equally essential that the IoT fits into the current system architecture, processes, and workflows.

### 5.2.2 Data mining with the IoT

Data mining is used to create an efficient way for predictive and descriptive solutions. When data are mined from the IoT, they need to be stored somewhere (see Figure 6).

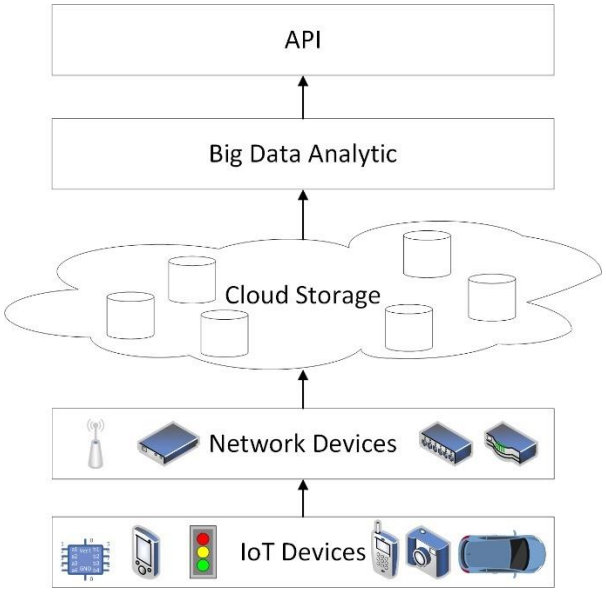


Figure 6: IoT Architecture by Marjani et al. (2017, p. 5253)

According to Čolaković & Hadžialić (2018, p. 29), the spread of IoT objects is also increasing the volume of data. There is a requirement to store the data for later investigation and analysis. Furthermore, they highlight that only cloud technology can handle the amount of data. Marjani et al. (2017, p. 5248) state that "traditional database systems are inefficient when storing, processing, and analysing rapidly growing amount of data". Hence, when a significant amount of data is transferred to the cloud infrastructure, this brings other issues as followed: network performances, costs of moving data through the internet, cost of storing data on cloud servers, security of data transmission and storing, privacy issue, and more. Also, they propose that the sensor or IoT data should raw processing data at locally deployed nodes so that this reduces the amount of data needed to be transferred through the internet. Also, this could prevent some privacy and security issues because the data will be transmitted anonymously. Besides the privacy and security discussion, there is another issue with the format of the collected data. IoT mostly provides its data in a semi-structured format such as XML or JSON. Semi-structured and unstructured data are required to be adjusted before they can be integrated and analysed. (Čolaković & Hadžialić, 2018, p. 29; Marjani et al., 2017, pp. 5248–5258)

Based on Gretzel et al. (2015, p. 182) argue that IoT shifts the service provision from always-on as it is in the web area to always-responsive. This means that an IoT only then communicates when it is important or to a specific need. For example, in tourist attractions, IoT provides new possibilities through sensors. For popular attractions, it could control the number of visitors. The sensor would register the number of visitors and compare it with the site's carrying capacity. Nitti et al. (2017, pp. 5–6) describe that a combination of sensors on vehicles such as buses and in the museum to measure how long the waiting time is, it would help to improve the tourist's experience. Through data analytics, an app could provide the needed

information to the tourist, so they can see how to get to the point-of-interest and how long they have to wait there.

Gretzel et al. (2015, p. 182) claim are supported by Atzori et al. (2010, pp. 2795–2796) that a museum could collect data through the sensor to exploiting their facilities at best. Also, data could be collected and processed automatically. This would reduce data entry and collection errors. Based on Marjani et al. (2017, pp. 5257–5258) that large data sets compared to small data sets comprise more abnormalities and ambiguities. This requires additional cleaning, reduction, and transmission of the data.

Nitti et al. (2017, pp. 5–6) describe an example from Cagliari. Cruise ships do stop in Cagliari, and a large number of tourists visit the city. They only have a particular time to visit the city and therefore want to see as much as possible. These tourists choose an App point-of-interests that they want to visit. Based on this, an analysis is made to calculate the optimal route. This is done on the one hand by the current position of the tourist and on the other hand by sensors that continuously provide the position of all buses as well as the current waiting times at the point-of-interest. From this information, the next destination for the tourist is calculated and which route leads there. Tourists receive the result of this calculation in their app on their smartphone. (Nitti et al., 2017, pp. 5–6)

IoT can lead to new services and applications. New data collected by IoT devices with a data analysis leads to new aggregated information. Tourists have advantages when they get better and accurate information about where to go and how to get there.

## 5.3 **Collecting data over social media**

Nowadays, social media is becoming more and more important. Users share their experiences with their friends. Companies are also using more and more social media as a marketing tool.

### 5.3.1 Definition of social media

Based on Gretzel & Yoo (2013, p. 492), Kaplan & Haenlein (2010) establish social media as “web-based applications built on the philosophical and technical foundations of the Web 2.0 that make it possible to create and easily transmit content.” Some authors (e. g. Gretzel & Yoo, 2013, p. 493) used the term SNS; however, through this thesis, the term social media is used; it is more appropriate than social networks (SNS). However, Zeng & Gerritsen (2014, p. 28) defined social media as tools or means of communication that people can use widely, reach and influence. However, social networking is described as how social media tools are used to interact and communicate with networked friends of individuals.

The term social media is used of many types of media such as blogs, message boards, review sites, social network sites (SNS), and so on. According to Munar & Jacobsen (2014, p. 47) are popular types of social media as follow: “wikis (e. g. Wikitravel). Blogs (e. g. Travelblog), and microblogs (e. g. Twitter), social network sites (e. g. Facebook), media-sharing sites (e. g. Flickr, YouTube), review sites (e. g. TripAdvisor), and voting sites (e. g. Digg).” Gretzel & Yoo (2013, p. 494) argue that each social media type has its purpose, but all have the same aspects.

Furthermore to Ghani et al. (2018, p. 2), Kaplan & Haenlein (2010) state that social media “was initially used around 2004 to describe contents and applications that can be continuously modified and altered by users in many ways through participation and collaboration, rather than traditionally created, prepared, and published.” Based to Gretzel & Yoo (2013, p. 493) sharing texts, pictures, videos, and audio files are called user-generated content (UGC).

Social media allows users to communicate and reach their friends, families, and followers. Although, social media is by its definition open this means that users want to share their messages, pictures, videos, and locations to be widely accessible. As a result, they share everything with the world. When a user contributes something, the content is mostly geo-tagged. It depends on the social media platform. (Brandt et al., 2017, p. 704) According to Ghani et al. (2018, p. 2), Ellison (2007) established that social media has three aspects: (1) everyone can create a profile if its public or only semi-public, (2) individuals can get in contact with others, therefore form their network, (3) through user-generated content (UGC) everybody from the network can see other’s activities. However, social media is not just a new communication tool; it is more an online environment built on participants’ contributions and interactions. (Zeng & Gerritsen, 2014, pp. 27–28) Also, Brandt et al. (2017, p. 704) state that mobile technologies and social media allows users to share their content or in the tourism sector to share their experiences.

Kietzmann et al. (2011, pp. 243–248) defined a honeycomb based on the seven functional blocks of social media which are identity, conversations, sharing, presence, relationships, reputation, and groups. See for this Figure 7.

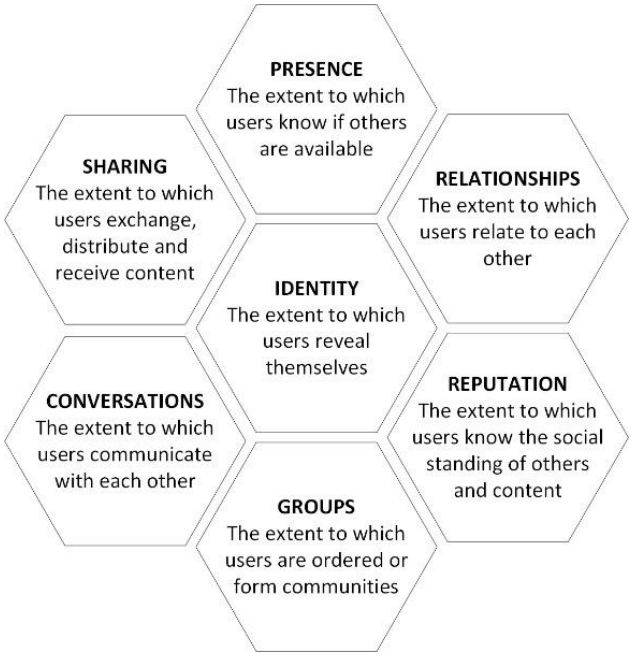


Figure 7: Honeycomb of seven functional blocks of social media by Kietzmann et al. (2011, p. 243)

Table 11: The seven functional blocks of social media definition

| No | Functional Block | Description |
|---|---|---|
| 1 | Identity | Identity identifies a user by name, age, gender, profession, location, and profile pictures. Everyone can determine what information others can see. Companies use this information as a source for data mining and monitoring. |
| 2 | Conversation | Many social media sites have the goal that users communicate with each other. There are several reasons why users communicate with each other, whether they are a private individual or a company. |
| 3 | Sharing | Users can exchange, receive and distribute content, be it text, video, images, sound, link or location. The medium used is social media. Illegality and copyright infringements, however, lead to new problems in the area of social media. |
| 4 | Presence | Users can see which of their friends are online and therefore available. On social media sites, there is a status that indicates who is online or available. Not everyone wants to be contacted via social media. Companies should pay attention to this. |
| 5 | Relationship | Two or more users build a form of association so that they share objects of sociality or meet. Kietzmann et al. (2011, p. 246), Hansen (1999) and Krackart (1992) shows that a strong relationship is "long-lasting and affect-laden", while weak ones are |

| No | Functional Block | Description |
|---|---|---|
| | | "infrequent and distant". An enterprise must define how it maintains its relationships with users and contributes content. |
| 6 | Reputation | Trust users or provide content to others. Both are important to build a good reputation on social media. |
| 7 | Group | If members have the same interests, they form a group on social media for this purpose. This creates a new form of social networking because it brings together users who would otherwise not have met. |

There are two major types of groups. First, users can create with their friends, buddies, followers, or fans self-created-groups and add them. Second, groups can be open to everyone, "closed (approval required), or secret (by invitation only)" (Kietzmann et al., 2011, p. 247). However, there could be a limitation of how users can share content with the group. (Kietzmann et al., 2011, pp. 243–248)

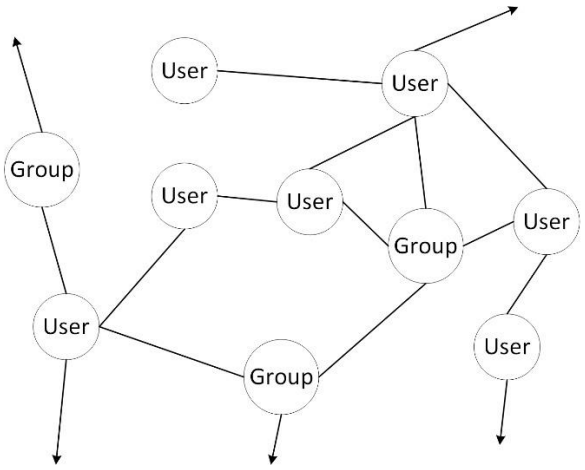


Figure 8: Relationships between users and/or groups by Barbier & Liu (2011, p. 337)

Figure 8 shows the two functional blocks relationships and groups and how users are connected between them (Barbier & Liu, 2011, p. 337).

Overall, social media changed the way people communicate and interact with others. Social media helped to create groups and find new friendships, therefore build new relationships. Additionally, users can share texts, pictures, and videos through social media.

### 5.3.2 Data mining in social media

According to Ghani et al. (2018, p. 1), Kwon et al. (2014) argue that "social media contents, such as tweets, comments, posts, and reviews, have

contributed to the creation of big data extensively from either platform providers or different websites". Ghani et al. (2018, p. 2) state that SNS generate a large amount of unstructured data and this mainly through users by UGC. As a result, any analysers can collect and analyse data in real time, but the data are full of irrelevant information and a considerable amount of inconsistent data. UGC comes from regular people and has the various quality they range from high-quality to low-quality. Data from social media are mostly fuzzy and unstructured. (Ghani et al., 2018, p. 2)

Moreover, they could incorporate users' opinion, behaviours, and thoughts. Therefore, it is necessary for extracting high-quality information from the data, but data need to be cleaned before they are usable. The most common analysis through social media is trend discovery, sentiment analysis, and opinion mining. (Ghani et al., 2018, p. 2)

Barbier & Liu (2011, p. 328) stress that social media data have three characteristics; (1) large means that there are a large number of users on social media, (2) noisy means that there could be irrelevant UGC like advertising tweets or spam blogs, and (3) dynamic means that the content on social media could have changes or updates frequently over short periods of time. Figure 9 shows how big data based on social media are collected and processed through analytics. (Ghani et al., 2018, p. 2)

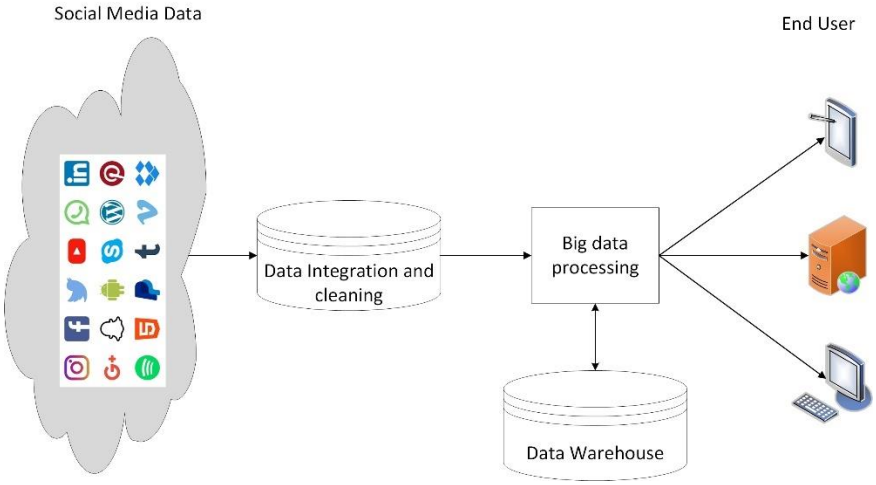


Figure 9: Social media data processing by Ghani et al. (2018, p. 3)

To analyse big data and therefore social media data Ghani et al. (2018, pp. 4–5) described four characteristics of data processing as shown in the table below.

Table 12: Characteristics of data processing by Ghani et al. (2018, pp. 4–5)

| No | Characteristics | Description |
|---|---|---|
| 1 | Descriptive | Descriptive analytics provides the historical data needed to obtain valuable information. It is also referred to as "post-mortem analysis". The most |

| No | Characteristics | Description |
|---|---|---|
| | | descriptive analysis is used for reporting and monitoring sales, department and finance. |
| 2 | Diagnostic | Diagnostic analysis is used to answer questions by discovering, breaking down, performing data mining and data correlation. It helps to examine data to find specific behaviour and causes of events. |
| 3 | Predictive | Predictive analytics looks to the future and attempts to predict it based on current and past data. Methods from the fields of statistics, machine learning, and game theory are used for data analysis. The prognosis will be used later for decision making. |
| 4 | Prescriptive | Prescriptive analytics is based on predictive analytics, which uses it to search for correlations between decisions and the effects and results of these decisions. |

Based on Ghani et al. (2018, p. 9), Aggarwal et al. (2011) explain that text mining in social media emerges as the most popular technique to gain information out of numerous types of unstructured contents, such as text, images and multimedia. Barbier & Liu (2011, p. 327) explain that data mining from social media can yield exciting perspectives on human behaviour and human interaction. This is also called Knowledge Discovery from Data (KDD). It helps to understand better people's opinions on a subject or even recommend the product. Therefore, this applies to a DMO as well when users write about their holiday experiences. According to Barbier & Liu (2011, p. 328), Larose (2005) highlights that "Data mining is related to machine learning, information retrieval, statistics, databases and even data visualisation".

Brandt et al. (2017, pp. 703–710) identify that most UGC on social media is geo-tagged. This provides "information on where the users are and at what times and content data that reflect the users' experiences." As an example, a user can create a UGC after a museum visit and write something about their visit. If the content is marked with the correct hashtags, a DMO could mine the data. However, when a DMO mine data from social media it can mostly focus on data with pictures and videos but has to monitor negative sentiment UGC on social media and react appropriately. (Brandt et al., 2017, pp. 703–710)

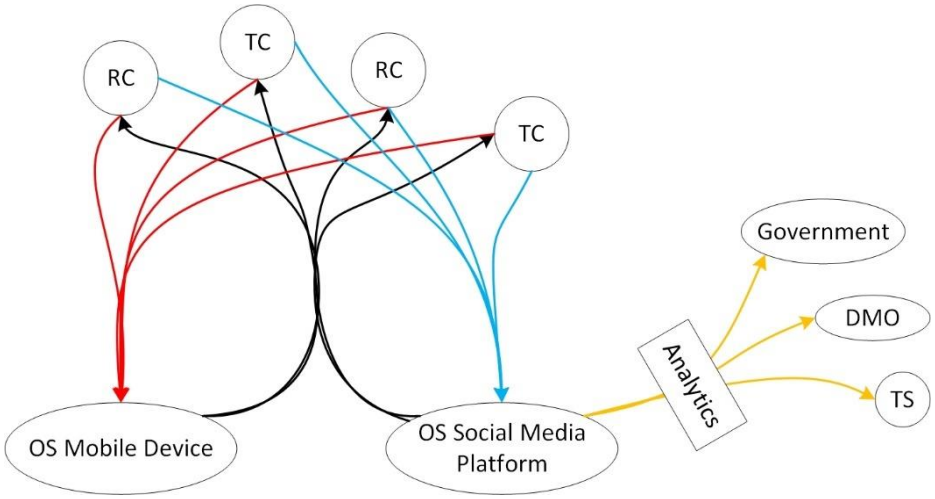


Figure 10: Data streams in an STE environment by Brandt et al. (2017, p. 704)

Brandt et al. (2017, p. 704) showed the data flow between social media users and a DMO. In this case, users are not only touristic consumers (TC) but also residential consumers (RC) as described in Figure 10. The infrastructure is provided by appropriate providers and is therefore independent of the SMO. The provided infrastructure is shown with black arrows. Red and blue arrows show how users regularly deliver data to the infrastructure operators. The orange arrows represent the data analysis by SMO. This can be Government, DMO or a tourism supplier (TS). The latter provides the appropriate services for the tourist.

As shown above, social media and the extraction of data from it is becoming more and more critical. A DMO has to understand how useful the data is, and which information help them for better decisions.

# 6 SOCIAL MEDIA INFLUENCE IN TOURISM INDUSTRY

Social media has changed the tourism sector in the long term. This affects not only the tourist themselves but also the service providers. The following subchapters describe the influence of social media on the sector. A distinction is made between tourists and service providers.

## 6.1 Influence on the tourist side

"Social media are increasingly relevant as part of tourism practices affecting destinations and businesses" (Munar & Jacobsen, 2014, p. 46). Zeng & Gerritsen (2014, p. 27) further argue that social media helps potential and current tourist to find relevant information and make proper decisions. Social media has changed the way tourists communicate today and how they share their experiences. Today not only pictures are sent, but also emotions and imaginations are shared. All in all, it is not only aspects like prices, weather conditions, beaches and other attractions, but also emotions, fantasies and imagination about future holidays.

Each tourist perceives emotions and experiences differently than others, as each has its perception. As a result, everyone communicates these emotions and experiences differently, but all use mostly the same channels. (Munar & Jacobsen, 2014, pp. 46–51)

Nowadays, photos or videos are becoming a new postcard, because in most holiday destinations Internet access is available so that they can be sent almost in real time. This means that sending pictures and videos is only a click away. This is independent of which channel is used. This was made possible through the expansion of new media and mobile technologies. (Munar & Jacobsen, 2014, pp. 46–51) Brandt et al. (2017, p. 704) additionally conclude that mobile devices allow users to communicate anytime from virtually any place.

Nevertheless, it must be remembered that not every tourist wants to share their pictures or videos publicly. Everyone can choose who has access to the corresponding pictures. However, a tourist looks at videos and pictures from future holiday destinations, which are created by other users. Tourists only share their experiences and pictures on sites which were helpful to them. Also, some tourists want to help others not using unsatisfactory products. According to Munar & Jacobsen (2014, p. 47), Beeton (2004) and Barthes (1993) argue that image-making is strong related to tourism sightseeing. (Munar & Jacobsen, 2014, pp. 46–51)

There is one crucial thing about generating new UGC for tourists. If someone is posting pictures or videos, they should have appropriate hashtags related to the UGC and the destination. Uploading pictures and videos is the most attractive way to generate new UGC. Furthermore, tourists have

a strong position with UGC because with just one content a dissatisfied tourist could have a negative influence. A UGC is nothing more than a powerful 'word-of-mouth' source. (Zeng & Gerritsen, 2014, pp. 29–33)

As can be seen, social media has a significant influence on tourists. Tourists communicate differently today than in the past. Moments, experiences, and emotions are transmitted almost in real-time. Even as a source for information social media is used. It is a part of the tourists' lifecycle (before, during and after the trip).

## 6.2 **Influence on the DMO side**

"Social media plays a significant role in many aspects of tourism, […] tourism promotion and in focusing on best practices for interaction with consumers" (Zeng & Gerritsen, 2014, p. 27). Based on Kietzmann et al. (2011, p. 242), Tim Weber (2010) explained that "one witty tweet, one clever blog post, one devastating video […] can snowball and kill a product or damage a company's share price." Further, they mention that this affects not only companies but also DMOs. However, social media has an influence on corporate communication and therefore also for DMOs. (Kietzmann et al., 2011, p. 242) The emerge of social media is challenging existing customer service, marketing, and promotional process. Any DMO can use social media as a brand building of their tourist destination and therefore use social media as new marketing or promoting tool, together with a new marketing strategy which is not focused on sale support but more on building new interactive relationships with tourists. (Zeng & Gerritsen, 2014, pp. 29–34)

The marketing department no longer has the power it had before social media because communication takes place with or without the permission of a DMO or company. In the same way referred to Zeng & Gerritsen (2014, p. 29), Dwivedi et al. (2007) argue that "the industry and businesses were losing control what got written about them online". The authors further argue that most firms ignored or mismanaged the opportunities and threats by social media or creative consumers. Representatives from companies ignored this because they had a lack of understanding of what social media is and which influence this could have. (Kietzmann et al., 2011, pp. 27–28) DMOs must understand that tourists will find UGC more trustworthy from other tourists than the information provided by DMOs themselves or commercial operator. One of the reasons could be, that tourists trust more social media marketing than traditional marketing tactics. However, this has an impact on how a DMO should communicate through social media because the information has to be reliable and valuable content. Furthermore, a tourist from a different country has a different reason to generate new UGC. Therefore any stakeholders of a DMO has to take this into account. (Zeng & Gerritsen, 2014, pp. 29–32)

As the influence of social media on travel and hospitality grows, DMOs can no longer ignore this. In addition, social media requires better monitoring,

response or interaction from the hotel and tourism sector. A DMO can give tourists tailor-made information about their needs and preferences. This means that if a traveller has questions or needs specific information, a DMO must be able to give the right answer as quickly as possible. In fact, the potential of social media for a DMO is more significant than most managers think. This can not only be achieved through a new marketing strategy. Instead, it requires the revision and implementation of new business models and processes. Besides the new marketing strategy, a DMO has to think and develop new services, networking, and knowledge management. (Zeng & Gerritsen, 2014, pp. 29–34)

A DMO must also know how to deal with crises. For example, the Deep-Water Horizon oil spill brought a tourist region to a standstill. As a reason, a DMO should include all stakeholders into crisis management activities and strategies. They have to exploit inbound and outbound communication, networking, and collaboration capabilities. (Zeng & Gerritsen, 2014, pp. 29–34)

Another concern could be in which language a DMO is communicating. This question is in non-English-speaking regions important. They have to create a strategy in which language(s) they are using throughout social media. One solution could be for DMOs to communicate in English in addition to their local language and thus reach a broader audience. (Zeng & Gerritsen, 2014, pp. 29–34)

Nowadays, DMOs use social media to promote their destinations. It should be noted that a DMO has a strategy on how to communicate via social media and how to deal with opposing opinions. Tourists are increasingly using social media to find the necessary information, make decisions or adjust them. An excellent social media marketing contributes to an increasing number of visitors to a destination.

# 7 BIG DATA INFLUENCE IN TOURISM INDUSTRY

According to Cocchia (2014, p. 39), big data can be used for analysis of various problems. Smart City measures data from various sensors and makes it available. This way it can be determined where traffic jams or other problems occur. Among other things, it determines where tourists gather and where there is a risk of overcrowding. As Nam & Pardo (2011, p. 286) mention, the data from Smart City is more likely to be used for traffic analysis. This should help to make the right investments where it also brings a greater benefit. Smart City's sensors provide the necessary information in real-time. In this way, it is possible to analyse exactly to the minute when the biggest overcrowding occurs.(Cocchia, 2014, p. 39; Nam & Pardo, 2011, p. 286)

Vecchio et al. (2018, p. 855) investigate what kind of UGC a tourist can generate. It turned out that many negative UGCs were written because of the price or overcrowding of attractions. This means that a DMO should analyse this in order to take targeted action. This means that a DMO should analyse this in order to take targeted measures. Brandt et al. (2017, pp. 705, 710) add that such tweets can be created immediately after a museum visit. However, it must be noted that each person has a different perception. This means that action does not have to be taken because of every negative tweet. This is only essential if the negative tweets on an issue increase. (Brandt et al., 2017, pp. 705, 710; Vecchio et al., 2018, p. 855)

Chareyron et al. (2015, p. 6) argue that social media is a source of how tourists behave at a destination. The fact that UGC is geotagged makes it possible to analyse how tourists move. What position were the tourists in when they created the UGC in social media? Such analyses can provide new insights about the destination. The more data collected, the easier it is to identify patterns. The prerequisite for this, however, is that enough tourists generate corresponding UGCs. (Chareyron et al., 2015, p. 6)

The Cagliari case shows the advantages of using sensors. If taxis or buses continuously report their position, this can be analysed and made available. This means that from an absolute position it can be calculated when the next bus or taxi arrives. Since the costs for the different means of transport are known, it is possible to calculate the price in order to get from A to B. (Nitti et al., 2017, pp. 4–6)

In summary, it can be said that big data influence tourism. This is shown by the analysis of the literature examined. On the one hand, the data can be used to eliminate problem points within the destination, and on the other hand, the behaviour of tourists can be analysed.

# 8 METHODOLOGY

Fundamental knowledge is essential for the development of the maturity model. This knowledge is built up through literature research. The relevant articles were found using various search sites. This was done via Google Scholar on the one hand and EBSCOhost on the other. Both were searched for terms or keywords. The following keywords were used: "maturity model", "open data", "open data storage", "social media", "Internet of Things", "Smart City", "Smart Tourism" and "Smart Tourism Destination".

The thesis is structured in such a way that the necessary knowledge is built up first. The description of this was based on the article found through the research. On the one hand, literature was searched, how a maturity model is developed and on the other hand also the essential knowledge, which is necessary for the individual stages. Also, an essential part of the work is used to give an insight into the tourism industry. This makes it possible to describe a kind of overall picture of the maturity model.

For the project management of this thesis, the tool Trello was used. This allowed the author to have an overview. For each chapter, a corresponding task was created in Trello. This includes a description and a checklist, which is described in the corresponding chapter. Thus it was always clear what is already described and what is still missing.

No maturity model for Smart Tourism Destination could be found through research. The new maturity model is oriented towards the Smart Tourism Destination. The reason for this is that there is a lack of maturity models in this area and tourists' expectations of a destination are rising. Literature research helped to develop a good maturity model, and examples were used to develop the model. As example were used the CMM (Paulk, Weber, Garcia, Chrissis, & Bush, 1991) and some supply chain maturity model (Lockamy III & Mccormack, 2004; Vaidyanathan & Howell, 2007). These examples gave an idea of what a future model might look like. The target group for this model are all DMOs around the world. This includes national as well as the local organisation. Much has been written in the literature about what a smart tourism destination should look like. This is one of the reasons why this maturity model was developed. The model is designed to help DMOs develop strategies to advance their destination according to the model. The most important criticisms of maturity models have also been taken into account.

# 9 MATURITY MODEL FOR SMART TOURISM DESTINATION

The knowledge acquired until now gives the fundamental theory to develop a maturity model in the tourism sector. Specific topics used by the maturity model are also explained. This section gives a brief overview of the maturity model and its levels. This also includes a rough overview of the individual levels of the model and what will later be necessary for the validation of the model. The motivation for creating a maturity model for the Smart Tourism Destination is that tourism is a vital source of income in some regions. The spread of smartphones will enable new services for tourists. These services are designed to enhance the tourist's experience and simplify their stay. The model shows how a DMO can develop them further, which steps are necessary. The literature research showed that the integration of different stakeholders in touristic services decrease the information asymmetries. They can retrieve the necessary information from their smartphone if the DMO makes it available. Anyone can ask themselves what their expectations are when they travel.

However, Lasrado et al. (2015) describe, that many maturity models are criticised. Many models have no theoretical basis or are too simple to be useful. The structure of the model should be developed from literature. Another point is an empirical validation of the model. Not every criticism could be included in this model. It was deliberately aimed at the most frequently voiced criticisms. This is, among other things, the lack of a theoretical basis. In addition, the emphasis was placed on the validation of the model. The corresponding methods are defined, how some criteria can be tested. The following table provides an overview of the maturity levels. Another essential point is that this model is developed conceptually. The model contains four levels.

Table 13: Maturity model level overview

| Level | Name | Description |
|---|---|---|
| 1 | Organisational Focus | All stakeholders together form a DMO. Together they form a kind of network for tourism services. |
| 2 | Social media integration | Social media is integrated into DMO activity. It is seen as a new tool for marketing and serves as an interaction platform with tourists. |
| 4 | Cross-enterprise | By integrating IoT with the stakeholders, the data exchange is automated. Tourists and app developers have access to open data in real-time. The DMO becomes an STE. Open data serves as a platform. |
| 5 | Optimise | On the one hand processes and systems must be maintained, and on the other hand, |

| Level | Name | Description |
|---|---|---|
| | | technological developments and new expectations lead to changes. |

The analysis of the literature showed that many maturity models weaken the assessments of individual stages. Often only criteria are defined which have to be fulfilled, but it is not described which methodology has to be applied. In the new maturity model, this point is given proper attention. For each level, criteria are defined that must be fulfilled. Only when these criteria have been met is the stage considered to have been reached. For each next level, the criteria of the previous level remain valid. This means that each DMO must regularly check whether the criteria of the previous stages are still fulfilled. Otherwise, the destination falls back to the level in the maturity level model that it continues to achieve.

Furthermore, it may happen that a DMO already meets the criteria of a higher level but not those of the previous one. This means that the level is not considered fulfilled. The criteria of a previous level must be met in order to reach the level.

The criteria per level specify the type of instrument to be used in the assessment. It is up to the DMO to decide whether the criteria are to be assessed by a self-assessment or by a third party. Some DMOs will be able to carry out a self-assessment because they have sufficient staff. Others, on the other hand, lack the necessary resources. In this case, it is helpful to have the evaluation carried out by a third party.

Figure 11 shows the individual maturity levels graphically.

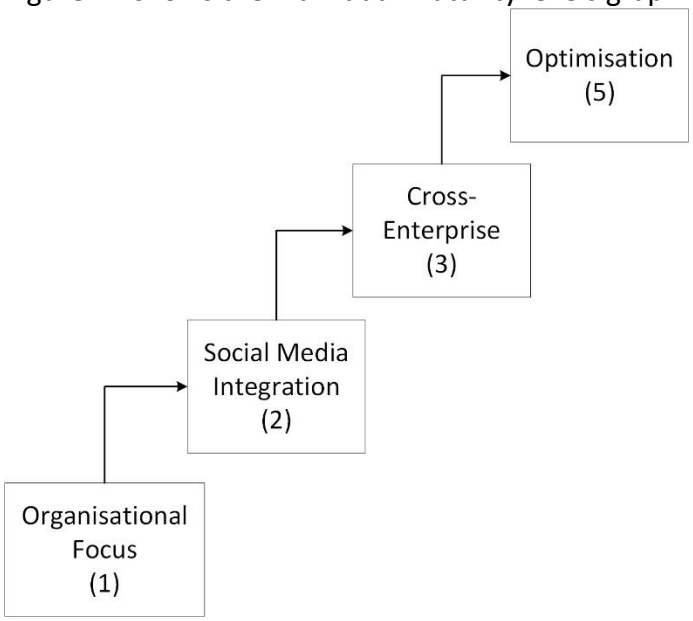


Figure 11: Connection between each maturity level

Damsgaard & Scheepers (2000, p. 138) used the seven S defined by Pascale et al. (1981). They defined for each maturity level what is the meaning of

each of the seven S. However, the seven S model is mostly used inside organisations.

Nevertheless, for this maturity model the seven S help to define for each level the meaning for the DMO, but it is slightly adapted because it spans over different organisation such as DMO and tourist service provider. Moreover, the seven S model is more a model for the management. It should help them to initiate the necessary processes and actions.

Table 14: The seven S by Pascale et al. (1981) mentioned in Damsgaard & Scheepers (2000, p. 138) and the meaning for this maturity model.

| **Element** | **Meaning in the Smart Tourism Destination Maturity Model** |
|---|---|
| Strategy | A strategy is necessary in order to achieve the objectives and to give a DMO a competitive advantage. |
| Structure | Describes the responsibilities within the organisation and where it resides, on the one hand, and how the organisation must adapt to the circumstances, on the other. |
| Systems | How to use this system of organisation and stakeholders. This includes content and functionality, usage types, and the relationship to other organisational processes and systems. |
| Staff | Important role players about managers, moreover, organisational service providers, developers and users |
| Style | Describes how key managers and critical stakeholders behave with regards to the Smart Tourism Destination. |
| Skills | The capabilities of staff and stakeholders who are involved with the Smart Tourism Destination. |
| Superordinate goals | The guiding concept regarding be a Smart Tourism Destination in the organisation and so through the DMO and the stakeholders. |

## 9.1 **Level 1 – Organisational focus**

Table 15: The seven S summary for organisational focus (Level 1)

| Element | Description for organisational focus (Level 1) |
|---|---|
| Strategy | All stakeholders and the tourism organisation work together more closely. The result is a DMO that takes over the marketing of the destination and acts as an intermediary on the market. |
| Structure | Each stakeholder is equally involved in the DMO and contributes its share to the success of the DMO. All those participating define the necessary structure. |
| Systems | An in-depth exchange of information is to take place within the DMO. The DMO will jointly determine the form of information exchange. |
| Staff | Visionary partners push the new organisation forward and see advantages in deepening cooperation. |
| Style | They all form an open culture and see the advantages and benefits of the DMO. |
| Skills | Each partner has its strengths and weaknesses, so they bring their know-how in their field into the new DMO. |
| Superordinate goals | The uniform appearance on the market as a DMO saves resources and bundles marketing activities via a single channel. All participants work towards a common goal. |

A tourism destination is successful if there is a network of independent but interdependent organisations or partners. However, this requires that all partners are willing and able to work together. On the respective market, the individual participants remain competitors. This can make cooperation more difficult, as some stakeholders do not want to participate or fear that they will suffer sales losses. This can lead to partners opposing cooperation. It is, therefore, necessary to convince those who see no value in deepening cooperation and are more cautious.

For a DMO to be effective, it must also work closely with government, local authorities and other businesses. Ultimately, everyone wants a piece of the cake. One goal of the intensified cooperation must be that the destination can take a better position and present itself on the world market. A DMO is an interface of the network because it acts uniformly and represents all participating partners equally. Citizens and tourists are part of the DMO because they are users of the services offered. All sit down at the same table and work out a joint strategy on how the destination can be

developed. The strategy also determines the expected outcome of the cooperation.

On the one hand, the result should be that more tourists visit the destination and thus make use of the services of the stakeholders. On the other hand, the marketing activities and thus the presentation of the destination should also be standardised. The cooperation forces the stakeholders to commit themselves and make a promise.

Different stakeholders are active in different sectors. Some are located in the private sector, and others are part of public enterprises and belong to the general public. In many cases, attractions and places of interest belong to the public sector. A tourism organisation is often part of an official department. A DMO crosses the boundaries between the public and private sectors. However, both sides have to take a step towards each other.

A DMO should also eliminate false and asymmetric information. The uniform appearance of all partners within the DMO should lead to a uniform flow of information. In addition, this new form of cooperation also makes new products possible along the tourism value chain. For example, a tourist can eat in any restaurant after a visit to a museum. Ultimately, a DMO is the intermediary between tourists and local tourism service providers and their products, because the role of a DMO is rarely to sell a product, but to bring buyers and sellers together.

The corresponding change processes must also be initiated inside the authorities. It must lead to a DMO becoming a quasi-non-profit organisation that remains with the authorities. The employees of the previous tourism organisation will be transferred to the new DMO and will continue to perform their previous functions. The necessary rights, duties and responsibilities must be defined. A DMO should be able to act independently of political influences. This presupposes that the necessary financial resources are available. This is not only approved and provided by the authority, but also by the individual stakeholders. The form of such participation will depend on the possibilities and resources of the company involved. The joint strategy ultimately determines this, and everyone commits to it. Furthermore, a DMO must be able to decide independently and freely, together with the participating tourist service providers.

In summary, it can be said that each DMO is an independent government body which has its responsibilities and makes decisions. The uniform and joint activities of the DMO create a competitive advantage on the global tourism market.

### 9.1.1 Data collection in the level

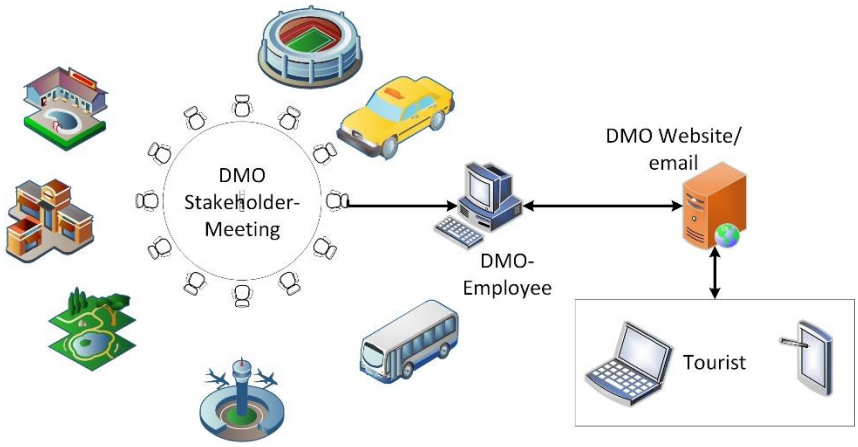


Figure 12: Data flow between involved partners on level 1

This level is a limited or moderate form of cooperation. This means that information is often exchanged at meetings. It is vital that this regular exchange takes place between the participants. Furthermore, information can also be transmitted via email or telephone. It is a matter for the DMO what should happen to the data. The focus must always be that it can be information that is important for the tourist. An example could be that a restaurant has a special culinary week, and this can also be marketed via the DMO.

It must be clear to everyone involved that this form of information exchange does not lead to asymmetries. Since the information is often available via the respective websites of the companies or the DMO, the same information must be available on all pages. Each operator of the associated website is responsible for these and maintains these.

### 9.1.2 Possible smartphone apps

Apps are not part of this layer. There may well be apps for the destination. If one is available, static and general information is provided, as it is available on the DMO website. However, if there is an app, it doesn't necessarily have to come from the DMO itself. It may also have been created by third parties.

### 9.1.3 Pitfalls on the level

There are pitfalls at this level. The significant problem is that the oral or written exchange of data can automatically lead to asymmetries. It is crucial that all participants are aware of this and take the necessary precautions. Each participant should regularly check whether their website is still up to date and provides the correct information.

Another problem is if the process of updating the website takes too long. This can usually happen when third parties are responsible. The website is therefore operated by third party. All this leads to the fact that the tourist retrieves outdated information.

### 9.1.4 Stakeholder management

The tourism organisation needs to know its stakeholders. This means it knows which companies offer tourism services. This requires active stakeholder management. The management of the DMO is primarily taken over by the head of the previous tourism organisation.

Closer cooperation can lead to problems or ambiguities with stakeholders. That is why active management is essential and that those involved meet regularly and exchange ideas. Sceptical stakeholders must continue to be convinced of the advantages of a good DMO strategy and the benefits that everyone can derive from it.

### 9.1.5 Validation of the level

The next table shows the criteria that are necessary for this level. All criteria must be met to reach the level. It also means that all participants perform their validation. This ensures that a more comprehensive result is available. This is because everyone participates in the DMO with their contribution and assumes responsibility for it accordingly. For each level, the corresponding business value is also described at the end of the table. Each criterion is measured on a specific scale.

At level 1, the government plays a role because it has to create the conditions for a DMO to act as an independent unit.

Table 16: Conditions and Scale for level 1

| Condition | | Scale |
|---|---|---|
| **Government** | Government ensures the legal basis for a politically independent tourism organisation | Likert (0 – 4) |
| | The essential responsibilities, rights and duties of the tourism organisation are defined. | Likert (0 – 4) |
| | Tourism organisation receives the necessary support within the government. | Ordinal Scale (0 decreased, 1 = same, 2 = increased) |

| | | |
|---|---|---|
| | Investments in tourism destination are compared to the previous year. | Ordinal Scale (0 decreased, 1 = same, 2 = increased) |
| | The seven S model defined in Table 15 helped to improve the destination. | Ordinal (0, 0.5, 1) 0 = not at all, 1 = partly, 1 = complete |
| **Tourist Organisation** | The tourism organisation identified stakeholders from the tourism service. | Ordinal (0, 0.5, 1) 0 = not at all, 0.5 = partly, 1 = all |
| | Tourism organisation encourages all stakeholders from the tourism sector to participate in the DMO. | Likert (0 – 4) |
| | Tourism organisation is well planned and structured. | Likert Scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| **Service providers** | The service providers recognise the advantages of a common DMO. | Likert (0 – 4) |
| | All service providers participate and are involved. | Likert (0 – 4) |
| | All service providers are committed and promise to make the necessary resources available for the benefit of the DMO. | Ordinal (0, 0.5, 1) 0 = not at all, 0.5 = partly, 1 = all |
| **Policy** | All stakeholders are equally integrated into the DMO. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| | All work for a common goal that tourists get a better experience. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| **Culture** | The measures for Culture are based on an organisation orientation towards tourist driven style of working and decision making. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| **Business Value** | The business value is that the new DMO has a competitive advantage in the global market. | Likert (0 – 4) |

## 9.2 **Level 2 – Social media integration**

Table 17: The seven S summary for social media integration (Level 2)

| Element | Description for social media integration (Level 2) |
|---|---|
| Strategy | A social media strategy determines how this medium is used. Which information is disseminated and how the medium is used for marketing purposes. |
| Structure | Social media channels are administered and managed by the DMO. Responsibilities and competencies are also defined. |
| Systems | The DMO is active on various social media platforms (e.g. Facebook, Instagram or Twitter). There are regular evaluations of the contributions on the platforms. This is intended to identify new trends or problems at an early stage. |
| Staff | The DMO determines who is responsible for and manages social media. They have the necessary authorisations and responsibilities. |
| Style | The DMO staff in charge answer questions from tourists who come up. Spread UGC themselves via social media. Be this from the stakeholders on the one hand or the other hand through pictures or videos for promotional purposes. |
| Skills | Employees have experience in dealing with social media and can deal with criticism and negative contributions. |
| Superordinate goals | Social media is used to promote and present the destination. This channel is also used for marketing purposes. It provides new insights and impressions of the destination. |

Nowadays, social media have an increasing influence on a tourist's decision whether or not to spend their holiday in a destination. For a DMO it is a new channel to promote the destination, therefore it is a new way of marketing. However, this presupposes that a strategy exists on how social media is managed. It makes it possible to reach a larger target group than was previously the case with conventional marketing activities. A DMO can create its videos or images and publish them on social media. Besides, it is crucial for a DMO if other stakeholders are equally active in social media. In this way, a DMO can efficiently disseminate stakeholder contributions through its DMO site when a stakeholder creates a UGC on social media. Stakeholders thus also reach a broader audience. However, it is essential that the stakeholders agree and that this is part of the destination's marketing strategy.

Social media presupposes responsibilities and those in charge. The DMO must ensure this. The responsible employees have the necessary know-how to deal with social media. They must be able to deal with criticism and other emerging problems. In addition, employees must know how to behave in social media. Social media has its own culture, which is lived

accordingly. A DMO must have committed employees who are responsible for social media and thus bundle all activities with them. A DMO should be active on various possible social media channels. In any case, they should be active on Twitter, Facebook and Instagram.

Further channels can also be edited depending on their capacities. Tourists will use social media as an information source and therefore seek for the respective DMO page and mark it with a like. So they will always see when DMO publishes something new about the destination.

A tourist creates various UGCs during or after their holiday via social media. These, in turn, can be used for the marketing strategy of the destination. This presupposes however that these are provided with the associated hashtag of the destination. Thus a DMO can spread these contributions further so that further tourists see what others have experienced.

A DMO should also have a strategy on how to analyse social media data. What benefits and results it expects from it. Because this can be used to identify new trends or problems at an early stage, the analysis should enable a DMO to make better decisions or to develop new products.

The oil disaster at Deep-Water Horizon has shown that such a disaster occurs unexpectedly but has a considerable impact on the tourism sector. This disaster has practically brought tourism to a standstill. Tourists no longer wanted to fly to the region and spend their holidays there. Social media can spread such events quickly. For this reason, it is crucial for a DMO to have good crisis management. How does the DMO deal with such a disaster and how does it communicate? Ultimately, the point is to show tourists that the disaster does not affect the region itself. Crisis management must be regulated within the DMO. It affects not only the official tourism organisation but also tourism service providers. The parties involved working together to develop crisis management and provide suitable solutions in the event of a disaster. (Zeng & Gerritsen, 2014, pp. 29–34)

In summary, it can be said that social media is a medium through which pictures, texts, videos and more can be distributed. As a result, an organisation no longer has control over what is written about it. For this reason, a strategy is needed on how to deal with the medium and such contributions.

### 9.2.1 Data collection in the level

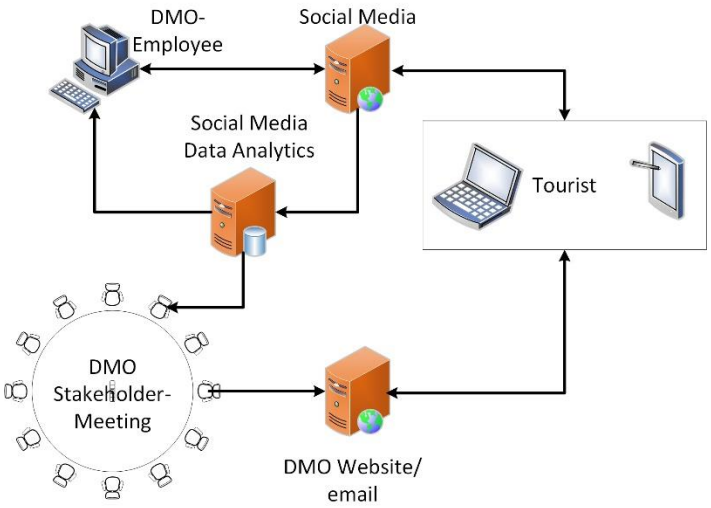


Figure 13: Data flow between involved partners on level 2

Every tourist follows a life cycle. Each of them dreams of a destination, begins with the planning and booking, sometimes arrives at the destination and at the end is recalled and looks at the pictures. A tourist may have questions or ambiguities even before their holiday. These can be posted via social media, for example, and the tourism organisation should answer them as quickly as possible. Twitter is an excellent example of how this can be achieved with a short message. A DMO then has the task of having its staff react appropriately and answer the tourist's questions. After the holiday, a tourist tells their family and friends about the holiday and what they experienced at the destination.

For a DMO it is crucial to know what is written about the destination. Therefore, the analysis of social media data is indispensable. As an example, Twitter provides an interface that delivers tweets based on a term. Facebook and Instagram also have interfaces for data analysis. Text contributions are essential for the analysis as they give a clear idea of whether the tourist was positive, negative or neutral when the contribution was created. It should not be forgotten that the data found must be saved. This requires a large data store that can process a large amount of social media data. How and where the data is stored is not prescribed here. The same applies to data analysis technology, which is also unspecified. This can be determined by each DMO itself. For example, the analysis can be done by artificial intelligence or natural language processing. A UGC may have different manifestations, but in the context of social media, it is unstructured data. This means that DMO determines how the data is formatted and how it can be used for analysis. Also, DMO management must determine what expectations and insights should be drawn from the analysis.

There is still no automatic data exchange between stakeholders and the DMO. The exchange of information continues to take place based on the description of Level 1.

### 9.2.2 Possible smartphone apps

Apps are not part of this level. There may well be apps for the destination. If there are any, static and general information will be provided. In the end, it is the same information as it is available on the DMO website.

If there is an app, it may have been commissioned by the DMO itself, or it may have been created by third party.

Note that there are separate apps for social media. The management of the DMO determines whether the employees are allowed to use them for their daily work at the DMO or not. This only applies to the official channels of the DMO.

### 9.2.3 Pitfalls on the level

Pitfalls at this level are that the privacy and security of social media data analytics are not sufficiently guaranteed. The analysis of social media can lead to high expectations among interest groups, which are not fulfilled. This is because they hope to receive information that is not available or nothing has been written about it.

With social media, it is vital that the DMO has a clear strategy on how social media is processed. Otherwise, there will be unnecessary miscommunication and asymmetric information. The handling of crises must also be regulated.

Employees and management lack the awareness to act actively for social media and to manage it.

### 9.2.4 Stakeholder management

Stakeholder management concerns all institutions and stakeholders that together form the DMO according to Level 1. The integration of social media does not require new or changed stakeholder management. However, it is essential that stakeholders are also active in social media. So that the DMO can further disseminate the stakeholders' contributions and thus also give the tourists knowledge about them.

### 9.2.5 Validation of the level

The next table shows the criteria that are necessary for this level. All criteria must be met to reach the level. It also means that all participants perform their validation. This ensures that a more comprehensive result is available. This is because everyone participates in the DMO with their contribution and assumes responsibility for it accordingly. For each level, the corresponding business value is also described at the end of the table. Each criterion is measured on a specific scale.

At level 2, the government no longer plays a role; it is assumed that a DMO is already an independent unit.

Table 18: Conditions and Scale for level 2

| Condition | | Scale |
|---|---|---|
| **Management** | Social media is being actively managed, and a strategy provides information on how this channel is being managed. | Likert (0 – 4) |
| | Management encourages stakeholders to participate in social media and operate their own social media channels. | Likert (0 – 4) |
| | There is crisis management in the event of a crisis or natural disaster that has a significant impact on tourism. | Likert (0 – 4) |
| | The seven S model defined in Table 17 helped to improve the Destination. | Ordinal (0, 0.5, 1)<br>0 = not at all, 1 = partly, 1 = complete |
| | To what extent could the expectations placed by management in the analysis of social media data be fulfilled? | Likert (0 – 4) |
| | A strategy for data storage determines the extent to which it has enough capacity to handle the large volume of data. | Ordinal (0, 0.5, 1)<br>0 = not at all, 1 = partly, 1 = complete |
| **Tourist Organisation** | Social media presence measured as the number of social media channels. | Count (0 – 8) |
| | Employees know what rights and tasks they have on social media. | Likert (0 – 4) |
| | Own picture and video contributions are regularly published via social media. | Ordinal (0 – 4) |

| | | |
|---|---|---|
| | Social media contributions from stakeholders are disseminated further via DMO social media channels. | Ordinal (0, 0.5, 1) 0 = not at all, 1 = partly, 1 = complete |
| | Service providers social media presence measured as the number of social media channels. | Count (0 – 8) |
| **Service Providers** | Service providers benefit from the analysis of social media data by the DMO. | Likert (0 – 4) |
| | Privacy and security are guaranteed in data analytics. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| **Policy** | All work for a common goal that tourists get a better experience. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| | The business value of social media is that the tourist receives more information through pictures and videos. It is calculated from the number of likings and contributions to social media. | Likert (0 – 4) |
| **Business Value** | | |

## 9.3 **Level 3 – Cross Enterprise**

Table 19: The seven S summary for Cross-Enterprise (Level 3)

| **Element** | **Description for Cross-Enterprise (Level 3)** |
|---|---|
| Strategy | The DMO develops a strategy for the automatic exchange of data as well as the acquisition of data by sensors and IoT in real-time. It is imperative that the relevant government commits itself to Smart City and has implemented it. Open data is essential in Tourism. |
| Structure | Stakeholders are responsible for their ICT while the data is collected and stored within the government. Open data is integrated into the government structure and is responsible for it. DMO carries and maintains open data in tourism-related matters. |
| Systems | Automatic data exchange through the use of ICT and IoT simplifies processes and delivers data in real time. There are distinct processes and structures for open |

| | |
|---|---|
| | data. The data is stored and managed centrally by the government. All tourism data from the DMO are stored and managed at the same location as the open data. |
| Staff | DMO supports stakeholders in their choice of infrastructure. Standardised products and technologies are crucial. Stakeholder data is also included in the open data. Employees know the responsibilities of open data. |
| Style | The use of IoT is anchored with the stakeholders, and the DMO receives data in real-time. Everyone can analyse data. New insights can be gained from this. Open standards are used to publish the data. Other DMOs are motivated to use the same standards. |
| Skills | All employees and stakeholders contribute their share to the open data. The use of IoT and the automatic data exchange encourage to provide better data for tourists. Real-time data allows users to obtain the right and most important information at any time. |
| Superordinate goals | Open data is an integral part of DMO and the government. Open data contributes to a competitive advantage. The automatic data exchange reduces the asymmetries of information. Real-time information enables tourists to make immediate decisions. This gives a destination a decisive competitive advantage. |

This level causes the full integration of different systems into one overall system. This means that the systems of the stakeholders and the DMO are connected and thus cause the automatic data exchange. Investments in new technologies are needed. On the stakeholder side, new sensors are needed to measure workload or waiting times in real-time. The DMO must convince the stakeholders of the investments. Stakeholders must see a benefit from the investments.

For a DMO, it is essential that the associated government agency has a well-defined strategy for open data. The goals and ideas of Smart City are applied and implemented. Both are prerequisites for open data that is freely accessible. One example is that all buses and taxis are equipped with appropriate sensors to transmit their position at any time. This allows tourists to see where the next taxi is or when it is at the tourist's location. The same also applies to buses, so that it is transparent when the next bus on the desired route arrives. The strategy for open data is initiated and implemented by the government. A DMO can have a supporting effect here and motivate the departments to implement the strategy. Furthermore, it is essential that the DMO provides contact and address data of the various attractions and sights via the data.

An open standard helps to ensure that the data reaches an ever-wider audience. The reason is that the structure of the data in a standard change

little to rarely. A developer can be sure that the data will be delivered in good quality. The developer must be able to trust the data to be correct and complete. However, the publication of the data is the responsibility of the government or the relevant department. A DMO should lobby for the use of public standards. The same applies to sensors, where a DMO encourages stakeholders to use the same products, which simplifies integration into the systems.

The open data strategy also includes where and how the data are kept. This means that the privacy and security of the data are guaranteed. The data store must be able to process and analyse a considerable amount of data in real-time. Furthermore, a developer also needs a plan for the future. This should show them what data they can expect in the future. It is also essential that open data is well documented and updated.

If stakeholders use sensors and other IoT technologies, they can use the data they gain to perform an analysis. This allows them to gain new insights. The data gained creates new bases for decision-making. Using the sensor data, tourists can see how long they are waiting at a museum for admission. This means that admission can be refused at any time if there is a risk of overcrowding. One condition is that the sensors carry out measurements in real-time and that the data is immediately available. Such sensors can also measure the number of people in a restaurant.

The case of Cagliari shows that it is helpful for tourists to see how far it is to their next point of interest and how they can get there most quickly based on their location. No matter over which transport route this is covered. For example, it shows the visitor when the next bus will arrive to take them to their destination. Further possibilities in an app are that the tourist is also given suggestions as to what they could still visit or suggests them a lousy weather program.

Stakeholder systems should be designed so that new sensors can be added quickly and easily. These automatically register with the respective system. In order to avoid overloading the network traffic, the sensor data is stored locally. After intermediate processing by the stakeholder, the data is transmitted to the DMO in compressed form. In order to guarantee privacy and security, no personal data is exchanged between the stakeholder and DMO and the data transfer is encrypted.

In short, a DMO becomes more and more an STE. The exchange takes place automatically, and tourists receive new and more precise information from this data. A DMO is involved in the development of an open data strategy. It is elementary that the data is made available using an open standard.

### 9.3.1 Data collection in the level

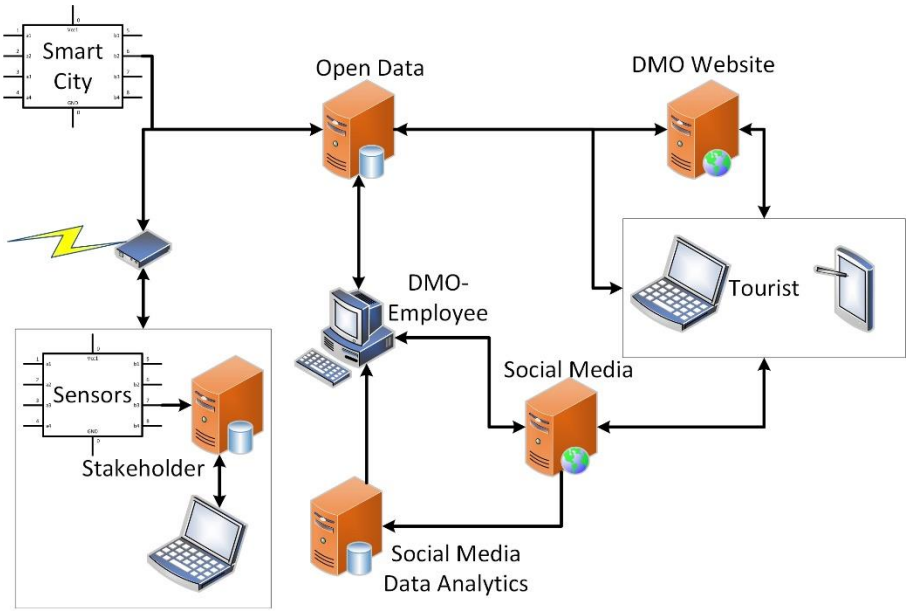


Figure 14: Data flow between all involved partners on level 3

A tremendous amount of open data is emerging from the Smart City effort. From a tourist point of view, the position of taxis and buses is as relevant as the public transport timetable.

The stakeholder system should not only be geared to sensors, but also to other devices that can capture data and integrate it into them. However, the sensors automatically connect to the network and start measuring immediately. This can immediately overload a network. This means that the data has to be buffered and pre-processed. In the end, only the most critical data is transmitted to the DMO. However, the original data of the sensors are still available to each stakeholder and can be used to create analyses. The sensor data from the stakeholders supplement the open data generated by Smart City. Developers benefit from the new data as they can make it available to tourists via apps. For example, a tourist can use the app to decide when a visit to a museum is better.

Standardisation is elementary in data exchange. Both sides use open standards that simplify data exchange. Also, it simplified the systems and data formats at a later point in time because systems have to be maintained.

### 9.3.2 Possible smartphone apps

Open data allows developers to create better apps by embedding them into their apps. This also means that the data is complete and trustworthy. Incorrect or incomplete data would result in developers not using them. Another point is that it is more convenient for a developer to create them in a standardised format and an open standard.

Open data allows a tourist to find their point of interest faster and, if necessary, how to get there. Be it on foot, by public transport or any other means of transport.

The generated data from the sensors allow new data in an app that a tourist can use. This is also shown in the literature example from Cagliari. There the tourist chooses in an app which sights they want to visit. The app uses this information to calculate the order of sightseeing based on the distance from the current point to the desired destination and the waiting time at the attraction. This leads to the fact that not only the data of the sensors must be included, but also the remaining publicly accessible data are integrated. If the app also includes the weather data, the app can suggest what the tourist can visit or do depending on the weather. (Nitti et al., 2017, pp. 4–6)

### 9.3.3 Pitfalls on the level

Pitfalls at this level are that the data are not always available or that their reliability is not given. Other problems occur when the format changes. It is difficult to explain to a developer why the format changes. This requires explicit discussion between the data provider and the developers. The data and associated interfaces must be maintained.

Some stakeholders are sceptical about the necessary investments. These are against or want compensation for it. In these cases, an objective discussion is necessary to convince the opponents of the advantages. Stakeholders who are convinced of this will help here. A DMO can decide for itself to what extent and what support it will give to the stakeholders.
The data exchange between stakeholders and DMO leads to problems because both sides use different interfaces and definitions. It is essential that a uniform interface is used within the DMO and thus by all parties involved. The problem with the various interfaces is that stakeholders outsource their development tasks to third parties. These must know the interface description.

Another problem is that the data is not reliably transferred to the DMO. On the one hand, this can be that the data is transmitted with considerable delay and therefore not in real-time, and on the other hand that not all relevant data is transmitted. The interface defines which information is mandatory and which is optional. Developers of apps rely on the data being provided reliably. Only in this way can the tourist receive correct and accurate information.

### 9.3.4 Stakeholder management

As stakeholders are involved in the data generation process, they need to be convinced that the appropriate investments will be made. This data is necessary to improve the tourist experience. The DMO must convince the stakeholders of the business value of the data. By collecting their data, the participants can analyse their own company. This allows the stakeholders to make the necessary investments and make the right decisions for the future of the company.

### 9.3.5 Validation of the level

The next table shows the criteria that are necessary for this level. All criteria must be met to reach the level. It also means that all participants perform their validation. This ensures that a more comprehensive result is available. This is because everyone participates in the DMO with their contribution and assumes responsibility for it accordingly. For each level, the corresponding business value is also described at the end of the table. Each criterion is measured on a specific scale.

In Level 3, the government plays a role in the context of Smart City. For this level, Smart City is a prerequisite that the government implements it.

Table 20: Conditions and Scale for level 3

| Condition | | Scale |
|---|---|---|
| **Government** | The financial funds for Smart City have been approved. | Ordinal (0, 0.5, 1)<br>0 = not at all, 1 = partly, 1 = complete |
| | Ideas and strategies for Smart City have been implemented | Ordinal (0, 0.5, 1)<br>0 = not at all, 1 = partly, 1 = complete |
| | The government assumes responsibility for open data | Likert (0 – 4) |
| **Management** | DMO gets a fully integrated organisation, and data exchange between all stakeholders is fully automated. | Likert (0 – 4) |
| | The management convinces all stakeholders to invest in IoT and sensors to obtain real-time data. | Likert (0 – 4) |
| | The seven S model defined in Table 19 helped to improve the destination. | Ordinal (0, 0.5, 1)<br>0 = not at all, 1 = partly, 1 = complete |

| | | |
|---|---|---|
| | DMO assists stakeholders. | Likert (0 – 4) |
| **Tourist Organisation** | DMO is involved in the provision of real-time open data. The data is tourism-oriented. | Ordinal (0, 0.5, 1) |
| | Data is exchanged automatically. | Ordinal (0, 0.5, 1) |
| | Sensor data from the service providers are available as open data for third parties. | Ordinal (0 – 4) |
| | Interfaces for data exchange are documented and up-to-date. | Ordinal (0, 0.5, 1) |
| **Service Providers** | Sensors measure the utilisation in real-time and make it available to the DMO. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| | All service providers participate and are involved. | Likert (0 – 4) |
| | Service providers see advantages in the fact that the collection of sensor data. | Likert (0 – 4) |
| **Policy** | Privacy and security are guaranteed in data. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| | All work for a common goal that tourists get a better experience. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| **Business Value** | Through the use of IoT, the tourist receives data in real-time. It allows them to make immediate decisions. Stakeholders can use the data for their analyses and decisions. | Likert (0 – 4) |

## 9.4 **Level 4 – Optimisations**

Table 21: The seven S summary for Optimisations (Level 4)

| Element | Description for Optimisations (Level 4) |
|---|---|
| Strategy | The processes and strategies created must be continuously adapted to the new circumstances. New findings also flow into the revision process. |
| Structure | New findings flow into the adaptation of the organisation. Bankruptcies, business closures or new openings on the part of service providers also lead to |

| Element | Description for Optimisations (Level 4) |
|---|---|
| | changes in the relationship between DMO and stakeholders. |
| Systems | System and applications within the DMO and stakeholders need to be maintained. New regulatory changes to data can lead to adaptations. |
| Staff | Both employees and stakeholders provide feedback to the DMO. All stakeholders continue to be integrated into the DMO. |
| Style | An open culture leads to problems and challenges being discussed and solved together. |
| Skills | Stakeholders and the DMO can adapt to environmental changes. Identify new trends and use them to create new services or products. |
| Superordinate goals | Over time, new insights are gained, or external influences lead to the need to optimise existing processes and organisations. New trends are recognised more quickly. |

This level deals with the optimisation of processes and organisations. Requirements or new trends are emerging among tourists. This leads to the fact that the cooperation within the DMO must be reconsidered or revised. It can also lead to new products or services.

Technology can also change over time. New sensors or new open standards are emerging to optimise data exchange. Another point is that the hardware used has a lifecycle. It takes constant investment in hardware to replace obsolete components.

Another important point is that feedback from different sides within the DMO is taken seriously and that appropriate actions are taken where necessary. Feedback helps on the one hand to improve processes and on the other hand to further develop the organisation.

Together with all stakeholders, a path for the future is created. This determines which goals are to be achieved. New customers are to be acquired and existing ones maintained.

### 9.4.1 Data collection in the level

Interfaces and data formats must be regularly reviewed and adapted to new developments. Technological developments can lead to new standards or data formats. The DMO has to weigh up what an adaptation or enhancement will bring.

### 9.4.2 Possible smartphone apps

Apps cannot ignore new developments. On the one hand, data standards or data formats can change, and on the other hand, they further develop the operating system of smartphones. The operating systems provide new functions that can be used in apps.

### 9.4.3 Pitfalls on the level

There are also pitfalls in optimisation. It may well be that stakeholders have hoped for more from the investment in sensors than they will ultimately get as a result. This leads to stakeholders turning from advocates to opponents.

Even developers have hoped for more from the data or tourists are dissatisfied with the apps developed. Here it is essential that a DMO actively seeks dialogue with the app developers and provides them with the necessary information. The Cagliari case from Level 3 shows how an app can be.

Technological progress continues. This also influences a DMO. A DMO may have developed a vision for the future that moves against technological progress. Accordingly, a DMO must also adapt to this progress. Nobody can stop progress.

### 9.4.4 Stakeholder management

Stakeholder management cannot avoid optimisation. New insights and developments create the need for optimisation. There will always be stakeholders who will turn from proponents into opponents. It is therefore essential that an open culture of discussion prevails within the DMO, where emerging problems are discussed and solved.

### 9.4.5 Validation of the level

The next table shows the criteria that are necessary for this level. All criteria must be met to reach the level. It also means that all participants perform their validation. This ensures that a more comprehensive result is available. This is because everyone participates in the DMO with their contribution and assumes responsibility for it accordingly. For each level, the corresponding business value is also described at the end of the table. Each criterion is measured on a specific scale.

Table 22: Conditions and Scale for level 4

| Condition | | Scale |
|---|---|---|
| **Management** | The DMO adapts its organisation and processes together with stakeholders in line with discoveries. | Likert (0 – 4) |
| | System and processes are open to change. | Likert (0 – 4) |
| | The seven S model defined in Table 21 helped to improve the destination. | Ordinal (0, 0.5, 1) 0 = not at all, 1 = partly, 1 = complete |
| **Tourist Organisation** | Data managers monitor and analyse data flow from stakeholders to DMO. | Ordinal (0, 0.5, 1) |
| | Data is still exchanged automatically. | Ordinal (0, 0.5, 1) |
| | The data manager updates the interface description. | Ordinal (0 – 4) |
| | All changes lead to a better tourist experience, which is measurable. | Ordinal Scale (0 decreased, 1 = same, 2 = increased) |
| | DMO may influence the developers of apps and make suggestions as to what they can improve. | Likert (0 – 4) |
| **Service Providers** | Service providers keep their systems up to date and incorporate their findings into the process of creating them. | Likert (0 – 4) |
| | Service providers participate in the optimisation of processes and data exchange. | Likert (0 – 4) |
| | Useful new findings in the area of IoT are adopted and implemented by stakeholders. | Likert (0 – 4) |
| **Policy** | Regulatory adaptations to privacy and security are adequately adopted and implemented. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| | All work for a common goal that tourists get a better experience. | Likert scale (-2 to 2) disagree entirely (-2) to completely agree (2) |
| **Business Value** | Adjustments and optimisations lead to an even better tourist experience. They benefit and can make better and more accurate decisions. | Likert (0 – 4) |

# 10 CONCLUSION AND RECOMMENDATION

Tourist destinations are subject to constant change. Tourists change their demands and desires. A destination must be able to react to this. Also, the advent of smartphones has changed the behaviour of tourists. Tourists can talk badly about a destination with a UGC. A DMO must be able to react quickly and correctly in such situations. Social media plays a vital role in marketing. As studies from the literature show, a goal can be promoted by selective UGC on social media. Tourists inform themselves about the destination before the planned trip. Social media is a source of information. There is also the possibility to use the UGC of other tourists to attract new tourists. It is visible what a tourist can experience at his destination or what is coming his way. In the end, everyone wants to have a great experience on holiday and report about it at home with families and friends. Social media now has a significant influence on tourist destinations.

The maturity model is a way for a tourism organisation to develop further. It involves stakeholders more closely in the organisation. They are part of it and contribute to decisions. A maturity model is created, made available and tested in defined sequences. This was shown in the literature examined. Furthermore, the model shows the degree of cooperation. Problems and difficulties arise through cooperation. Each level has its pitfalls, and these are recorded in the maturity model.

Open data helps tourists to obtain better and more reliable data. This enables them to make quick decisions. It goes one step further by allowing tourists to plan their stay or what sights they would like to see. Here the app developers are obliged to design their apps in such a way that this is possible as the Cagliari case showed. The tourist organisation does not create every app. Third parties created many apps and made available to tourists.

This work laid the foundation for the maturity model. Future literature will deal with the validation of the model by applying it to different destinations and comparing the results. A DMO can also become active and apply the model independently to get questions and answers about what development steps are necessary for the future. An attempt was made to take into account the most important criticisms from the literature and to provide certain instruments and ideas for validation. Academic researchers can also further investigate the model and complement it with empirical research.

Another point for the future is that DMOs should ensure that only a few apps are needed to explore as many tourist destinations as possible. This means that globally the DMOs should also work together. The result should be that they develop together a global standard, which data is necessary and which requirements are given to such an app.

# 11 REFLECTION

With this thesis, a new maturity model for Smart Tourism Destination was developed. For the author, it was the first self-developed maturity model. Developing a new model is an even more important step than applying existing ones. The University offered appropriate support to develop the model. It was not easy to find good literature on how to develop a maturity model. Thanks to some tips, articles were found and used for development. Maturity models are always subject to criticism. The model seeked to consider at least some critics and to incorporate them into the model. However, this was not an easy task. In many cases, empirical research is necessary to develop the model according to demand. The problem is that on the one hand there was not enough time and on the other hand the amount of work would have been exceeded.

The majority of the research questions posed in the introduction could be answered with the work. Over time, it became clear that the question of apps is not easy to answer for every level of the maturity model. On the one hand, the model should remain as general as possible in order to keep this decision open to the competent authorities. On the other hand, as much information as possible should be communicated so that appropriate apps can be created. Limiting the number of apps is essential.

Through this thesis, the author gained new insights around tourism. Which can lead to the fact that with the next vacation on some points from the maturity degree model more value is put? If over Social Media impressions and experiences are shared, one pays more attention to the correct Hashtags. This allows a DMO to use them.

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