



Acceleration of Human Resource Development for the UAV data processing in Indonesia

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Abstract. Geospatial Information (GI) utilization needs acceleration in conjunction with the unprecedented improvement of GI technology infrastructures. Unmanned Aerial Vehicles (UAV) is one instance that demonstrates some advantages by enabling on demand flexible geospatial data acquisition. However due to the frequent use of non-metric camera such as consumer grade cameras, it requires the calibration procedure in order to fulfil the acceptable geometrical accuracy. The relatively simple procedures and high resolution produced data are the major advantages of the UAV data acquisition. With a land area approximately five times of the Federal Republic of Germany, the provision of GI in Indonesia requires innovative acceleration strategies that also considers cost production efficiency moreover due to the preparation of human resource in GI as its primary component. In this case, certification and accreditation in GI area are still mandatory especially in conjunction with technological improvements and weather situation (cloud coverage) as the main constraints to be considered for the geodata acquisition in Indonesia. This process includes knowledges, skills and/or advancements as well as working behaviour relevant with the tasks and conditions in a so-called Competency Working Standards of Indonesia (SKKNI). In addition to the SKKNI, GI competency standards can also use relevant international standards or specific standards as a reference. Competency standards are the basic requirements for any activities related with the national GI provision. Based on analysis of the national interests, the qualification identifications can be performed by specific study in the context of business process and GI industry from the scope of above mentioned national/international view as well as particular (GI) industry.

Finally, this paper discusses and formulates the competency standards that can be used by corresponding stakeholders involved in the national GI provision from the actual regulation as well as technological/industrial perspectives. The standards of GI empowerments are fundamental especially in a situation where there are various technology and method available in the society as well as GI industry. For this purpose, the proper professional certification must be essentially well defined in order to prepare excellent GI human resources as the primary source for the provision of reliable GI data and information in a favour of the Large Scale Topographic Mapping (LSTM) and Updating acceleration program.

Keywords. competency, UAV, certification, standard

1 Introduction

Governmental regulation in a set of legislation act number 4/2011 (UUIG) about Geospatial Information (GI) encouraged the provision of both Fundamental Geospatial Information and Thematic Geospatial Information which are reliable, up-to-date and accurate in Indonesia. On the other hand, Geospatial Industry requires highly qualified Human Resource Development (HRD) that can actively involve in the nationwide acceleration of the provision of GI infrastructures.

Considering the GI provision can be initiated by every person based on section 55 of UUIG that has been ratified by legislation act number 11/2020 about Omnibus Law (UUCK), the aforementioned person must comply with the qualification competencies (Figure 1). In this case, those are Profession and Certification Bodies in GI area which have discretion to certify the corresponding person.

Moreover, every responsible Human Resource Development (HRD) department applies comprehensive approaches which is synchronized with the strategies of nationwide GI development.

The role of Geospatial Information Agency of Indonesia (BIG) in the context of guidance and directive for GI professionals becomes more prominent especially in conjunction with its mandatory task and responsibilities. As a state agency, BIG takes responsibility to provide and/or initiate a platform for accountable and accessible GI. Indeed, reliable GI only can be developed in a professional environment. An important key step towards professionalism in GI area is indicated by the proper certification of work competency.

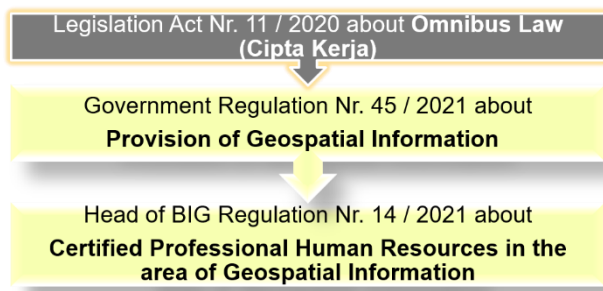


Figure 1. Indonesian regulatory mandates in GI area.

2 Methodology

The advent of new alternative platforms triggers a relatively new different approach to address the demand of GI data as a recent solution to the old-fashioned hard copy maps. Crowd sourcing in terms of geospatial data production as a portrayal service is a prominent issue to provide reliable and relevant information nowadays especially in the recent years while a lot of Volunteered Geospatial Information (VGI) is freely available.

The study of different certification schemes and their contributions to the GI development are the main reasons why the new certification initiatives were introduced. The progressive certification scheme will not only valuable for the GI workers but also for the GI industries (companies). However, the certification shall be received from limited number of the institutions which are already accredited by the corresponding standardization bodies. This acceleration in certification therefore must also fit with the industrial and academic needs of geospatial business in Indonesia.

2.1 Literature Studies

In order to define the appropriate scope of work of GI area, the method and approach must be identified at the first place. Body of Knowledge (BoK) is used as a

reference method to identify the details (DiBiase, et.al., 2007). This method was designed to be able to establish proper GI curricula especially for the certification and accreditation purposes. From this perspective, the current and prospective GI professionals in the society, government, company, etc. can be well recognized.

In addition, BoK approach has been effectively used in the accreditation procedures for any certification bodies involved in GI HRD (Reinhardt, 2014). As an example, every university degree course in GI area can be accredited by using BoK approach.

One instance from the actual GI activities is the Geographic Information - Need to Know (GI-N2K). The GI-N2K project e.g. in Europe was developed by a network of many collaborative institutions from the academic, industry and partners from the GI area, GI associations and professional experts (GI-N2K, 2016). For the implementation of link and match program between academic and industry sites, GI-N2K project focus on addressing how the course degree in the origin of existing Geographic Information Science and Technology Body of Knowledge (GI S&T BoK) can provide a practical solution aiming on the continuous improvement of GI HRD. GI-N2K was made based on University Consortium for Geographic Information Science, published in 2006 by the Association of American Geographers (UCGIS, 2006). The 'BoK' was designed for the purpose of on-going improvements and therefore can work in line with the new technological developments from the European perspective e.g. importance of Infrastructure for Spatial Information in Europe (INSPIRE). In this case, the updated BoK will use a collaborative approach and will apply the form of a growing e-platform including tools to simulate the BoK requirements. For example, this BoK will be used to establish an up-to-date curricula, training and courses as well as to identify the job occupancies in the GI area.

The approach for the generic and geospatial certifications is already introduced by many GI institutions, e.g. GIS Certification Institute, GeoAcademy, American Society for Photogrammetry and Remote Sensing (ASPRS), and software companies such as ESRI, Oracle, and RedHat (Behr, 2016). The examples show the variety of fields, levels and assessment methods which are offered within many business schemes.

2.2 Tools

The implementation of conceptual model as well as the data model requires some tools and/or infrastructures for further development in a more practical way (Reinhardt, 2014). For handling the BoK more conveniently the text modules of the new proposed Knowledge Area (KA) and some other improvement of the existing BoK have been

extended in the certification scheme. To ensure the appropriateness of the data model, the new technology must be identified at the first place and then instigated by using a relational database management system. More details on the tool executions will be discussed in the next chapter.

In addition, the development of some functions in form of a software tool is initiated. The main motivation to further develop this tool is to enable pre-defined user activities based on the database implementation of the BoK. Aforementioned activities shall focus in the definition of GI courses, modules and lectures based on the BoK graphical representation and the analysis of the content of the defined module etc. As a test scenario for the approach, definition of new competency standard for the UAV data acquisition in GI area is selected as a constraint.

2.3 Implementations

The most important factor that triggers the open certification procedures as an alternative was the rising of crowdsourcing and technology driven demand (Harrison, 2013). The QGIS Certification Program is one example of open access mechanism on the software developer sites.

Open certification is made based on two important criteria. Firstly, it must address the role of GI professionals for the community in the context of QGIS project. On the other hand, it must contribute in the development purpose of QGIS software. Therefore, at the end of the certification process, the GI certified persons must present both detail of their technical contributions to the QGIS project and publish their training materials available for review purposes (QGIS, 2021).

Actually, those two approaches assemble the advantages of flexible certification procedure and knowledge transfer capabilities in the context of GI certification management systems. Therefore, many certification institutions implement the hybrid concept of certification scheme in order to perform and complete necessary technology updates e.g. sensor (acquisition), processing (application), and cartography (visualization). For instance, the hybrid implementation in GI area presents a reliable performance for a big data from Open Street Map (OSM) datasets (Tampubolon, Reinhardt, 2014 and Behr, 2016).

Hence, the aim of this paper is the implementation of the enhanced curriculum modification and competence certification by enabling the open access certification in addition to the existing conventional/traditional certification. Specifically, for handling the accelerated nationwide certification, the open source certification has been selected as an alternative procedure in the GI production line with the capability to cope with disaster preparedness and quick emergency response activities. In

addition to these main objectives a study of integration tools to modify the GI curricula is discussed in brief (Figure 2).

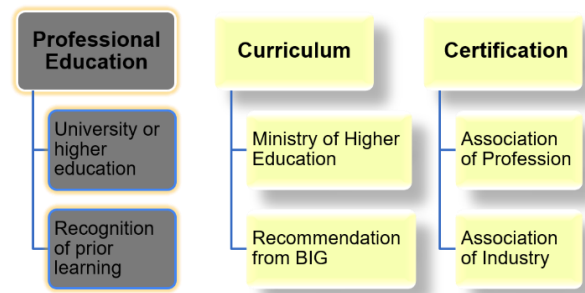


Figure 2. GI professional and educational aspects

3 Discussions

For further evaluation purposes, the performance of this proposed hybrid certification has been investigated. In this use case, the comparison between open access and conventional certification has been done by incorporating the corresponding institutions i.e. academia (university), curricula (government/ministry) and certification (association) bodies (see Figure 2).

As listed in Table 1 (Behr, 2016), there are some examples of GI certification scheme provided by various institutions/organizations with some notes:

- The certification types are classified and grouped from different organizations;
- The method of examinations e.g. written, oral and on purpose;
- The level of competencies are fixed.

Table 1. Available certification schemes.

Institution	Type	Level	Examination
ASPRS	Photogrammetrist, Mapping Scientist	Professional, Technician	Peer review, written
GIS Certification Institute	GIS Professional	Professional	Technical knowledge exam
QGIS	User Certification	Technician	Peer review, output based
ESRI	Desktop Developer Enterprise-Geodata management, System Design and Administration	Professional	Computer-based test

The main expected result from this combination is the hybrid GI certification platform. Therefore, the main motivation of this paper is to incorporate an emerging open access certification into an organizational certification that mostly uses conventional examinations. Presumably, it shows also that an open access certification is a reliable additional platform for managing the GI professionals up to the operational/technical level.

3.1 GI Body of Knowledge (BoK)

Body of Knowledge is a comprehensive inventory of the intellectual content that defines a field (DiBiase et al., 2007). In the BoK approach, there are some involved stakeholders or sectors:

1. Curriculum planners and assessors;
2. Certification and Accreditation Bodies;
3. Current and prospective students;
4. GI professionals (government, industry, academia, society).

In line with the progressive technology updates especially due to the starting of Internet of Things (IoT) era, the role of BIG in Indonesia is significantly growing as the only government institution responsible for the HR development in GI area. Based on UIG section 56, it is BIG's responsibility to ensure the preparation and provision of accountable GI data through the competency certification of GI professionals.

On the other hand, legislation act number 20/2014 about Standardization and Compatibility Assessments defines scope of work of compatibility assessments which are implemented in the procurement activities, system, process or person based on the certain references. In details, certification is a sequence of compatibility assessments related with written guarantee statement that any product, service, system, process or person is complying certain standards and/or regulations. This regulation was in line with the previous legislation act number 13/2003 stating that one important form of competence recognition is by issuing the certificate of competence.

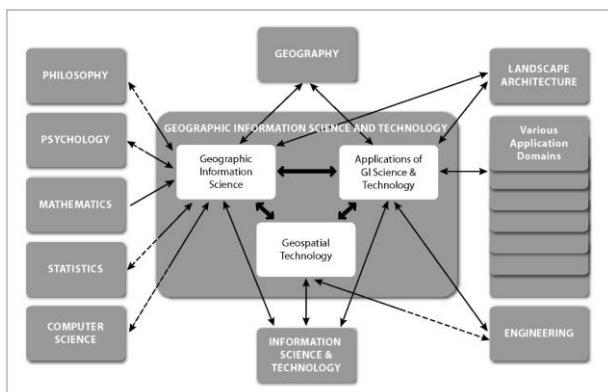


Figure 3. Body of Knowledge of GIS&T (UCGIS, 2006)

However, the BoK of GIS&T is still heavily compiled to the perspective of Geographic point of view (Reinhardt, 2008). It must be noted that there are a lot of involved discipline area in GI science. For example, Geodesy, Geomatics and Computer Science also play an important role in GI Science. Therefore, it is recommended to add Geodesy, Computer Science and any relevant discipline more explicit to the conceptual development of BoK, preferably on the top level. In addition, the consideration of topics related to basics in Natural Sciences, Mathematics, Computer Science, etc. is also as important as the definition of GI Science topics.

3.2 Curriculum tools

Since the initiation of UIG in 2011, the GI area were increasingly growing along with the demand of geospatial-based analysis within the governmental activities in Indonesia. The main objective in this case was the challenge for adopting the curricula to the different competence profiles. Obviously, there are many of field area as well as to the number of credit points course which are not intended only for answering GI issues. Therefore, for the detail design of GI courses the BoK can be used but in a modified form as developed by Reinhardt, 2011.

An extension or restructuring of the BoK related to a broader consideration of SDI topics was needed as some issues about SDI are not considered properly (Reinhardt, 2017). This extension can be used as a role model and reference for further discussions since it is expected that lecturers and experts in GI area will contribute to a wider development of this newly proposed KA (Figure 4).

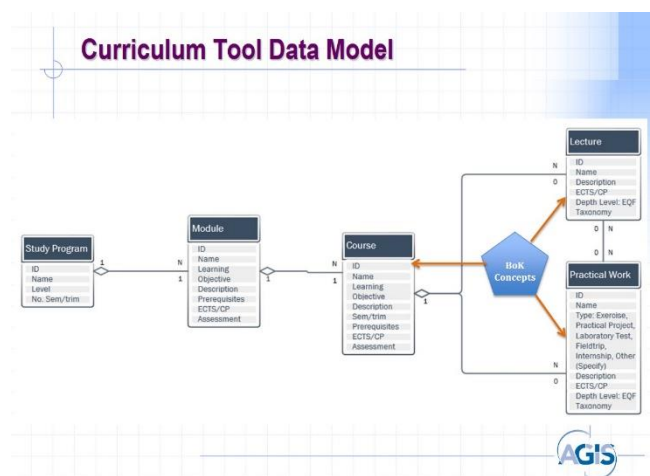


Figure 4. Tools on Curriculum definition (Reinhardt, 2011)

3.3 Strategic value of the HR development

The urgency of HRD management reflects in the impact of BIG's capabilities to accomplish the completion of GI provision with a reliable quality. Without professional GI

HRD support, it can't be avoided that the produced GI will give no gain and useful impact for the public interests.

In addition, the main reason why GI HRD is very essential for any company or government institution such as BIG is that through the proper GI HR management, the organization can create primary balance in GI industry as well as potential foreign investment for the nationwide GI provision. National primary balance includes objective target, aim and achievement among the corresponding stakeholders for the aforementioned provision.

Given the primary balance already achieved, the efficiency and productivity of GI provision will increase significantly for both government (BIG) and private sector (companies). For that purpose, many GI institutions give highest priority to the GI HRD starting from recruitment process as well as to the existing GI HR within their organization. GI HRD will also help the decision maker to choose the appropriate GI strategies especially from the government perspective. Through the effective and efficient GI HRD management, BIG can contribute in GI HRD with more responsibility in ethical, strategic and social ways. As a final result, national GI HRD can give productive contributions in order to achieve national development goals as planned.

Basically, GI provision includes a sequence of activities in GI area starting from planning, measuring/collecting, processing, storing, securing, disseminating, innovating the GI data. To support the implementation of GI provision, at least there are some required expertise based on SKKNI as the following:

1. Terrestrial survey
2. Hydrographic survey
3. Photogrammetry
4. Remote Sensing
5. Geographic Information System (GIS)
6. Cartography
7. Regional survey

3.4 Competency updates

For the use case of UAV data acquisition, the extension of GI BoK is also planned by identifying the appropriate KA as well as the unit of competencies. The consideration of regulations, standards, initiatives (INSPIRE), technologies, policies, and also the integration among GI and other disciplines indicates the importance of regional/national perspectives (SKKNI) that have to be considered in the GI BoK. Based on the latest SKKNI, the following unit of competencies are suggested under the KA of Geospatial Data (GD10 Aerial imaging and photogrammetry):

- M.71IGN00.001.1: Acquisition planning: UAV with Optical sensor (camera)

- M.71IGN00.002.1: photo production with < 10% cloud coverages
- M.71IGN00.003.1: Ground Control Point (GCP) measurements (Premark and Postmark) for Orthophoto and DEM production
- M.71IGN00.004.1: Field data integration of Indonesian Geospatial Reference System (SRGI) into UAV data processing
- M.71IGN00.005.1: DEM generation by Structure from Motion (SfM) algorithm
- M.71IGN00.006.1: Feature data production and compilation based on UAV data

All competence units as above mentioned are belonged to the UAV-based GI data acquisition (Figure 5). As mentioned, acquisition planning also has a strong relationship to other KA such as Organizational and Institutional Aspects (OI).

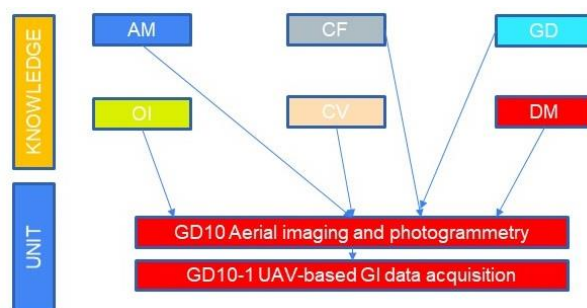


Figure 5. Knowledge Area and Competency Unit identification based on UCGIS GI BoK

4 Conclusions

In order to support the Large Scale Topographic Mapping (LSTM) in Indonesia, the establishment of GI competency standards must be developed in an accelerated way. Indeed, the acceleration programs implement an adaptive approach by the involvement of multisector roles. To achieve that goals, an up-to-date GI Curriculum is mandatory by implementing appropriate use case i.e. UAV data acquisition. In this case, certain tools and standards are required.

In addition, GI competency standards by proper HRD qualification identification are also required by means of detail and specific studies in the context of business process and GI industry. However, various technologies and methods available in the society as well as GI industry shall be selectively incorporated.

Finally, proper professional certification in the area of UAV data processing must be essentially well regulated by defining the GI HRD national road map. The aforementioned road map aims on the preparation of

excellent GI professionals in a more feasible way especially to support LSTM acceleration program.

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