Working Group Progress for IEEE P3141 - *Standard for 3D Body Processing,* 2018-2019

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https://doi.org/10.15221/19.185

Abstract

The 3D Body Processing (3DBP) Industry Connections Working Group, an adjunct group of IEEE P3141, Draft Standard for 3D Body Processing (3DBP), brings together diverse entities devoted to making recommendations for 3D body processing interoperability between creators and consumers of 3D body models. Members are mainly related to the apparel, footwear and accessories industry and include large retailers, scanner providers, data processors, hardware solutions providers, virtual fit providers, small start-ups and universities.

This paper summarizes the main activities conducted during the past year and provides an overview of the topics to be addresses in 2020. During 2019, the working group published two white papers focused on File Formats and Communication, Security and Privacy (CSP). The group conducted Phase 1 and 2 of a comparative study of full body using different anthropometric measuring methods including traditional and digital (including phone apps).

Keywords: 3D Body Processing, Landmarks, Measurements, Anthropometry, Mass Customization, 3D Scanning, File Formats, Metadata, Digital Shoe Last, Comparative Analysis, GDPR, Footwear, Apparel, Communication, Security, and Privacy

1. Introduction

The IEEE 3DBP Industry Connections Group (3DBP) brings together an international, multi-disciplinary set of individuals representing many companies that are in the process of proposing new standards and/or practices to enhance 3D body processing interoperability between creators and consumers of 3D body data. The standards will be used in existing industries to develop new businesses around 3D body models.

Companies involved in the 3DBP working group include large retailers, scanner providers, virtual fit providers, CAD tool developers, product manufacturers and small start-ups. The industry use cases considered thus far range from size recommendation to product personalization, through custom manufacturing, fit predictions and virtual simulation. These activities will influence the design of consumer goods, including apparel, footwear, and wearable accessories.

Through its members, the IEEE Working Group is connected to other standardization organizations including ISO, X3D, AIST, H-Anim, and ASTM. The group does not intend to duplicate standards and will leverage existing work and practices but intends to create complementary standards and practices that establish the ecosystem required for future growth of 3D body processing. To help understand the ecosystem's requirements for 3DBP, the working group is closely connected with the 3D Retail Coalition (3DRC).

The ultimate objective of IEEE 3DBP is to facilitate interoperability and data exchange of digital 3D body data across the different stakeholders along the data value chain. 3DBP scope encompasses 3D capture, processing, storage, sharing and representation. The initiative brings together stakeholders from across technology, retail, research and standards development. This paper summarizes the main activities conducted from Q4 2018 to Q3 2019 by the working group and provides an overview of the activities planned for 2020.

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2. 3DBP Industry Connections Group Current Publications

In 2019, the 3DBP group will publish two white papers in addition to this overview paper. The white papers reflect the work of the IEEE subgroups. These papers will be made available on the IEEE 3D Body Processing website.

White paper: *File Format Recommendations for 3D Body Model File Processing* [1]

In Q4 2019, the File Formats subgroup will publish a white paper detailing the recommendation of file formats that will support 3D Body Model file formats. The paper gives a detailed review of currently available file formats along with the alignment for 3D Body Model Processing. Responses from a questionnaire of experts will be used to establish requirements for meta data and import/ export protocols. The file format needed to be open and currently maintained.

White paper: *IEEE 3D Body Processing Industry Connections (3BDP IC) Communication, Security and Privacy* [2]

The Communication, Security, and Privacy (CSP) subgroup published a white paper assessing the transmission, storage, and use of data, information that contains detailed anthropometric facts. The secure communication or transmission of this privileged or private information is a key consideration. The topics included: what mechanisms can impact, influence, or contribute to secure transmission or data sharing, and as devices become increasingly connected, how can privacy and security be ensured. This research will help facilitate the IEEE P3141 to move forward creating a standard for interoperability and deployment of 3D body processing technologies.

3. Technical Working Subgroups

The 3DBP is an umbrella technology working group with separate subgroups focused in the following five areas:

- File Formats (including Metadata)
- Quality
- Communication, Security and Privacy (CSP)
- Footwear
- Mega Technology Trends

3.1. File Formats Subgroup

The File Formats group focused on two areas in the Retail environment for file formats. The first area is the file format best suited for 3D Body Model Processing. The review of file formats is described in detail in the previously listed paper listed. The second area of focus will be Apparel CAD for material modeling and body model quality.

The File Formats subgroup concluded that a new advanced file format was the best compromise. Among those formats, five advanced formats were short-listed: FBX, glTF, X3D (ISO/IEC 19775/19776/19777, successor to VRML), BLEND (Blender native format), and DSON (Daz Studio native format). After a thorough analysis and comparison by the subgroup members and invited experts, two formats were determined to be most suitable for 3D Body Processing: X3D [3] and glTF [4].

Both glTF and X3D are feature-rich evolving formats, so their comparison in the published paper will probably become outdated quickly. Official information on these formats can be found in websites listed in the Reference Section. Both formats have their pros and cons depending on the application. So, X3D, being an ISO/IEC 19775/19776/19777 standard, can be beneficial for archival applications, government, military, and medical organizations. Alternatively, glTF has wider software support, so its adoption will likely be faster. Also, The X3D format can be used to store a 3D body model, complex scene representation and associated metadata. An interesting thing to consider is that the glTF file can be directly embedded into an X3D scene (via Inline or X3DOM External Geometry/Shape), so the 3D body model stored in glTF file can also be opened in an X3D-enabled software that has support implemented for these features.

The scope and handling of personal data have been impacted due to the release of the European Union (EU) General Data Protection Regulation (GDPR) in May 2018 [5]. Personal data is any data that can be used to identify a person. This European regulation puts emphasis on guaranteeing that each person, as rightful owner of his personal data, should be in control of it. Thus, any personal data and metadata involved in 3DBP pipelines will require explicit permissions with respect to an extensive list which includes recording, storage, transfer, use, depersonalization, and additional data operations. In this regard, this group has worked on distinguishing which data associated with a 3D object can be considered what is personal and what is definitely non-personal data. Strictly, personal data is the data that enables identification of a specific person. A 3D scan of a face or an email are clear examples of personal data. The gender or the age, for instance, would not be personal data. However, if one combines both and adds the IP address of the acquired data, the combination of anonymous data leads to identifying a person and thus becomes personal data. This was an important topic of investigation and discussion during 2019.

During 2019, 3DBP had a focus group with the Apparel companies. One of the key requirements from Apparel CAD is the interoperability of file formats between applications. The items in blue in Figure 1 are the focus of the IEEE 3DBP group. Recommendations so far included: identifying quality levels for 3D body model scans, identifying the number of polygons, noting the level of scan from meshed data to completed avatars with landmarks and measurements, pose of avatar and editability, animation of avatar, if the texture levels include color, and skin and hair texture regardless if the person was de-identified or not.

The second area of focus consists of the material modeling requirements for Apparel CAD. The 3DBP is working with the 3DRC and Apparel CAD companies to understand essential requirements for textile design and product approval, the impact of the supply chain and understanding the accuracy of output from the simulation engines of the CAD to fully represent textures. As the following diagram shows, the Retail industry, not only needs file formats for avatars but also file formats that will work with Materials (visuals – including textures and physics). Per request from 3D.RC, the texture map file can be “contained” within a 3D file format in alignment with the Physical Property Standardization Project from the 3DRC.

Examples of texture maps for materials may include: diffuse color, normal, specular color, roughness, Fresnel, anisotropic rotation, alpha, height, clear coat normal, and transparency. Physical properties of candidate materials may include: stiffness, structure, surface/ texture (see above), surface hardness, warp, welt, orientation of warp and welt, surface compression, drape coefficient, drape distance ratio, and drape profile ratio.

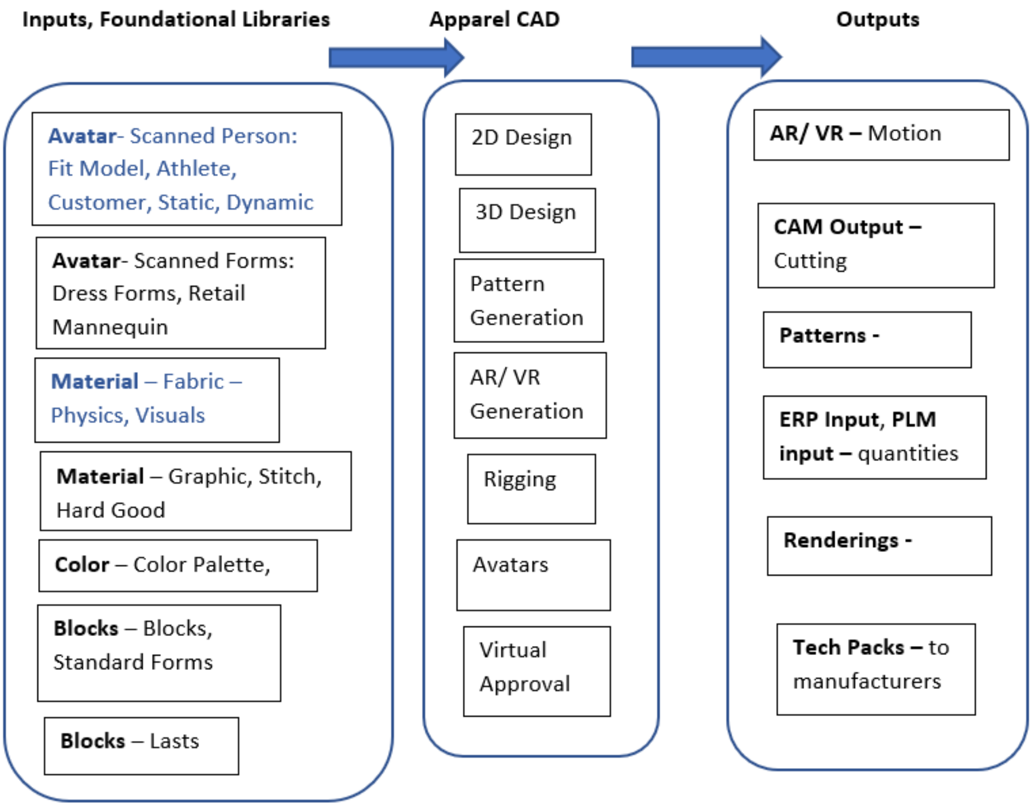

Figure 1: Flowchart of Apparel CAD requirements

In 2020, the group plans to provide metadata specifications for a future *IEEE P3141 Standard for 3D Body Processing*, which sets compatibility limitations on feature-rich file formats. The group also plans to continue working on file formats for textiles clothing, footwear, accessories, and equipment. File formats recommended by 3DRC for review are U3M, SBSAR, AxF, MDL and xTex.

Regarding compatibility limitations on feature-rich file formats, an important option to consider is providing for different recommended subsets in the standard. An entity participating in a 3D body model processing pipeline may declare that it complies with a chosen subset depending on its capabilities and resources. The subsets may consist of: *basic,* the easiest to implement with focus on limiting representation options), *full* (the hardest to implement, supporting a wide range of options), and *industry specific* for all methods of additive manufacturing, apparel, medical and other industries. The complete set of features has not yet been determined and is a living list.

3.2. Quality Subgroup

The *Quality* subgroup is preparing phase two of a study on *Comparative Analysis of Body Measuring Methods,* which results will be released in 2020. The objective of the study is to gather anthropometric data on living humans using different technologies, namely traditional anthropometric methods (past), 3D scanners (present) and smartphone apps (future), to:

1. Assess the reliability and compatibility of body measurements extracted from full body scans.
2. Release examples of the outcome datasets, i.e. 3D scans and measurements, from the different technologies and make them publicly available.
3. Create data resources for the IEEE 3DBP initiative to develop and test 3D quality metrics

The results of this study will help apparel companies consuming or using body measurements, to better understand the benefits and limitations of this type of data -- in particular, the reliability of the available methods, as well as the compatibility between same measurements obtained by different methods.

The data gathering for the Comparative Analysis study was performed during two phases in 2018 and 2019; Phase 1 (November 2018) Portland, Oregon, USA and Phase 2 (October 2019) Valencia, Spain. Phase 1 (2018) was coordinated by Kalypso and Gneiss Concept. Phase 2 was coordinated by Instituto de Biomecánica de València (IBV). A planned data gathering event in Atlanta, GA, USA in 2019 did not occur due to logistical issues.

This study includes 11 body measurements gathered by both traditional and digital anthropometry. These measurements were selected by industry members of the working group to cover all body parts due to their relevance in apparel applications (Table #1, measurements #1-11). Phase 2 also included an additional experimental waist measurement developed by Fashion Should Empower (Table #1, measurement #12). Since digital measuring is much more efficient and is not constrained by time during data gathering, measurements derived from scanning data may not be limited to the first 11 listed measurements.

Table 1. List of measurements designations and ISO reference

#	Designation	ISO 8559-1:2017 [6]
1	Neck girth	5.3.2
2	Back neck point to waist	5.4.5
3	Upper arm girth	5.3.16
4	Back neck point to wrist	5.4.17
5	Across back shoulder width	5.4.3
6	Bust girth	5.3.4
7	Waist girth	5.3.10
8	Hip girth	5.3.13
9	Thigh girth	5.3.20
10	Total crotch length	5.4.18
11	Inside leg height (L or R)	5.1.15
12	Static Waist Girth	NA

Sixty volunteers representing a variety of male and female body shapes were recruited at each phase. In both phases, all subjects were measured twice in order to enable both repeatability and compatibility analyses. The number of subjects was optimized to enable independent analyses of data by gender and body fat percentage (BFP), using the optimal experiment design methods proposed by Walter et al. [7].

Phase 1 included six measuring stations: two body scanning booths (VITUS Bodyscan by Human Solutions GmbH and SS20 by SizeStream, LLC and four stations where apparel industry experts took traditional anthropometry measurements. Phase 2 included eight measuring stations: two body scanning booths (Move 4D by IBV and Portal MX by Texel Graphics LLC), two stations where experts took manual measurements, and four stations using body measurement apps (3D Avatar/body by IBV, 3DLook, Size Stream app and one more). One of the manual measurers is from the apparel industry and other is accredited by ISAK, a sports industry organization. Generally, the body measurement apps incorporate scanned data into information already stored within the apps which can then generate additional 3D output, such as size recommendations.

The data analyses will be completed after the 2019 3D Body Tech conference. Each scanner company will analyze their own data, as well as, the other's.

The analytic procedures planned include the quantification of the reliability of each technique and the reliability of different combinations of techniques (i.e., traditional and digital); and the quantification of the biases between pairs of techniques or pairs of combination of techniques. The results will be communicated in a white paper planned for 2020. The data will be available for review.

Based on the results of this study, companies consuming or using body data (e.g. measurements or 3D models) will be able to make an informed use of current methods (traditional and digital) and to effectively integrate 3D data into their design methods. Moreover, this Quality group and other research/technology organizations will be able to use the results and gathered data to investigate and build new standards that help resolve existing problems pertinent to reliability and compatibility of measurements with 3D data.

The partial data from Phase 1 was reviewed by Size Stream and will be presented at the 2019 3D Body Tech Conference, *Man versus Machine, Measuring People for the Apparel Industry* [8]. Phase 1 and 2 of the *Comparative Analysis of Measuring Methods* will be completed and reported upon.

Another focus for 2020 will be on the vocabulary of fit, which is essential for understanding clothing comfort in terms of fit. 3D measurement tools and equipment have the ability for quick and accurate measurements. On other hand, understanding the usage of these measurements and other data (like point cloud, scanatar, avatar, datasheets, etc.) remain partly unclear. A 3D scanned image can display the fit and appearance of a garment (if the garment image is superimposed over the body image in a static position). Scanning CAD software will detect wrinkles as defects or imperfections. However, comparisons of transverse planes taken up and down the body gives an idea of the shape and volume of the of a human body under the garment. Thus, it is possible to obtain human body measurements in an automatic, fast and precise way. Nevertheless, there is a gap between garment production dependent upon 3D human body measurements into a pattern, versus measurements from parametrized CAD/CAM data into patterns. For example, a chest horizontal circumference measurement is more accurate (more horizontal) when using human body scanners than by manual methods. This chest measurement is the main measurement that sets the overall width in most of the pattern making. Patternmakers and tailors have developed approximate construction methods to compensate for the uncertainties in the measurement. However, the construction methods are not universal and are dependent on the morphotype of the person being measured. It is essential to generate new rules on how to implement scanned measurements into patterns, and how to determine new sizing and fit assessment rules. This area of research is an expansion of the research by one of the group's members [9], whereas, the need for corresponding fit definitions is supported by other group members based on their own research.

Patterns also reflect a brand's understanding of a garment's ease. However, understanding how garments fit on the actual customers versus the garments purchased by the customer is a new area of exploration. Currently the customer can only imprecisely describe loose or tight fit. It is likely that this fitting related topic may become a specific sub-group in 2020.

3.3. Communication, Security, and Privacy (CSP) Subgroup

Together the decreased cost of computing and the increased availability of wired and wireless connectivity has resulted in generating millions of terabytes of data daily, which has led to an ever-increasing privacy issue. For example, millions of Facebook users' personal data was misused by Cambridge Analytica [10] and personal data was compromised from the Office of Personnel Management, involving roughly 22 million U.S. federal workers [11]. In response, U.S. lawmakers introduced a flood of privacy-related legislative proposals, unfortunately with no resulting statues or regulatory changes. The U.S. does have limited regulatory privacy related requirements in the Code of Federal Regulations, Titles 15, 18 & 47, while at the State level there are varying regulatory requirements. Regardless, data breaches have doubled from 2018 to 2019 in the U.S. This contrasts to the European Union (EU), which implemented a sweeping new data privacy law, the GDPR. The U.S. has no comprehensive regulatory entity or agency and no succinct regulatory requirements. Organizations within the U.S. that have interactions or business with EU entities must be compliant with GDPR or forfeit business. While the number of breaches is up year-to-year in the EU, it is unclear if the reported breaches increased or there were actual increases. However, it is clear that privacy and security standards work, but vigilance must continue.

Cisco Visual Networking Index: Forecast and Trends: 2017−2022 White Paper [12] indicates that 82% of the global network (IP or Internet Protocol) video traffic will be consumer driven by 2021, and that consumer IP traffic will reach 261.6 EB per month by 2021. Consumer Internet, which 3DBP data could further add to, continues to be the main originator of network traffic through 2021.

The Communication, Security and Privacy (CSP) subgroup is investigating the secure transmission and storage, as well as the use, protection and privacy of records that contain personal information as it pertains to 3D body processing. The IEEE 3DBP hopes to leverage existing global practices to examine adjacent projects that may provide insights into CSP procedures, establish and formalize processes to help ensure CSP methods, and develop minimum CSP practices to improve individual privacy and security, regardless of the communication protocol used in information or record exchange and storage. This includes working with the Internet Engineering Task Force (IETF) as they continue to work on the DNS privacy solution. Additionally, RFC 7721 *(Security and Privacy Considerations for IPv6 Address Mechanisms)* examines privacy and security considerations for IPv6 addressing and threat mitigation. Privacy and Security is a program by the Internet Architect Board (IAB) and is designed as a forum as it relates to Communication, Security and Privacy (CSP) within the internet technical standards community.

Internet connected 3DBP devices may be a subset of the Internet of Things (IoT) and big data, and the CSP is working to ensure specific sensitivity for consumers and users. If 3DBP devices or their information is compromised, the sensitive or personal data information may be used for non-authorized or illegal activities. Thus, the CSP subgroup is evaluating practices and procedures necessary to establish and maintain reasonable procedures to protect the confidentiality, security, and integrity of personal information that may be collected or used with 3DBP.

All communications shared between 3DBP equipment or devices may be transmitted via unencrypted and unauthenticated HTTP (GET and POST) requests. Communications include sharing of static and dynamic content, thus potentially enabling a spoof event with the arbitrary 3DBP content. One preventative approach is to ensure all personal or private information is behind secured networks that have controlled access, and that information is encrypted via Secure Socket Layer (SSL) technology.

To fully examine and address 3DBP data and information, CSP is surveying and evaluating the physical and network layers in terms of authentication, access control, confidentiality, integrity and availability to help ensure minimal risk.

The 3DBP defines communication as the transmission of data between two or more computers or devices via a computer or data network that provides telecommunication of data. The telecommunication link or transmission media may be wired (twisted-pair wire, coaxial, or fiber optic cable) or wireless in a LAN, WAN, MAN configuration, and may include encoding, transmitting, and decoding information. There are various entities working on communication, including the IEEE 802 Working Group. The 5th generation (5G) of mobile communication aims to deliver ubiquitous mobile service with enhanced quality of service that may enable new use scenarios. As a result of the continuous spread of the Internet, we have more functional or smarter devices or objects and the growing ability to connect them together as part the Internet of Things or Objects (IoT/ IoO), where the smart device can sense the surroundings and share information with other connected devices. The development of various communication protocols, along with the miniaturization of the smart devices, as well as the growing computational power, energy capacity (better batteries), and data storage, potentially exacerbates privacy and security.

For the 3DBP, security mainly includes data confidentiality, availability, and integrity. Privacy is the relationship between collection and dissemination of personal data. With the growing number of devices connected, and as more people use smart devices to store data, CSP has an opportunity to develop a shared understanding for the 3DBP arena. The IEEE and other global organizations, including public, private, and non-profit, are all working on aspects of CSP. With that, existing ISO/IEC and IEEE standards for LAN. MAN, WAN and other network solutions will be providing the guiding principles and standards for 3DBP communication.

Related to 3DBP CSP is blockchain technology. Blockchains are tamper evident and tamper resistant digital ledgers that are implemented in a distributed topology (i.e., no central repository). Blockchains enable users to record transactions in a shred ledger within that community. Blockchain is a newer technology and there is ongoing research regarding its use and potential benefits. With that, the 3DBP will work with IEEE P2418 on the use and deployment of blockchain technologies.

The 3DBP has more recently identified the IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems as a reasoned approach related to 3DBP privacy and security requirements.

The purpose of the IEEE P70xx series of standards is to translate the principles that discussed in the Ethically Aligned Design document into actionable guiding principles that can be used as industry standards. The eleven IEEE P70xx standards that are currently under development include:

- IEEE P7000: Model Process for Addressing Ethical Concerns During System Design
- IEEE P7001: Transparency of Autonomous Systems
- IEEE P7002: Data Privacy Process
- IEEE P7003: Algorithmic Bias Considerations
- IEEE P7004: Standard on Child and Student Data Governance
- IEEE P7005: Standard on Employer Data Governance
- IEEE P7006: Standard on Personal Data AI Agent Working Group
- IEEE P7007: Ontological Standard for Ethically Driven Robotics and Automation Systems
- IEEE P7008: Standard for Ethically Driven Nudging for Robotic, Intelligent and Autonomous Systems
- IEEE P7009: Standard for Fail-Safe Design of Autonomous and Semi-Autonomous Systems
- IEEE P7010: Wellbeing Metrics Standard for Ethical Artificial Intelligence and Autonomous Systems

As the standards development work is in-process, the 3DBP has identified P7002 as a primary vehicle for privacy and security. There is continued liaison with the P7002 Group and it appears at this point that 3DBP specific sensitivities may be addressed in a formal addendum to the finalized P7002 standard.

Security aspects for 3DBP are central for deploying a viable IEEE P3141 solution. The 3DBP realizes that security is dynamic that demands continuous innovation as computing advances. The IEEE 802 has brought security to the front and is innate to the various standards (e.g., 802.1, 802.3, 802.11, etc.), and with each new standard or standard revision, there has been a stepping-stone of security to the next architecture. The 3DBP will further assess the IEEE 802 Working group to further assess and leverage, to the extent possible, their ongoing activities.

Restrictions on 3DBP information use or transmission shall occupy a central place in CSP framework as it did last year. Considerations include the use of technology (e.g. machine learning/ deep learning) to assist with practices and enforcement of 3DBP information. The CSP subgroup will leverage practices and procedures as it relates to 3DBP data integrity. The CSP subgroup will coalesce existing standards information and review for completeness relative to 3DBP data. The subgroup will do a gap analysis and drive new initiatives to ensure interoperability, as well as data integrity and confidentiality.

3.4. Footwear Subgroup

The Footwear subgroup was formed to address how the different concerns of footwear can impact customer 3D scanning data.

Footwear sizing concerns are as follows:

- Footwear dimensions are impacted by the amount of weight on the foot
- Footwear is last based—either physical and/or digital
- There is a lack of consensus as to what constitutes critical measurements for fit in footwear
- There is a lack of understanding of how mobility affects fit in footwear

Instead of focusing on predicative indicators and soft tissue research, which the group thought would be important, the footwear subgroup realized that even the definitions for foot measurements were not consistent across the industry and as such went "back to the basics" of definitions.

The recommendation from the IEEE 3D Body Processing (3DBP) Industry Connections (IC) Footwear Subgroup is that the industry should make their definitions and measurement methods publicly available.

There are two main reasons for the industry to make their definitions known:

- If a brand would like to use more than one input device (scanner or phone app), they need to understand which definitions were used to determine those measurements and the measuring techniques used to get them. Otherwise, the difference in the values between multiple input technologies is not understood.
- If a brand is tying their process to a particular input technology, the process used to obtain those measurements by that input technology need to be understood.

The IEEE 3DBP IC Footwear Subgroup has compiled footwear definitions from various sources for a comparison. This paper is a compilation of definitions from industry. The sources included ISO 19408 [13], Satra, Iware, Volumental, IBV, TryFit, TechMed3D and Aetrex. The white paper: *Footwear Measurement Terminology* is planned to be published in 2020. If other companies or standards would like to be included in a future paper, please contact the authors. The paper includes recommendations for defining foot measurements and methods, foot attire, and additional new measurements for better fitting footwear. The need for new measurements is derived from discussions are found in supporting references. Measurements that are required for certain types of footwear are also presented.

The gaps that the IEEE 3DBP have identified are the following:

- Sources have the same terminology but different definitions and different measurement methods – measurement results are not the same
- Not all sources have the same terminology, either they are using manufacturing terminology or anatomical or Latin medical terms or a combination depending on the term.
- Not all sources include all the definitions listed – many sources have only partial definitions
- Not all sources specify how each measurement is taken – no weightbearing (in air), partial weightbearing (sitting position), or full weightbearing (on both feet, bilateral stance).
- Not all sources specify what the attire of foot (barefoot, light stocking, sock)
- Additional definitions for new measurements for foot or leg comfort have been identified but there is no clear definition currently. The new measurements have references to papers supporting their inclusion.

Improved the understanding of measurement definitions will aid methods based on Virtual Fitting Algorithms (VFA), Artificial Intelligence (AI), Best-Fit-between-lasts and Temporarily-Modified-Lasts. Additional research will be focused on mobility and how mobility and other foot characteristics can be understood while utilizing foot scans. A comparison of the foot scanners (including phone apps) will be conducted in Europe in 2020.

3.5. Mega Technology Trends Subgroup

The Mega Technology Trends subgroup continues to assess and analyze how evolutionary and revolutionary technologies may influence or impact 3D body model processing. This includes adjacent technologies, as well as autonomous systems, artificial intelligence (AI), cloud computing, Internet of Things (IoT), big data, 5G communications, and other mobile (e.g. smart phone) technologies with the potential to impact the retail environment.

There are many theories on information technology and its possible impact on society. However, because of varying cultural norms, there is mostly likely not a single action that the Mega Technology Subgroup can provide as an all-encompassing solution or answer regarding footwear solutions. Today, people live in an information society where data and communications play an ever-evolving and constantly expanding role in daily life. The subgroup is exploring the sociological aspects that may be experienced with or related to 3DBP and will help ensure a shared vision of understanding of how the technology and its use may be better understood by consumers. The 3DBP endeavor is reaching out to the extent possible, to adjacent standards bodies, as well as industry practitioners to help facilitate a shared understanding of the technology and its deployment.

The growth of social networks, IoT, and consumer technologies are enabling more shared and increasing variety of information, as well as higher volumes and frequency of data, all with varying levels of veracity. More and more people are swimming in a lake of data, and there are efforts to make the lakes of data into smaller, potentially friendlier ponds by means of creating metadata from the mega technologies. Smarter devices are helping to deliver increasing useful information and services for nearly everywhere. One key component of this action is data scientist and data analytics preparing, analyzing, and generating inferences or conclusions. Augmented analytics is the automation of analysis using algorithms to explore a plethora of hypotheses and generating a plausible outcome that may be best suited to an individual or situation.

The image below is a pictorial representation of the mega technology data lake, the complex multi-step processes of data assimilation, and how the data deluge is transforming businesses and becoming seamlessly incorporated into many aspects of human life.

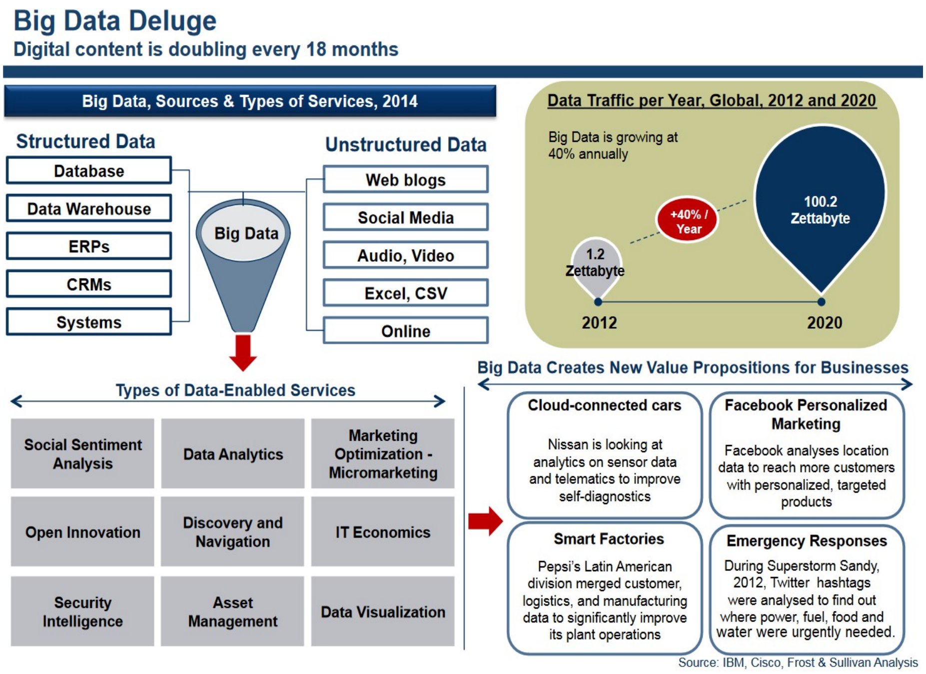

Figure 2. Image from from IBM, Cisco, Frost & Sullivan Analysis [14]

3D printing started making its way into the apparel industry nearly 3 years ago with designers using additive or layer-by-layer manufacturing processes to produce one-off objects. Nike and Adidas sell 3D printed footwear using 3D models and CAD software for customized designs, and with a $3 trillion USD global apparel market, tailored solutions from footwear to ready-to-wear personal apparel, the opportunities appear almost boundless at this point. Further enabling the mega technology trends is wearable transactions that may account for 20 percent of mobile transactions and 1% of all cashless payments in retail according to a report from Tractica [15], while Zion Market Research [16] indicates mobile payment technology may reach USD $3.3B by 2024

With the continued development of AI, researchers are exploring ways of 3D human reconstruction for a single image or using a holistic monocular 3D reconstruction. We also have 3D body scanning applications on smart phones that allow consumers to shop online using precise body measurements. Aside from aesthetics and style, shopping for clothing is in large measure a process of determining fit, and the apparel industry has never settled on a standard sizing system. Finding a really good or perfect fit may be nearly impossible with online purchases. Next generation connectivity (e.g., 4G and 5G), along with 3D body scanning using one's smart phone would allow consumers to use their camera to capture precise body measurements, thus solving the fit and return issues facing online retailers.

Datafication, collective tools, technologies, and processes will be used to transform aspects of life into valued ($$$) information in the Retail industry.

4. Conclusions

The vision and goal of the 3DBP initiative is to create complementary standards and practices that further promote an ecosystem that "lifts all boats" and drives future growth opportunities for players across the 3D body processing value chain.

For file formats, it will be important to identify the different recommended subsets in the standard. An operator participating in a 3D body model processing pipeline may declare that it complies with a chosen subset depending on its capabilities and resources. The participants in this effort encourage experts in these topics to provide feedback on relevant issues, results and prospects, as well as encourage them to join the IEEE 3D Body Processing initiative.

Collaboration with other standards committees and organizations is integral to the goals of this committee, and industry participation is critical to ensure current and future standardization needs of this expanding industry are addressed. Interested parties are invited to contact IEEE 3DBP for further information, https://standards.ieee.org/industry-connections/3d/bodyprocessing.html

References

[1] Fedyukov, M., "File Format Recommendations for 3D Body Model File Processing", Q4 2019, New York, IEEE, PDF, STDVA23902 ISBN 978-1-5044-6179-5 https://standards.ieee.org/develop/indconn/3d/bodyprocessing.html.

[2] Rannow, Randy K., "IEEE 3D Body Processing Industry Connections (3BDP IC) Communication, Security and Privacy", Q4 2019, New York, IEEE, PDF, STDVA23901 ISBN 978-1-5044-6178-8 https://standards.ieee.org/develop/indconn/3d/bodyprocessing.html.

[3] *Web 3D Consortium What is X3D?*, https://web3d.org/x3d/what-x3d, accessed 2019

[4] *Khronos Group glTF Overview*, https://khronos.org/gltf/, accessed 2019

[5] Regulation (EU) 2016/679 (General Data Protection Regulation) in the current version of the OJ L 119, 04.05.2016; cor. OJ L 127, 23.5.2018, (GDPR), https://gdpr-info.eu/

[6] ISO 8559-1:2017, Size designation of clothes – Part 1: Anthropometric definitions for body measurement, https://www.iso.org/standard/61686.html

[7] Walter, S.D. Dr., Eliasziw, M., Donner, A., "Sample size and optimal designs for reliability studies", Dec 1998,John Wiley & Sons, Ltd, https://doi.org/10.1002/(SICI)1097-0258(19980115)17:1<101::AID-SIM727>3.0.CO;2-E

[8] Wright, W., Man versus Machine, Measuring People for the Apparel Industry. In: Proceeding of 3D BODY TECH 2019, Switzerland, Lugano, 22-23 October 2019, Lugano: 2019, p 33. ISBN 978-3-033-07528-3.

[9] Dāboliņa, I., Lapkovska, E. 3d Digital Anthropometry in Case of Fit and Ergonomics of Army Uniform. In: Proceedings of 3DBODY.TECH 2018, Switzerland, Lugano, 16-17 October 2018. Lugano: 2018, pp.106-112. ISBN 978-3-033-06970-1. Available from: doi:10.15221/1

[10] *Facebook ignored staff warnings about 'sketchy' Cambridge Analytica in September 2015*, https://techcrunch.com/2019/07/25/facebook-ignored-staff-warnings-about-sketchy-cambridge-analytica-in-september-2015/, accessed 2019

[11] *22 Million Affected by OPM Hack, Officials say*, https://abcnews.go.com/US/exclusive-25-million-affected-opm-hack-sources/story?id=32332731, accessed 2019

[12] *Cisco Visual Networking Index: Forecast and Trends: 2017−2022 White Paper*, https://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html, accessed 2019

[13] ISO/TS 19408:2015, Footwear – Sizing – Vocabulary and Terminology, https://www.iso.org/standard/62158.html

[14] *World's Top Global Mega Trends to 2025 and Implications to Business, Society and Cultures*, https://www.thegeniusworks.com/wp-content/uploads/2016/01/Megatrends-2025-Frost-and-Sullivan.pdf, accessed 2019

[15] *Wearable Payments to Drive More than $500 Billion in Transaction Volume Annually by 2020*, https://www.tractica.com/newsroom/press-releases/wearable-payments-to-drive-more-than-500-billion-in-transaction-volume-annually-by-2020/, accessed 2019

[16] *Global Share of Mobile Wallet Market to Surpass $3,142.17 Billion by 2022: Zion Market Research*, https://www.globenewswire.com/news-release/2019/07/10/1880730/0/en/Global-Share-of-Mobile-Wallet-Market-to-Surpass-3-142-17-Billion-by-2022-Zion-Market-Research.html, accessed 2019