

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SHENZHEN TUOZHU TECHNOLOGY CO., LTD.,
Petitioner,

v.

STRATASYS, INC.,
Patent Owner.

IPR2025-00438
Patent 10,569,466 B2

Before HYUN J. JUNG, CHRISTOPHER L. OGDEN, and LILAN REN,
Administrative Patent Judges.

REN, *Administrative Patent Judge.*

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Shenzhen Tuo Zhu Technology Co., Ltd. (“Petitioner”) filed a Petition requesting *inter partes* review of claims 1–5, 7–13, and 16–20 (“the challenged claims”) of U.S. Patent No. 10,569,466 (Ex. 1001, “the ’466 patent”). Paper 2 (“Pet.”). Petitioner filed a declaration of Dr. Michael Hickner (Ex. 1003) in support of the Petition. Stratasys, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 8 (“Prelim. Resp.”). On October 6, 2025, we instituted this *inter partes* review as to all challenged claims and all grounds presented in the Petition. Paper 11 (“Dec.”).

After institution, Patent Owner filed a Response in opposition to the Petition (Paper 19, “PO Resp.”) supported by a declaration of Dr. Denis R. Cormier (Ex. 2013). Petitioner filed a Reply in support of the Petition (Paper 22, “Reply”) and Patent Owner filed a Sur-Reply (Paper 24, “Sur-Reply”). At the request of both parties, we held an oral hearing, the transcript of which has been entered into the record. Paper 33 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the challenged claims of the ’466 patent. For the reasons discussed below, we determine Petitioner has established by a preponderance of the evidence that claims 1–5, 7–13, and 16–20 of the ’466 patent are unpatentable.

II. BACKGROUND

A. *Real Parties in Interest*

Petitioner identifies itself as a real party in interest, and notes that Bambulab Limited, Shanghai Lunkuo Technology Co. Ltd., Tuo Zhu Technology Limited, and Bambulab USA Inc. are potential real parties in interest. Pet. 85. Patent Owner identifies itself and Stratasys Ltd. as real parties in interest. Paper 4, 2 (Patent Owner Mandatory Notices). On the

record developed at trial, we find that each of the identified entities is a real party in interest. *See* Pet. 85; *see also* Paper 4, 2.

B. Related Matters

The parties indicate that the '466 patent is involved in *Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd.*, No. 2:24-cv-00645 (E.D. Tex.) which has been consolidated with No. 2:24-cv-00644 (E.D. Tex.) involving the same parties. Pet. 85–86; *see also* Paper 4, 2. The parties indicate that the '466 patent is also involved in *BambuLab USA, Inc. v. Stratasys, Inc.*, No. 1:24-cv-01511 (W.D. Tex.). Pet. 86; *see also* Paper 4, 2. The parties further indicate they are involved in IPR2025-00257, IPR2025-00311, IPR2025-00321, IPR2025-00354, IPR2025-00531, and IPR2025-00532. Pet. 86; Paper 4, 2. Patent Owner states that the parties are additionally involved in IPR2025-00585 and IPR2025-00611. Paper 4, 2.

C. The '466 Patent

The '466 patent, titled “Tagged Build Material For Three-Dimensional Printing,” relates to “three-dimensional printers [which] use build material of various type and configuration to print three-dimensional objects.” Ex. 1001, 1:16–18. “In order to properly process the build material through the three-dimensional printer extruder for the fabrication of an object, the three-dimensional printer controller may need at least a basic set of characteristics of the build material to determine operation.” *Id.* at 1:18–22. To obtain these characteristics, the '466 patent provides that “[a] supply of build material such as a spool or cartridge is instrumented with a data tag that includes information about the build material. A three-dimensional printer can read the information from the tag and determine how to use the build material during fabrication of a three-dimensional object.” *Id.* at 1:29–33.

In particular, the '466 patent provides a process which “can dramatically simplify use of a three-dimensional printer by automating those aspects of printer configuration that depend on the type of build material being used.” *Id.* at 22:24–27. As a result, “a user may simply load a build material [sic] from a suitably instrumented container and select an object to print without specifying various configuration details that might otherwise be required.” *Id.* at 22:27–31. Figure 6 reproduced below is a flowchart of such a process:

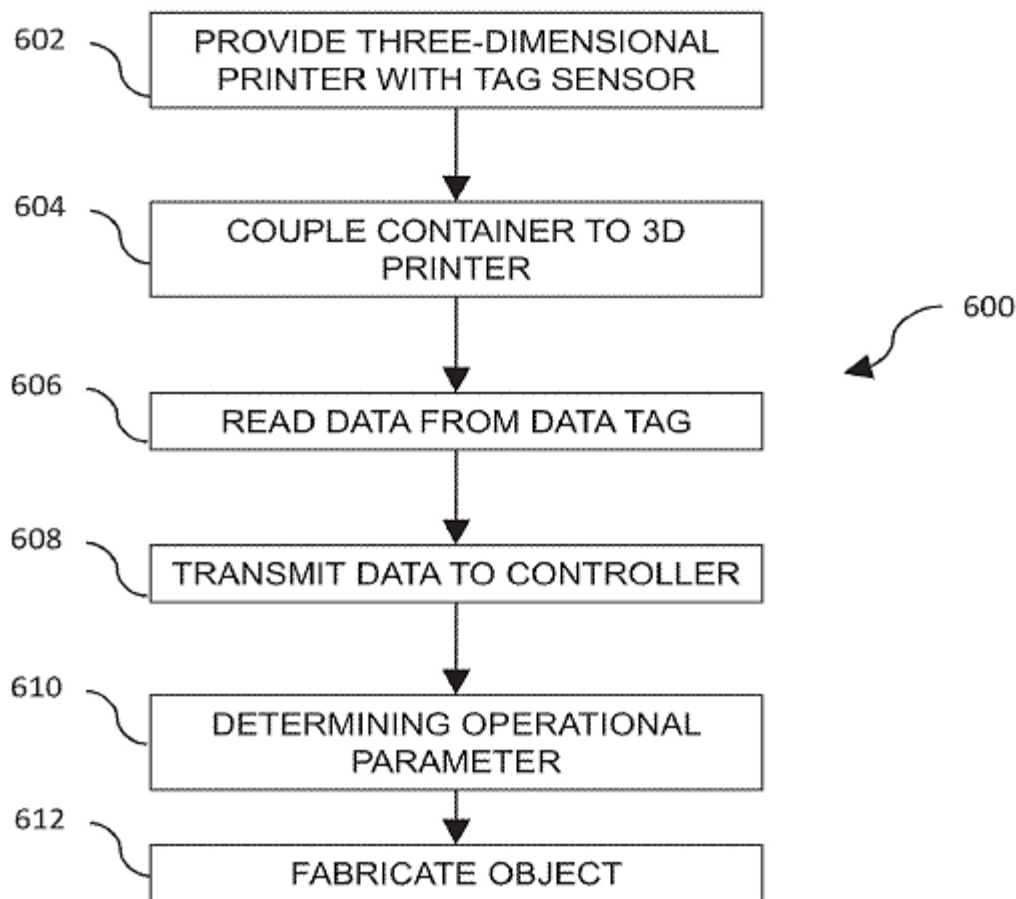


Fig. 6

As Figure 6 illustrates, step 602 includes “providing a three-dimensional printer with a controller and a tag sensor.” Ex. 1001, 20:64–66. Step 604 includes “coupling a container with a data tag to the three-dimensional printer.” *Id.* at 21:5–7. Such a “data tag may be a radio frequency identification (RFID) tag” and the like which “may store information about the build material such as a property of the build material in the container.” *Id.* at 21:7–13. The stored information may include “mechanical or structural properties of the build material, thermal properties of the build material (including phase change data), aesthetic properties of the build material, or any other properties useful for determining operational parameters.” *Id.* at 21:15–20.

Upon reading the data from the data tag at step 606 and transmitting the data from the tag sensor to the controller at step 608, “determining an operational parameter for the fabrication of an object by the three-dimensional printer based on data from the data tag” takes place at step 610. *Id.* at 21:39–45, 21:50–53. Such parameters may include “an extruder temperature, a feed rate, a build platform temperature, a build volume temperature, a build platform temperature, an infill requirement, a rafting requirement, a support structure requirement, an extruder movement speed, and a cooling requirement.” *Id.* at 21:58–61. “In one embodiment, the controller may make the determination of operational parameters using only the data from the data tag. . . .” *Id.* at 15:25–27. “For example, the data tag 304 may explicitly specify an extruder temperature and the controller may use the extruder temperature as an operational parameter. . . .” *Id.* at 15:27–30. Alternatively, the data tag “may identify a type of build material and the controller may calculate a suitable extruder temperature based on the type. Similarly, the controller may calculate other operational parameters such as

build platform temperature, feed rate, cooling parameters, build chamber heating parameters, and so forth.” *Id.* at 15:30–35. Lastly, “[a]s shown in step 612, the method 600 may include fabricating an object while using the operational parameter(s) to control operation of a three-dimensional printer.” *Id.* at 22:21–24.

D. Illustrative Claims

Of the challenged claims, claims 1 and 19 are independent. Claim 1 and claim 19, each reproduced below with bracketed reference letters corresponding to those used by Petitioner, are illustrative of the claimed subject matter.

1. [p] A method comprising:
 - [a] providing a three-dimensional printer that includes a tag sensor;
 - [b] receiving a request from a client over a network to fabricate an object on the three-dimensional printer, [c] the three-dimensional printer coupled to a supply of a build material including a tag that stores at least one property of the build material;
 - [d] reading data from the tag with the tag sensor;
 - [e] providing the data from the tag to the client over the network, the data including at least one property of the build material;
 - [f] receiving one or more operational parameters from the client selected for use in controlling operation of the three-dimensional printer when fabricating the object with the build material having the at least one property stored in the tag; and
 - [g] fabricating the object with the build material according to the one or more operational parameters.

19. [p] A method comprising:
- [a] providing a three-dimensional printer that includes a controller and a tag sensor;
 - [b] coupling a container of a build material to the three-dimensional printer, the container including a tag that stores at least one property of the build material;
 - [c] reading data from the tag with the tag sensor;
 - [d] transmitting the data to the controller;
 - [e] determining an operational parameter for configuring the three-dimensional printer for a fabrication process using the build material based upon at least one property of the build material in the data, the operational parameter including at least one of a build platform temperature, a build volume temperature, an infill requirement, a rafting requirement, a support structure requirement, and a cooling requirement;
 - [f] controlling operation of the three-dimensional printer with the controller according to the operational parameter; and fabricating an object with the three-dimensional printer based upon the operational parameter.

Ex. 1001, 23:32–50, 24:54–25:7; *see* Pet. v, vii (providing Petitioner’s claim labeling).

E. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability:

Ground	Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1A	1–5, 7–13, 16, 18, 20	103(a) ¹	Loughran, ² Dubois ³
1B	1–5, 7–13, 16, 18, 20	103(a)	Loughran, Dubois, Jazayeri ⁴
1C	5	103(a)	Loughran, Dubois, KISSlicer ⁵
1D	5	103(a)	Loughran, Dubois, Jazayeri, KISSlicer

¹ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. §102 and § 103, effective March 16, 2013. The ’466 patent claims priority to an earlier provisional application (filed on October 29, 2012). Without explanation, Petitioner argues that the ’466 patent is not entitled to the earlier priority date, yet Petitioner still applies the pre-AIA version of § 102. Pet. 2. Thus, we apply the pre-AIA versions of §§ 102 and 103. Our decision would be the same if we were to apply the current versions of §§ 102 and 103.

² Loughran, US 2006/0091199 A1, published May 4, 2006, filed Oct. 29, 2004 (Ex. 1004). Petitioner contends that Loughran is prior art to the ’466 patent under pre-AIA 35 U.S.C. § 102(b). Pet. 2.

³ Dubois, US 2008/0192074 A1, published August 14, 2008, filed August 17, 2004 (Ex. 1005). Petitioner contends that Dubois is prior art to the ’466 patent under pre-AIA 35 U.S.C. § 102(b). Pet. 2.

⁴ Jazayeri, US 2011/0299110 A1, published December 8, 2011, filed March 16, 2010 (Ex. 1010). Petitioner contends that Jazayeri is prior art to the ’466 patent under pre-AIA 35 U.S.C. § 102(a). Pet. 2.

⁵ KISSlicer, KISSlicer Quick Start Guide, published February 15, 2012 (Ex. 1018). Petitioner contends that KISSlicer is prior art to the ’466 patent under pre-AIA 35 U.S.C. § 102(a). Pet. 2.

Ground	Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1E	17	103(a)	Loughran, Dubois, Menchik ⁶ , Dahlin ⁷
1F	17	103(a)	Loughran, Dubois, Jazayeri, Menchik, Dahlin
2	19	103(a)	Devos ⁸
3A	1, 3–5, 7, 9–11, 19, 20	102/103(a)	Menchik
3B	1, 3–5, 7, 9–11, 20	103(a)	Menchik, Jazayeri
3C	2, 8, 12, 16	103(a)	Menchik, Loughran
3D	2, 8, 12, 16	103(a)	Menchik, Jazayeri, Loughran
3E	17	103(a)	Menchik, Dahlin
3F	17	103(a)	Menchik, Jazayeri, Dahlin
3G	5	103(a)	Menchik, KISSlicer
3H	5	103(a)	Menchik, Jazayeri, KISSlicer

Pet. 1–2.

III. ANALYSIS

A. Legal Standards

A claim is unpatentable as anticipated if “each and every limitation is found either expressly or inherently in a single prior art reference.”

Sanofi-Synthelabo v. Apotex, Inc., 470 F.3d 1368, 1375 (Fed. Cir. 2006) (citation omitted). Anticipation under § 102 may be established by showing, as a matter of fact, that all elements arranged as specified in a claim are

⁶ Menchik, US 2006/0127153 A1, published June 15, 2006, filed Nov. 12, 2003 (Ex. 1009). Petitioner contends that Menchik is prior art to the ’466 patent under pre-AIA 35 U.S.C. § 102(b). Pet. 2.

⁷ Dahlin, US 6,022,207, issued Feb. 8, 2000, filed Jan. 26, 1998 (Ex. 1011). Petitioner contends that Dahlin is prior art to the ’466 patent under pre-AIA 35 U.S.C. § 102(b). Pet. 2.

⁸ Devos, US 2007/0026102 A1, published February 1, 2007, filed July 28, 2005 (Ex. 1008). Petitioner contends that Devos is prior art to the ’466 patent under pre-AIA 35 U.S.C. § 102(b). Pet. 2.

disclosed within the four corners of a reference, either expressly or inherently, in a manner enabling one skilled in the art to practice an embodiment of the claimed invention without undue experimentation. *See ClearValue, Inc. v. Pearl River Polymers, Inc.*, 668 F.3d 1340, 1344 (Fed. Cir. 2012).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” The question of obviousness is resolved based on underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when presented, objective evidence of obviousness or nonobviousness, i.e., secondary considerations.⁹ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

The obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring the adjudicator to provide “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)). A patent claim “is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *Id.* In particular,

⁹ Neither party presents evidence or arguments regarding objective evidence of obviousness or non-obviousness. *See* Pet.; PO Resp.

“[a]lthough the *KSR* test is flexible, the Board ‘must still be careful not to allow hindsight reconstruction of references . . . without any explanation as to *how* or *why* the references would be combined to produce the claimed invention.’” *Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1066 (Fed. Cir. 2016) (alteration in original) (quoting *Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1368 (Fed. Cir. 2012) (emphases added)).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Technology, Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3)); *see also Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016). Therefore, to prevail in an *inter partes* review, Petitioner must explain how the proposed combinations of prior art would have rendered the challenged claims unpatentable.

We analyze the asserted grounds of unpatentability in accordance with the above-stated principles. In making such an analysis, we find that Petitioner has shown by a preponderance of the evidence that the challenged claims of the ’466 patent are unpatentable.

B. Level of Ordinary Skill in the Art

Determining whether an invention would have been obvious under 35 U.S.C. § 103 requires resolving the level of ordinary skill in the pertinent art at the relevant time. *Graham*, 383 U.S. at 17. The person of ordinary skill in the art is a hypothetical person who knows the relevant art. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Factors in determining the level of ordinary skill in the art include the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *Id.* One or more factors may predominate. *Id.*

Petitioner contends that a person of ordinary skill in the art in the field in the relevant time frame “would have had (1) at least a bachelor’s degree in Mechanical Engineering, Computer Engineering, Chemical Engineering, Materials Science, or a related field, and (2) at least two years of research or industry experience in 3D printing or materials used for 3D printing.” Pet. 6 (citing Ex. 1003 ¶ 20). Petitioner also contends that “[a]dditional experience could substitute for a formal degree or formal training (and vice versa).” *Id.* (citing the same).

Patent Owner contends that an ordinarily skilled artisan “would have had a bachelor’s degree in Mechanical Engineering, Computer Engineering, Electrical Engineering, Chemical Engineering, Materials Science, or a comparable field and at least two years of experience related to 3D printing, with additional experience potentially being a substitute for a formal degree or training (and vice versa).” PO Resp. 7 (citing Ex. 2013 ¶¶ 21–26).

Patent Owner’s proposed skill level does not substantively differ from Petitioner’s definition of the level of ordinary skill in the art, and Petitioner’s definition appears consistent with the disclosures of the ’466 patent and the prior art of record. Accordingly, we adopt Petitioner’s definition. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

C. Claim Construction

In an *inter partes* review, we apply the same claim-construction standard as would be used by a district court to construe a claim in a civil action involving the validity or infringement of a patent. 37 C.F.R. § 42.100(b). Under that standard, claim terms are given their ordinary and customary meaning, as would have been understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history of record. *Id.*;

Phillips v. AWH Corp., 415 F.3d 1303, 1312–19 (Fed. Cir. 2005) (en banc); *Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365–66 (Fed. Cir. 2012). “The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (quoting *Vivid Techs., Inc. v. Am. Sci. Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Neither party contends that any formal claim construction is necessary. *See* Pet. 6 (“Petitioner submits that no claim terms require a formal construction for purposes of evaluating the prior art and resolving issues [in] this proceeding.”); PO Resp. 7 (“Patent Owner submits that the Board does not need to construe any claim terms to conclude that the Petition is deficient.”). After reviewing the parties’ respective arguments and the evidence of record, we determine that we do not need to expressly construe any claim term to resolve any controversy in the proceeding.

D. Asserted Obviousness Over Loughran and Dubois (Ground 1A)

Petitioner alleges claims 1–5, 7–13, 16, 18, and 20 of the ’466 patent would have been obvious over Loughran and Dubois. Pet. 7–28. Patent Owner argues that Petitioner fails to show a motivation to combine Loughran with Dubois and that the combination does not teach or suggest all elements of the challenged claims. PO Resp. 9–25.

As explained in more detail below, having considered the arguments and evidence before us, we find that the full record establishes by a preponderance of the evidence that claims 1–5, 7–13, 16, 18, and 20 would have been obvious over Loughran and Dubois.

1. Loughran

Loughran, titled “Retrieving Information on Material Used in Solid Freeform Fabrication,” describes certain solid freeform fabrication or SFF systems and “material 112 from which physical objects can be fabricated” at the SFF system. Ex. 1004 ¶ 20. The SFF system includes “first SFF system 102 and the material information server 108” and “second SFF system 104” to which “the first SFF system 102 may be considered a client” because “the first SFF system 102 provides SFF jobs to the second SFF system 104, and the second SFF system 104 fabricates these jobs.” *Id.* ¶ 12.¹⁰ “[T]he SFF systems are able to retrieve information regarding materials from the material information server” *Id.* ¶ 5.

Each of the first SFF system 102 and the material information server 108 may be or include a general-purpose computing device, like a desktop, portable, or server computer running computer-aided drafting (CAD) software. The first SFF system 102 and the material information server 108 may also each be another type of device other than a general-purpose computing device.

Id. ¶ 12.

The SFF system also includes “tag 114 [which] may be a bar code tag having a bar code encoding the unique material identifier of the material 112.” *Id.* ¶ 21. The SFF system “is able to recognize the material 112 being introduced thereto” “[b]ased on the material identifier of the tag 114.” *Id.* ¶ 20. The SFF system may request and retrieve information regarding material 112 from the material information server “based on the unique

¹⁰ Contrary to the texts of Loughran, Figure 1 of Loughran illustrates “second SFF system 102” and “first SFF system 104.” Ex. 1004, Fig. 1. Unless otherwise noted, this Final Written Decision refers to these SFF systems based on the texts of Loughran.

material identifier with which the material 112 is associated.” *Id.* ¶ 22. Such retrieved information “may include material data sheet (MDS) information regarding the material 112, including safety, storage, and other information that is more pertinent to the users of” the SFF system. *Id.* ¶ 25. “Thus, the information retrieved from the material information server 108 regarding the material 112 may be both information on which basis the second SFF system 104 dynamically adjusts its own parameters for fabricating physical objects from the material 112, as well as information intended for user education.”

Id. Loughran provides:

These parameters may include the operating temperature that the second SFF system 104 needs to achieve to melt the material, the temperature that the second SFF system 104 needs to maintain to store the material, the length of time to wait after one layer of the material has been fabricated before processing the next layer, and so on.

Id.

2. Dubois

Dubois, titled “Method and Device for The Production of a Three-Dimensional Multi-Material Component by Means of Ink-Jet-Type Printing,” provides means for the “production of three-dimensional structures consisting of a plurality of different materials.” Ex. 1005 ¶ 21. According to Dubois, “[c]onventionally, the production of a component is preceded by a stage of computer-aided design which involves producing a three-dimensional (hereinafter ‘3D’) representation of this object on the basis of a specification assembling all the requirements and properties to be fulfilled thereby.” *Id.* ¶ 57. The invention in Dubois “determines a set of printing characteristics” based on such “3D representation and the specification.” *Id.* ¶ 58. For example, Dubois describes “an algorithm for seeking an optimum printing order for the layers [of a 3D product] which

takes into account all of the printing characteristics of the print layers.” *Id.* ¶ 120.

The device in Dubois includes a printer and data processing unit 105 which controls various components of the printer. *See, e.g., id.* ¶¶ 130, 132 (data processing unit 105 controlling unidimensional displacement plates of the printer), 136 (data processing unit 105 controlling nozzles). Data processing unit 105 includes “database 199 [which] contains . . . the choice of optimum values of printing parameters as a function of the nature of the materials, the characteristics of the printer and the deposition conditions.” *Id.* ¶ 148.

3. Reasons to Combine and Reasonable Expectation of Success

Petitioner argues that a skilled artisan would have combined Loughran with Dubois “so that the SFF printer 104 uses—for each individual fabrication job—the ‘optimum values of printing parameters as a function of the nature of the materials, the characteristics of the printer and deposition conditions.’” Pet. 11 (citing Ex. 1005 ¶ 149; Ex. 1003 ¶ 46). Petitioner argues that Dubois’s teaching regarding the “importan[ce] to control the nature of the materials in the printer to provide materials having the properties required for printing and to use the various functions of the printer optimally” provides motivation to combine “so that various functions of the SFF printer 104 are optimally utilized for each individual fabrication job.” Pet. 12 (citing Ex. 1005 ¶ 11; Ex. 1003 ¶ 47). Petitioner also argues that “the systems of Loughran and Dubois are each related to systems for fabricating three-dimensional objects in a layer-by-layer manner, which is the same as the ’466 patent,” and combining the prior art teachings “would have been merely the application of known techniques to a known system ready for

improvement to yield predictable results.” Pet. 12 (citing Ex. 1003 ¶ 48; *KSR*, 550 U.S. at 417).

Patent Owner argues that Petitioner’s proposed combination would alter the principles of operation of Loughran and render Loughran inoperable for its intended purpose. PO Resp. 17. Quoting various passages of Loughran related to its teaching of automatically and dynamically adjusting the printing operation, Patent Owner argues that “Petitioner’s proposed combination would displace Loughran’s server-driven, printer-side retrieval and dynamic adjustment of material-linked parameters by shifting parameter-setting into the client-generated job” as well as “undermining Loughran’s mechanism for material-appropriate fabrication and risking omission of printer-side inputs Dubois associates with generating/validating ‘optimum values.’” *Id.*.

Patent Owner emphasizes that “Loughran assigns different roles to the client and the printer” in that the client in Loughran “uses material information to generate jobs” whereas the “printer . . . retrieves machine-readable material information, extracts parameters, and ‘automatically and dynamically’ adjusts itself for fabrication.” Sur-reply 1. Patent Owner also argues that “even if software modules may reside on a PC, Dubois still discloses a printer-centric control architecture—not a remote CAD client receiving tag data and sending back selected operational parameters over the network.” *Id.* at 2.

A preponderance of the evidence supports Petitioner’s arguments regarding a motivation to combine Loughran with Dubois. Dubois teaches to choose “optimum values of printing parameters as a function of the nature of the materials, the characteristics of the printer and deposition conditions.” Ex. 1005 ¶ 148. Dubois teaches that “[t]he nature of the materials is also

important with regard to the printer employed” and that “it is important to control the nature of the materials in the printer in order to provide materials having the properties required for printing and to use the various functions of the printer optimally.” Ex. 1005 ¶¶ 9, 11. The method in Dubois includes “establishing a set of printing parameters as a function of the nature of the materials deposited and the deposition conditions thereof for each print layer and for each discrete spatial trajectory. *Id.* ¶ 27. The method in Dubois also includes “seeking an optimum printing order for the layers which takes into account all of the printing characteristics of the print layers” which may “correct[] printing errors which have occurred during printing of the layer which has just been printed.” *Id.* ¶¶ 120, 123.

Based on these express teachings of Dubois, Dr. Hickner testifies that “a POSITA [person of ordinary skill in the art] would have beneficially applied Dubois’s suggestions to the system of Loughran such that the CAD information additionally includes operational parameters, as suggested by Dubois.” Ex. 1003 ¶ 46. Dr. Hickner reasons that Dubois’s improved system “provid[ing] ‘micrometre precision in production’ and ‘high-definition structures’ during 3D printing” would have motivated the skilled artisan

to implement Loughran’s SFF fabrication job based on Dubois’s suggestion of sending the fabrication job from the CAD client using CAD information that includes printing parameters concerning the state or characteristics of the materials and identifying and correcting printing errors to advantageously allow production of structures with multiple different materials, printing of structures and patterns with micrometre precision and high definition, and production of a higher quality object.

Id. (citing Ex. 1005 ¶ 22). Dr. Hickner testifies that Dubois’s teaching of the “importan[ce] to control the nature of the materials in the printer in order to

provide materials having the properties required for printing and to use the various functions of the printer optimally” would have motivated a skilled artisan to combine Dubois with Loughran “for optimal use of the various functions of the printer based on the nature of the materials in the printer.” Ex. 1003 ¶ 47; Ex. 1005 ¶ 11.

Because Petitioner’s obviousness analysis “implements Dubois’s suggestion to provide additional details on material-based operational parameters that would be beneficially determined during fabrication job generation” in Loughran’s system “of generating print jobs at the remote client computer based on the information regarding that material” (Reply 2), the proposed combination does not prevent any further “printer-side automatic and dynamic adjustment based on information retrieved from a material-information server” (PO Resp. 12) as Patent Owner argues. Patent Owner’s argument that Petitioner’s obviousness contention requires “redesigning Loughran . . . i.e., shifting parameter-setting into the client-generated job” rendering Loughran inoperable for its intended purpose (PO Resp. 12) is therefore not based on – and does not address – Petitioner’s proposed combination. Patent Owner’s argument that “Petitioner’s proposed combination would displace Loughran’s server-driven, printer-side retrieval and dynamic adjustment of material-linked parameters by shifting parameter-setting into the client-generated job” rendering Loughran inoperable for its intended purpose (PO Resp. 17) fails essentially for the same reason.

Patent Owner’s assertion that “Loughran already discloses the printer obtaining the relevant material-linked parameters from the server and dynamically adjusting itself accordingly” (PO Resp. 12–13) does not undermine Dr. Hickner’s various reasons to combine the references. This

includes the rationale that the skilled artisan “would have recognized that including the functionality for correcting printing errors described by Dubois in the system of Loughran would have resulted in optimal outcomes by allowing the resulting system to correct for such identified errors.” Ex. 1003 ¶ 47 (citing Ex. 1005 ¶¶ 123, 124).

Patent Owner’s argument that Petitioner’s rationale “conflicts with Loughran’s disclosed architecture” because Dubois’s “‘computation unit’ and ‘data processing unit’” are “printer-side” (PO Resp. 13; Ex. 2013 ¶ 80) is unsupported by the record. Dubois explicitly discloses that “[t]he description of the data processing unit 105 is a function description” which “can be implemented, by means of software or hardware and may be distributed in various components of the device” including “by means of software on a personal computer.” Ex 1005 ¶ 170. Figure 5 of Dubois “is a basic diagram of a printer” whereas figure 6 “a basic diagram of the data processing unit used in the formation of the printer shown in FIG. 5.” Ex. 1005 ¶¶ 48, 49. These illustrations show physical components such as ejection nozzles of a printer as well as “functional” aspects of Dubois’s system including “means of software” which may be executed on a personal computer. *Id.* ¶¶ 134, 170. Because Dubois teaches using software executed on a personal computer for printing whereas Loughran’s systems also uses software that “provides SFF jobs to the second SFF system” for printing (Ex. 1004 ¶ 12), the record before us does not support such a structural conflict between Dubois and Loughran as Patent Owner argues. Such purported conflict also does not sufficiently rebut Petitioner’s showing of a reasonable likelihood of success in combining the references.

Lastly, Patent Owner faults Petitioner for failing to “explain[] how Loughran’s remote CAD client would possess (or be provided) the

printer-characteristics and deposition-condition inputs that Dubois identifies as necessary to determine ‘optimum values.’” PO Resp. 13. As we explain *supra*, Petitioner in this case has, by a preponderance of the evidence, “identif[ied] a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does,” and we decline to require more from Petitioner on this aspect of the obviousness inquiry. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418–19 (2007).

Patent Owner’s remaining arguments address Petitioner’s rationale that combining Loughran and Dubois is no more than a “combination of familiar elements according to known methods . . . [which] does no more than yield predictable results.” *Compare* Pet. 11–12, *with* PO Resp. 14–16. As we explain *supra*, Petitioner has shown even without this argument, by a preponderance of the evidence, that a skilled artisan would have combined the references for the purported benefits and improvements that Dubois teaches. Ex. 1003 ¶¶ 46, 47. Thus, we need not address this part of Petitioner’s rationale.

Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that there is sufficient rationale to combine as well as a reasonable expectation of success in combining the teachings of Loughran and Dubois in the manner suggested.

4. Analysis of Independent Claim 1

a) [1p] A method comprising

Petitioner argues that Figures 3 and 4 of Loughran teach claim element 1p. Pet. 13–14 (citing various portions of Ex. 1004 (Loughran), Ex. 1003 ¶ 49). Patent Owner does not provide arguments for this claim

element. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1p is taught by the prior art.

b) [1a] providing a three-dimensional printer that includes a tag sensor

Petitioner argues that Loughran teaches claim element 1a. Pet. 14–16 (citing various portions of Ex. 1004 (Loughran)). Petitioner argues that “Loughran’s FIG. 1 shows a system 100 including a SFF system 104 that fabricates SFF jobs received from client system 102.” *Id.* at 14. Petitioner argues that because Loughran’s SFF system 104 fabricates physical objects “in a layer-by-layer manner,” the system is a three-dimensional printer. *Id.* at 15 (citing various portions of Ex. 1004 (Loughran), Ex. 1003 ¶ 50).

Petitioner argues that Loughran, as Figure 5 illustrates, teaches a tag sensor in the form of “communication mechanism 506.” *Id.* at 15–16 (citing various portions of Ex. 1004 (Loughran), Ex. 1003 ¶ 51). Patent Owner does not provide arguments for this claim element. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1a is taught by the prior art.

c) [1b] receiving a request from a client over a network to fabricate an object on the three-dimensional printer

Petitioner contends that Loughran teaches client system 102 and SFF system 104 which “are communicatively coupled to one another via a network 106.” Pet. 17 (citing Ex. 1004, Fig. 1, ¶¶ 12, 48, 49). Petitioner contends that SFF system 104 receives “SFF fabrication jobs over the network” from system 102. *Id.* at 18. Petitioner argues that Loughran teaches claim element 1b because “Loughran’s SFF fabrication job corresponds to a

request to fabricate an object on the three-dimensional printer.” *Id.* (citing Ex. 1003 ¶ 53).

The record before us shows that Petitioner cites various portions of Loughran to support the assertion that “Loughran’s SFF fabrication job corresponds to a request to fabricate an object on the three-dimensional printer.” Pet. 17–18 (citing Ex. 1004 ¶¶ 5, 12, 44, 48–50). Patent Owner does not address this issue in the Response. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1b is taught by the prior art.

d) [1c] the three-dimensional printer coupled to a supply of a build material including a tag that stores at least one property of the build material

Petitioner argues that Loughran, as Figure 1 illustrates, teaches claim element 1c in the form of “material container 110 containing material 112” which “is a supply of build material and is coupled to the SFF system 104.” Pet. 19 (citing various portions of Ex. 1004 (Loughran)). Petitioner argues that the material container 110 “contains a tag 114 that includes a material identifier” which “is a property of the build material.” *Id.* at 19–20 (citing various portions of Ex. 1004 (Loughran), Ex. 1003 ¶ 55). Patent Owner does not provide arguments for this claim element. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1c is taught by the prior art.

e) [1d] reading data from the tag with the tag sensor

Petitioner argues that Loughran teaches claim element 1d because “Loughran’s SFF system 104 includes a ‘communication mechanism 506’ that ‘receives the unique material identifier from the material container 110 containing the material 112 and that is presented to the second SFF system 104.’” Pet. 20–21 (citing various portions of Ex. 1004 (Loughran), Ex. 1003 ¶¶ 57, 58). Petitioner argues that “mechanism 506 may include an RF reader to detect signals returned by the tag 114 of the container 110, where the tag 114 is an RFID tag” and that “mechanism 506 may further include a bar code reader to scan a bar code of the tag 114, where the tag 114 is a bar code tag.” *Id.* at 21 (citing various portions of Ex. 1004 (Loughran), Ex. 1003 ¶ 59). Patent Owner does not provide arguments for this claim element. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1d is taught by the prior art.

f) [1e] providing the data from the tag to the client over the network, the data including at least one property of the build material

Petitioner argues that Loughran, as Figure 1 illustrates, teaches claim element 1e because “the SFF system 104 sends ‘the material identifier for the material 112 to the system 102, as indicated by the letter C 122’ shown in FIG. 1, and the client system 102 ‘may receive the unique material identifier of the material 112 from the second SFF system 104.’” Pet. 21 (citing various portions of Ex. 1004 (Loughran)) (alteration omitted). Petitioner argues that communication mechanism 510 of Loughran “includes ‘network adapters and/or other types of communication technologies to communicate with the system 102 over the network 106’” and “mechanism

510 provides the system 102 with the actual information regarding the material 112.” *Id.* at 22 (citing various portions of Ex. 1004 (Loughran), Ex. 1003 ¶¶ 60, 61) (alteration omitted). Patent Owner does not provide arguments for this claim element. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1e is taught by the prior art.

g) [1f] receiving one or more operational parameters from the client selected for use in controlling operation of the three-dimensional printer when fabricating the object with the build material having the at least one property stored in the tag

Petitioner contends that

Loughran’s client system 102 “receive[s] the information regarding the material 112. For instance, the [client] system 102 may have CAD software running thereon to generate SFF fabrication jobs outlining the fabrication of physical objects by the second SFF system 104 from materials, like the material 112. The [client] system 102, such as its CAD software, may have to have the information regarding the material 112 so that ***the SFF fabrication jobs can be accurately generate[d] for ultimate fabrication of physical objects from the material 112.***”

Pet. 23 (alterations in original). Petitioner contends that Dubois describes a “design process [that] includes ‘establishing a set of printing parameters as a function of the nature of the materials deposited and the deposition conditions thereof for each print layer and for each discrete spatial trajectory.’” *Id.* at 25. Petitioner argues that a skilled artisan would have combined Loughran with Dubois to “enable[] Loughran’s system to complete each fabrication job based on CAD information with the optimal set of material parameters.” *Id.* at 26.

Paragraph 55 of Loughran states:

The CAD software 610 generates a SFF fabrication job for fabrication from a specific material based on the information regarding that material which has been received. The CAD software 610 then sends the SFF fabrication job to the second SFF system 104 over the network 106 via the communication mechanism 604 of the first SFF system 102.

Paragraph 27 of Loughran states:

The first SFF system 102, such as its CAD software, may have to have the information regarding the material 112 so that the SFF fabrication jobs can be accurately generate[d] for ultimate fabrication of physical objects from the material 112. For instance, build time estimation, feature orientation suggestion, and part scaling based on expected shrinkage are determinations that the CAD software may make based on the information regarding the material 112 from which a physical object is to be constructed.

Paragraph 41 of Loughran teaches “first SFF system 102 receives a first list of material identifiers known to the second SFF system 104 over the network 106, as well as optionally other information (402).”

Paragraph 128 of Dubois teaches that “the values of the printing parameters have been determined to satisfy the static properties of the component to be produced and the characteristics of the materials and the printer.” Paragraph 150 of Dubois teaches:

The computation unit 198 is also adapted to slice the 3D representation of the component and to determine, as a function of the input data and the information stored in the database 119 about the component to be produced, the print layers to be printed successively and all of the printing parameters by employing, for example by means of software

Paragraph 148 of Dubois teaches computation unit 198 which may be “adapted, in particular, to cut up a 3D representation of the component to be

produced into characteristic objects” and “has as its inputs said 3D representation,” and “the production specification of the component, parameterized in the form of digital data.” Computation unit 198 “is connected to a database 199” which “contains all the results of investigations . . . relate[d] to the choice of optimum values of printing parameters as a function of the nature of the materials, the characteristics of the printer and the deposition conditions.” Ex. 1005 ¶ 148.

Based on these prior art teachings, Petitioner has shown, by a preponderance of the evidence, that the combined prior art teaches claim element 1f.

Patent Owner’s arguments on this claim element address individual teachings of each reference instead of the combined prior art teaching. Patent Owner’s argument that “Loughran’s disclosure of the printer being ‘automatically and dynamically adjusted’ based on server-provided material information reflects printer-side selection and application of process settings, not receipt of client-selected operational parameters as recited in element 1[f]” (PO Resp. 19) ignores Loughran’s teaching of “[t]he CAD software [which] sends the SFF fabrication job to the second SFF system 104” which fabricates the SFF job (Ex. 1004 ¶¶ 12, 20, 55) combined with Dubois’s teaching of computation unit 198 “adapted . . . to determine, as a function of the input data and the information stored in the database 119 about the component to be produced, the print layers to be printed successively and all of the printing parameters.” Ex. 1005 ¶ 150. Patent Owner’s arguments are unpersuasive also because the arguments are incommensurate in scope with claim 1 which is open-ended and does not exclude further adjustments. As we provide *supra*, Petitioner’s proposed combination does not prevent further adjustments to the operational parameters of the printer.

Patent Owner's arguments that Loughran's "printer-side 'automatically and dynamically adjust[ed]' architecture is inconsistent with Petitioner's element 1[f] premise that the printer instead 'receiv[es]' from the client selected operational parameters for controlling printer operation during fabrication" (PO Resp. 19–20) and that "Dubois's framework is printer-centric and does not disclose that a remote CAD client selects printer-control operational parameters and transmits them to the printer for use in controlling printer operation during fabrication as claim 1 requires" (*id.* at 21) fail essentially for the same reason that these arguments attack the references individually rather than the combined teaching as a whole. As we note *supra*, Loughran teaches that "[t]he CAD software sends the SFF fabrication job to the second SFF system 104" which fabricates the SFF job (Ex. 1004 ¶¶ 12, 20, 55). Dubois teaches that "[t]he description of the data processing unit 105 is a function description" which "can be implemented, by means of software or hardware and may be distributed in various components of the device" including "by means of software on a personal computer." Ex 1005 ¶ 170. Figure 6 of Dubois shows "a basic diagram of the data processing unit used in the formation of the printer shown in FIG. 5" which includes computation unit 198. Ex. 1005 ¶ 49. Dubois teaches using software executed on a personal computer for printing whereas Loughran's systems also uses software that "provides SFF jobs to the second SFF system" for printing (Ex. 1004 ¶ 12), and the record before us does not support Patent Owner's argument that there is such a structural conflict between Dubois and Loughran that would have rendered Dubois or Loughran inoperable for its intended purpose.

*h) [1g] fabricating the object with the build material
according to the one or more operational parameters*

Petitioner argues that “Loughran’s SFF system 104 (three-dimensional printer) receives SFF fabrication jobs from clients, such as system 102 and fabricates SFF jobs received from client system 102.”

Pet. 26 (alteration omitted). Petitioner argues:

Loughran’s “second SFF system 104 is automatically and dynamically adjusted for utilization with the material 112. Such information may include parameters of the material 112, including, but not limited to, melting temperature, storage temperature, minimum feature size, horizontal and vertical shrinkage rates, material lifetime, inter-layer delay time, and amount of ultraviolet (UV) light required per layer, among other parameters.”. . . Loughran’s SFF system 104 includes “SFF mechanism 502” that “fabricates a physical object directly from the CAD information of a SFF fabrication job received from the system 102, in a layer-by-layer manner.... The SFF mechanism 502 can fabricate the physical object from the material 112, since the parameters of the second SFF system 104 are dynamically adjustable based on the information regarding the material 112.”

Id. at 27 (citing various portions of Ex. 1004 (Loughran), Ex. 1003 ¶¶ 68, 69) (internal citations omitted; alteration omitted). Patent Owner does not provide arguments for this claim element. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1g is taught by the prior art.

5. Conclusion on Independent Claim 1 (Ground 1A)

We determine that Petitioner establishes, by a preponderance of the evidence, that Loughran and Dubois teach every element of claim 1. Petitioner also sufficiently establishes that one of skill in the art would have been motivated with a reasonable expectation of success to combine the references.

For these reasons and others set forth above, we find that Petitioner sufficiently demonstrates, by a preponderance of the evince, that the combination of Loughran and Dubois teaches each of the elements of claim 1 and that one of skill in the art would have been motivated with a reasonable expectation of success to combine the references. The information presented in the Petition demonstrates by a preponderance of the evidence that claim 1 is unpatentable under 35 U.S.C. § 103 over that combination based on ground 1A.

6. Analysis of Claim 2

Claim 2 depends from claim 1 and additionally recites: “further comprising receiving a request from the client for the data from the tag.” Ex.1001, 23:51–52.

Petitioner argues that Loughran teaches that “client system 102 ‘may query the second SFF system 104 for information regarding the second SFF system 104. In response, the second SFF system 104 may provide the system 102 with information about itself, including a list of material identifiers known to the second SFF system 104.’” Pet. 28 (citing Ex. 1004 ¶ 41, Ex. 1003 ¶ 71) (alternation omitted). Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 2 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

7. Analysis of Claim 3

Claim 3 depends from claim 1 and additionally recites: “wherein the three-dimensional printer is coupled to a first supply of a first build material and a second supply of a second build material different from the first build material, the first supply including a first tag that stores at least one property

of the first build material, and the second supply including a second tag that stores at least one property of the second build material.” Ex. 1001, 23:54–59.

Petitioner argues that “Loughran’s SFF system 104 can include ‘a wide-area thermal inkjet or a single jet inkjet SFF system’ where ‘a jet for each of a plastic build material and a wax-like support material is used.’” Pet. 28 (citing Ex. 1004 ¶ 16). Petitioner argues that “[t]he build material is a first build material, and the support material is a second build material.” Pet. 28 (citing Ex. 1003 ¶ 72). Petitioner also argues that “Dubois describes a printer that includes a ‘plurality of material storage tanks 106a, 106b, with one tank per material used during the production of the multi-material component.’” Pet. 28 (citing Ex. 1005 ¶ 133). Petitioner argues that when Loughran is combined with Dubois, “the SFF system 104 (three-dimensional printer) would fabricate the object with the materials according to the CAD information of a SFF fabrication job which includes the printing (operational) parameters concerning the state or characteristics (at least one property stored on the tag) of the materials.” Pet. 28–29 (citing Ex. 1003 ¶ 73). Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 3 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

8. Analysis of Claim 4

Claim 4 depends from claim 3 and additionally recites: “providing data from the first tag and the second tag to the client over the network, the data including at least one property of the first build material and the second build material.” Ex. 1001, 23:60–63.

Petitioner argues that the prior art teachings cited for claim element 1e as well as claim 3 teach all elements of claim 4. Pet. 29 (citing Ex. 1003 ¶ 74). Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 4 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

9. Analysis of Claim 5

Claim 5 depends from claim 4 and additionally recites: “receiving a selection of one of the first build material and the second build material from the client for use in fabricating the object using the three-dimensional printer.” Ex. 1001, 23:64–67.

Petitioner argues that “Loughran’s ‘SFF mechanism 502 is the mechanism that actually fabricates a physical object directly from the CAD information of a SFF fabrication job received from the first SFF system 102, in a layer-by-layer manner.’” Pet. 29 (citing Ex. 1004 ¶¶ 1, 13, 45). Petitioner argues that Dubois similarly teaches “a method ‘for production by ink-jet-type printing which allow production of three-dimensional structures consisting of a plurality of different materials.’” Pet. 29 (citing Ex. 1005 ¶ 21). Petitioner argues that “Dubois explains that ‘[c]omputer-aided design conventionally consists in cutting up a representation of the object to be produced in successive print layers and defining for each layer patterns which are to be printed by the printer’ and is ‘implemented by means of software on a personal computer.’” Pet. 29 (citing Ex. 1005 ¶¶ 16, 24, 25, 59, 61, 62, 67, 75-106, 170). Petitioner argues that “Dubois slices ‘the 3D representation of the component into print layers,’ which ‘involves slicing the 3D representation of the component to be produced into print layers

which are to be printed in succession’ and is carried out as a function of the characteristic objects.’” Pet. 29–30 (citing Ex. 1005 ¶ 75).

Based on these prior art teachings, Dr. Hickner testifies that the “POSITA would have understood that a slice specifies a selection of build material for use in printing the layer of the multi-material component.” Ex. 1003 ¶ 78. Dr. Hickner corroborates the testimony with a reference known as Napadensky (Ex. 1006) whose teachings include that “the virtual object is preferably sliced by the system into thin slices, . . . and transferred to the fabrication engine for transforming into layers forming the three-dimensional object.” *Id.* (citing Ex. 1006 ¶ 39). Based on the combined prior art teaching of Loughran and Dubois and based on his knowledge as corroborated by Napadensky, Dr. Hickner testifies that a “POSITA would have found it obvious to include, in Loughran’s SFF fabrication job received from the client, a selection of the build material for use in fabricating the object using the three-dimensional printer.” Ex. 1003 ¶ 79.

Patent Owner’s argument that “Petitioner does not identify any disclosure in Loughran or Dubois where the printer provides tag data for two supplies to the client and then receives back a client instruction selecting one of the two tagged supplies for use in fabricating the object” (PO Resp. 24) is unavailing because the argument is based on the individual teachings of each reference rather than the combined prior art teaching. Patent Owner’s argument that Dr. Hickner is not entitled to rely on Napadensky to corroborate his testimony (*id.* at 24–25) does not cite to statute, regulation, or case law as legal support and we find no such authority to preclude Dr. Hickner from using corroborating evidence.

Lastly, Patent Owner argues that “[n]othing in Dubois teaches that the printer receives from a client a selection between two tagged build-material

supplies after the printer provides tag data for both supplies to the client. *Id.* at 25. The plain language of claim 5 requires no more than a step of “providing data from the first tag and the second tag to the client over the network” as well as a step “receiving a selection of one of the first . . . and second build material” without requiring any particular order of these steps. As we provide *supra*, Petitioner has established by a preponderance of the evidence that the step of “providing data from the first tag and the second tag to the client over the network” that claim 4 recites is taught by the combination of Loughran and Dubois. To the extent Patent Owner’s argument regarding claim 5 requires more than the step of “receiving a selection of one of the first . . . and second build material,” the argument is incommensurate in scope with the claim language.

Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 5 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

10. Analysis of Claim 7

Claim 7 depends from claim 1 and additionally recites: “providing a recommendation to the client for selecting the one or more operational parameters for use in fabricating the object using the three-dimensional printer.” Ex. 1001, 24:1–4.

Petitioner argues that the prior art teachings cited for claim elements 1f and 1g teach all elements of claim 7. Pet. 30 (citing Ex. 1003 ¶ 80). Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 7 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

11. Analysis of Claim 8

Claim 8 depends from claim 1 and additionally recites: “wherein the tag includes at least one of a radio frequency identification (RFID) tag, an optically-identifiable tag, a magnetically-identifiable tag, and a mechanical feature of the supply.” Ex. 1001, 24:9–12.

Petitioner argues that the prior art teachings cited for claim element 1c teach all elements of claim 8. Pet. 30 (citing Ex. 1003 ¶ 81). Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 8 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

12. Analysis of Claim 9

Claim 9 depends from claim 1 and additionally recites: “wherein the data includes at least one of a material identification number, a build material type, a build material diameter, an extruder temperature requirement, a build material melting temperature, a build material color, a build material color lot number, a cost per unit of build material, a build material density, a build material tensile strength, a build material viscosity, a build material recycle code, and a build material expiration date.” Ex. 1001, 24:13–20.

Petitioner argues that Loughran “expressly discloses using a material identification number.” Pet. 30 (citing Ex. 1004 ¶ 31, Ex. 1003 ¶ 82). Petitioner argues that the prior art teachings cited for claim elements 1c and 1d teach all elements of claim 9. *Id.* Petitioner also argues that a skilled artisan “would have recognized that a ‘material identifier’ provides, or at least renders obvious a material identification number.” *Id.* (citing Ex. 1004 ¶ 28, Ex. 1003 ¶ 82). Patent Owner does not provide arguments for this

dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 9 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

13. Analysis of Claim 10

Claim 10 depends from claim 1 and additionally recites: “wherein the one or more operational parameters includes at least one of an extruder temperature, a feed rate, a build platform temperature, a build volume temperature, an infill requirement, a rafting requirement, a support structure requirement, and a cooling requirement.” Ex. 1001, 24:21–26.

Citing Dr. Hickner’s testimony, Petitioner argues that based on Dubois’s teaching of claim element 1f, all elements of claim 10 are taught based on Dubois’s teaching of printing parameters such as “a temperature of dispersion, a speed of travel of the ejection means, a temperature of the environment in which the material is deposited, and a predetermined temporal evolution of the temperature of the environment in which the component is reproduced satisfies this claim.” Pet. 31 (citing Ex. 1003 ¶ 83).

Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 10 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

14. Analysis of Claim 11

Claim 11 depends from claim 1 and additionally recites: “wherein the supply includes at least one of a cartridge, a spool, a filament, a number of pellets, and a liquid.” Ex. 1001, 24:27–29.

Petitioner argues that the supply in Loughran includes a liquid as well as a filament. Pet. 32 (citing various portions of Ex. 1004 (Loughran)). For example, Loughran states: “The materials are held in a melted liquid state in reservoirs. The liquids are fed to individual jetting heads that squirt tiny droplets of the materials in the required pattern as they are moved to form a layer of the object.” Ex. 1004 ¶ 16 (cited in Pet. 31–32). Loughran also states that “a plastic filament is unwound from a coil and supplies material to an extrusion nozzle” in the prior art SFF system. Ex. 1004 ¶ 17 (cited in Pet. 32).

Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 11 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

15. Analysis of Claim 12

Claim 12 depends from claim 1 and additionally recites: “wherein the tag includes a radio frequency identification (RFID) tag, and the RFID tag is at least one of a passive RFID tag and an active RFID tag.” Ex. 1001, 24:30–32.

Petitioner argues that the analysis of claim element 1c shows “Loughran discloses a RFID tag.” Pet. 32 (citing various portions of Ex. 1004 (Loughran)). Petitioner also argues that “Loughran’s RFID tag is either passive or active because RFID tags are of one of two types: passive or active.” Pet. 32 (citing Ex. 1007, 1, Ex. 1003 ¶ 86).

Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the

evidence, that claim 12 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

16. Analysis of Claim 13

Claim 13 depends from claim 1 and additionally recites: “wherein the tag includes an optically-identifiable tag, and the optically-identifiable tag is at least one of bar code and quick read (QR) code.” Ex. 1001, 24:33–35.

Petitioner argues that the prior art teachings cited for claim element 1c teach all elements of claim 13. Pet. 32 (citing Ex. 1003 ¶ 87). Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 13 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

17. Analysis of Claim 16

Claim 16 depends from claim 1 and additionally recites: “wherein the tag sensor includes at least one of a radio frequency identification (RFID) reader, an optical scanner, a magnetic reader, and a contact point sensor.” Ex. 1001, 24:42–46.

Petitioner argues that the prior art teachings cited for claim element 1a teach all elements of claim 16. Pet. 32 (citing Ex. 1003 ¶ 88). Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 16 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

18. Analysis of Claim 18

Claim 18 depends from claim 1 and additionally recites: “performing a diagnostic test to determine whether the one or more operational

parameters is suitable for the three-dimensional printer.” Ex. 1001, 24:47–50.

Petitioner argues that the prior art teachings cited for claim elements 1e and 1f teach all elements of claim 18. Pet. 32. Petitioner argues that “Loughran also expressly discloses using a material identification number (‘101785’) to retrieve operational parameters.” *Id.* (citing Ex. 1004 ¶ 31, Ex. 1003 ¶ 91). Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 18 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

19. Analysis of Claim 20

Claim 20 depends from claim 1 and additionally recites: “wherein the client includes a computing device.” Ex. 1001, 25:8–9.

Petitioner argues that the prior art teachings cited for claim element 1b teach all elements of claim 20. Pet. 33. Patent Owner does not provide arguments for this dependent claim. PO Resp. 18–22. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 20 is unpatentable under 35 U.S.C. § 103 based on ground 1A.

20. Conclusion for Ground 1A

As detailed above, based on our review and consideration of the full record, we determine that Petitioner has sufficiently shown that Loughran and Dubois teach claims 1–5, 7–13, 16, 18, and 20 by a preponderance of the evidence and that these claims are unpatentable under 35 U.S.C. § 103 based on ground 1A.

E. Asserted Obviousness Over Loughran, Dubois, Jazayeri (Ground 1B)

Petitioner alleges claims 1–5, 7–13, 16, 18, and 20 of the '466 patent would have been obvious over Loughran, Dubois, and Jazayeri. Pet. 33–36. Patent Owner contends in response that Jazayeri is non-analogous art, that there is no motivation to combine the references, and that the proposed combination does not teach various claim elements. PO Resp. 26–30. Patent Owner also argues that there is no motivation to combine the references as Petitioner asserts. PO Resp. 30–33.

1. Jazayeri

Jazayeri, titled “Cloud-Based Print Service,” describes

A print server may include an application manager configured to receive a print request over a network from an application executing on a device, and configured to provide, over the network, a print dialog to a user of the application, the print dialog configured to provide for a selection of at least one printer associated with a user account of the user and thereafter receive a selected printer from the selection.

Ex. 1010, code (57). Jazayeri seeks to address certain issues involved with “conventional printers and printing paradigms [which] often provide a fragmented, expensive, resource-intensive, potentially unpredictable user experience which is suboptimal at best and unworkable at worst for many users.” *Id.* ¶ 7.

2. Analogous Art

Two criteria have evolved for determining whether prior art is analogous: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor’s endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.

In re Clay, 966 F.2d 656, 658–59 (Fed. Cir. 1992).

Patent Owner argues that Jazayeri is non-analogous art because it is “a cloud-based 2D print-service reference centered on printer registration and paper/ink settings,” which is not in the same field of endeavor as the ’466 patent, which “is directed to three-dimensional printing using tagged build materials and using tag-derived build -material information/properties to determine operational parameters for fabrication.” PO Resp. 27. Patent Owner argues that whereas the ’466 patent describes a “networked environment. . . in the context of three-dimensional printers, tag sensors reading tag data, and a controller that may be associated with a remote resource within a networked three-dimensional printing environment,” “Jazayeri describes a cloud-based print service/print server paradigm in which an application manager receives print requests and manages print jobs in a conventional printing environment.” PO Resp. 27–28.

Patent Owner also argues that Jazayeri is not reasonably pertinent to the problem that the ’466 patent addresses. *Id.* at 28. Patent Owner argues that whereas the ’466 patent “addresses problems tied to material-dependent fabrication in three-dimensional printing—using tag data/identifiers to obtain build-material information and determine operational parameters for fabrication, including by using that build material,” Jazayeri, on the other hand, is “directed to issues associated with ‘conventional printers and printing paradigms,’ and proposes a cloud-based print-service solution to improve that user experience.” *Id.* Patent Owner argues that Jazayeri does not address the “tagged-build-material problem of selecting/deriving operational parameters for control of three-dimensional fabrication based on build material identity/properties.” *Id.* at 29.

Petitioner argues that “Jazayeri is analogous art because it falls within the same general field of endeavor of the ’466 patent of ‘a networked three-

dimensional printing environment.” Reply 20 (citing various exhibits). Petitioner argues that “Jazayeri is directed toward the same field of endeavor of providing ‘printing capabilities over a network.’” Reply 20 (citing Ex. 1001, 1:41–42, Ex. 1010 ¶ 18, Ex. 1042 ¶ 36). Petitioner argues that “Jazayeri is also reasonably pertinent to the problems addressed by the ’466 patent of a system ‘interconnecting a plurality of participating devices in a communicating relationship’ to provide ‘a networked three-dimensional printing environment.’” Reply 21 (citing Ex. 1001, 4:57–65). Petitioner argues that “Jazayeri describes a system that ‘provides an ability for virtually any application running on any device within the network . . . to communicate with the cloud print service . . . to thereby print to any printer which is also in (direct or indirect) communication with the cloud print service.’” Reply 21 (citing Ex. 1010 ¶ 28, Ex. 1042 ¶ 37) (alterations in original).

A preponderance of the evidence in this case supports Petitioner’s argument that Jazayeri is analogous art, at least because Jazayeri is reasonably pertinent to the problem that the ’466 patent addresses. *See Clay*, 966 F.2d at 658–59. Although Jazayeri’s cloud-based printer network appears to comprise two-dimensional printers, rather than three-dimensional printers, Petitioner cites Jazayeri for its teachings about a networking arrangement in which there is a “print server including an application manager that receives ‘a print request over a network from an application executing on a device.’” Pet. 33 (citing Ex. 1010, code (57), ¶¶ 8–10, 19–21, 36). This logically would have commended itself to an artisan’s attention in considering the problem of implementing the method of claim 1, and in particular limitation 1[b] which recites “receiving a request from a client over a network to fabricate an object on the three-dimensional printer.”

Rather than addressing the issue of whether Jazayeri is reasonably pertinent to the problem addressed in the '466 patent, Patent Owner instead essentially reiterates its argument that Jazayeri is not in the same field of endeavor as the '466 patent. *See* PO Resp. 28–29 (“Jazayeri’s teachings . . . are not directed to – and do not address – the '466 Patent’s tagged-build-material problem of selecting/deriving operational parameters for control of three-dimensional fabrication based on build material identity/properties.”), 30 (arguing that the comparison should be between “Jazayeri’s cloud/document-printing focus on print dialogs, registered printers, and paper/ink print characteristics,” and Jazayeri’s entire “cloud-print request paradigm,” “versus the '466 Patent’s focus on tagged build materials and operational-parameter control for three-dimensional fabrication”). In other words, Patent Owner incorrectly characterizes the specific “problem to be solved” essentially the same way it characterizes the '466 patent’s entire field of endeavor.

Based on the record before us, we conclude that Petitioner has established that Jazayeri is analogous art by a preponderance of the evidence. *See* Reply 21–22; Ex. 1042 ¶¶ 37, 38.

3. Reasons to Combine and Reasonable Expectation of Success

Petitioner argues that combining Jazayeri with Loughran may allow users to “benefit from increased printing options and abilities” based on Jazayeri’s teaching of “an ability for virtually any application running on any device within the network 106 . . . to communicate with the cloud print service 102 to thereby print to any printer which is also in (direct or indirect) communication with the cloud print service 102.” Pet. 35 (citing Ex. 1010 ¶ 28). Petitioner argues that the combination would allow a user to “use software that is not printer specific for generating the SFF fabrication job”

based on Jazayeri's teaching of a "cloud-aware printer." Pet. 35 (citing Ex. 1010 ¶ 24, Ex. 1003 ¶ 98); *see also* Pet. 36 (citing Ex. 1003 ¶ 99). Petitioner also argues because both Loughran and Jazayeri are related to a "networked printing environment," combining these prior art teachings "would have been merely the application of known techniques to a known system ready for improvement to yield predictable results." Pet. 36 (citing Ex. 1003 ¶ 100; *KSR*, 550 U.S. at 417).

Patent Owner argues with citations to the record that Jazayeri does not address any deficiency in Loughran; Jazayeri is directed to cloud print services and not Loughran's SFF fabrication-job workflow; and Jazayeri's cloud-print paradigm would not have been introduced into printer-specific and printer-side parameter determination. PO Resp. 31–33. Patent Owner also argues Petitioner's purported benefits are generic to cloud printing and would not have motivated the proposed combination. *Id.* at 33.

Based on our review of the full record, we find that a preponderance of the evidence supports Petitioner's arguments regarding a motivation to combine Loughran, Dubois, and Jazayeri. Loughran discloses that the SFF system 104 "may be or include in particular one or more of: a selective laser sintering SFF system, a stereo lithography SFF system, a wide-area thermal inkjet SFF system, a fused deposition modeling SFF system, a single jet inkjet SFF system, a three-dimensional printing SFF system, and a laminated object manufacturing SFF system, among other types of SFF systems." Ex. 1004 ¶¶ 13–19, 45. The combined Loughran and Jazayeri system "provides an ability for virtually any application running on any device within the network 106 . . . to communicate with the cloud print service 102 to thereby print to any printer which is also in (direct or indirect) communication with the cloud print service 102." Ex. 1010 ¶ 28.

Dr. Hickner testifies that “the resulting combination would have allowed users to utilize their preferred CAD software without having to use software that is specific to a given printer for generating the SFF fabrication job.” Ex. 1003 ¶ 98. Dr. Hickner’s testimony is corroborated by Jazayeri’s teaching of a “platform-independent” system so that “virtually any application 112 that may be configured to communicate with the cloud print service 118 may make use of the cloud-aware printer 118.” Ex. 1010 ¶ 25. Dr. Hickner’s testimony is also corroborated by Jazayeri’s teaching that “a decreased or eliminated need to provide users with the (updated) driver(s) and other prerequisites for users to fully experience the benefits of their products” which “may result in, for example, higher customer satisfaction, and a decreased cost of producing and maintaining printers.” Ex. 1003 ¶ 99 (citing Ex. 1010 ¶ 28).

Patent Owner acknowledges that Jazayeri teaches these benefits including “increased printing options/abilities, platform-independence, [and] reduced cost of drivers” but argues that these benefits should be limited to “conventional printing paradigms” which “are implemented through cloud-print workflows involving print dialogs, registered printers, and user accounts.” PO Resp. 33. Patent Owner argues that these benefits are inapplicable and cannot be implemented “through Loughran’s SFF job exchange and printer-side dynamic process-parameter adjustment.” *Id.* Patent Owner’s arguments are not supported by evidence in the record and we discern no such evidence that would limit Jazayeri’s teaching as Patent Owner argues.

Instead of addressing Jazayeri’s benefits which form the basis of Petitioner’s motivation to combine as described above, Dr. Cormier testifies that “adding Jazayeri’s GUI/account-driven printer-selection workflow to

Loughran would introduce layers that are irrelevant to Loughran’s SFF job exchange and would not improve—and would potentially complicate—the material-parameter control that is central to Loughran.” Ex. 2013 ¶ 114 (cited in PO Resp. 31). To the extent Dr. Cormier’s testimony is that Petitioner’s proposed combination would affect “the material-parameter control that is central to Loughran” (Ex. 2013 ¶ 114), the testimony does not demonstrate that the proposed combination would render Loughran inoperable.

Patent Owner’s argument that “Petitioner’s asserted benefits for adding Jazayeri emphasize ‘platform-independent’ and ‘not printer specific’ cloud printing, which is in tension with Dubois’s printer-characteristics-dependent parameter selection and Loughran’s printer-side dynamic adjustment” (PO Resp. 32) does not clearly explain what “in tension” means and does not argue that the proposed combination renders any prior art system inoperable.

Patent Owner argues that “Petitioner’s asserted ‘need’ to add Jazayeri’s cloud-print request layer is not tied to any deficiency in Loughran’s disclosed job-submission architecture,” but does not address Petitioner’s asserted motivation to combine based on Jazayeri’s teachings PO Resp. 31. Patent Owner’s remaining arguments fault Petitioner for not explaining how the prior art references are bodily incorporated without rebutting Petitioner’s contention that the combination would have had a reasonable likelihood of success. For example, Patent Owner argues that “Petitioner’s rationale does not explain why a POSITA would graft Jazayeri’s UI-driven cloud-print request framework onto Loughran’s SFF fabrication-job workflow merely to add a pre-job ‘request.’” *Id.* at 32. Patent Owner argues that “Petitioner does not explain why a POSITA would be

motivated to introduce Jazayeri's printer-agnostic cloud-print paradigm into a system whose combined teachings rely on printer-specific and printer-side parameter determination." *Id.* at 32–33. These arguments do not sufficiently rebut Petitioner's rationale to combine or Petitioner's arguments that there would have been a reasonable expectation of success in combining the references.

Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that there is sufficient rationale to combine as well as a reasonable expectation of success in combining the teachings of Loughran, Dubois, and Jazayeri in the manner asserted.

4. Analysis & Conclusion for Independent Claim 1 (Ground 1B)

Petitioner argues that "[w]here Ground 1A relies on Loughran's disclosure to satisfy 1[b], Ground 1B relies on the additional disclosure of Jazayeri." Pet. 33. Petitioner argues that the remaining claim elements, namely, 1p, 1a, and 1c–1g, are taught or suggested by the prior art as provided in ground 1A. *Id.*

For claim element 1b, Petitioner argues that "[t]o the extent that Loughran's fabrication job (*supra*, Ground 1A, element 1[b]) is not considered a request," a skilled artisan would have found it obvious for the SFF system 104 to receive a request prior to receiving the SFF fabrication job. Pet. 33. Petitioner argues that, based on Jazayeri's teaching of "a print server including an application manager that receives 'a print request over a network from an application executing on a device,'" a skilled artisan would have combined Jazayeri with Loughran to arrive at claim 1b. *Id.* at 33–34.

Patent Owner argues that a motivation to combine is lacking and that claim element 1f is not taught for the same reasons as ground 1A. PO Resp.

34–35. Patent Owner emphasizes that Jazayeri is non-analogous art. *Id.* at 34.

As we note *supra*, the record before us sufficiently supports Petitioner’s contention, by a preponderance of the evidence, that claim 1 is unpatentable based on ground 1A and that Jazayeri is analogous art. Patent Owner’s arguments regarding the asserted unpatentability of claim 1 based on Loughran, Dubois, and Jazayeri essentially follow the arguments regarding the asserted unpatentability based on Loughran and Dubois set forth *supra*. PO Resp. 34–35. For the reasons provided *supra*, we determine that Petitioner establishes, by a preponderance of the evidence, that the combination of Loughran, Dubois, and Jazayeri teaches or suggests all elements of claim 1 and that claim 1 is unpatentable under 35 U.S.C. § 103 based on ground 1B.

5. *Analysis & Conclusion for Claims 2–5, 7–13, 16, 18, & 20*
(Ground 1B)

Petitioner argues that other than the analysis of claim 1b, “Ground 1B is substantively identical to, and incorporates the analysis of, Ground 1A[.]” Pet. 33. Patent Owner’s arguments regarding the asserted unpatentability of dependent claims 2–5, 7–13, 16, 18, and 20 based on Loughran, Dubois, and Jazayeri essentially follow the arguments regarding the asserted unpatentability based on Loughran and Dubois set forth *supra*. PO Resp. 35. As our analysis shows *supra*, based on the full record before us, we determine that Petitioner establishes, by a preponderance of the evidence, that the combination of Loughran, Dubois, and Jazayeri teaches or suggests all elements of each dependent claims at issue and claims 2–5, 7–13, 16, 18, and 20 are unpatentable under 35 U.S.C. § 103 based on ground 1B.

F. Asserted Obviousness Over Loughran, Dubois, and KISSlicer (Ground 1C) & Loughran, Dubois, Jazayeri, and KISSlicer (Ground 1D)

1. KISSlicer

KISSlicer is a document that guides a user “through the creation of [a user’s] first print file.” Ex. 1018, 1. KISSlicer allows the user to “assign the extruder to [the user’s] available heads” as the following illustration shows:

Extruder

The screenshot shows the 'KISSlicer Settings' dialog box with the '...Extruders' tab selected. The dialog contains three sections for Extruder 1, Extruder 2, and Extruder 3. Each section has a '[mm/rev]' input field (all set to 1.25) and a 'Material' dropdown menu (set to ABS, PLA, and ABS respectively). Below these are four dropdown menus for 'Object Extruder', 'Raft Extruder', 'Support-Obj Interface Ext', and 'Support Main Ext', all set to 'Ext 1'. At the bottom are two buttons: 'Save Settings' and 'Close Without Saving Settings'.

Figure on Page 5 of KISSlicer (Ex. 1018).

2. Reasons to Combine and Reasonable Expectation of Success

Based on Loughran’s teaching that its “system can include an ‘inkjet SFF system’ where ‘a jet for each of a plastic build material and a wax-like support material is used,’” Petitioner argues that

A POSITA would have found it obvious to implement Loughran’s inkjet SFF system to allow the user of the client system to select the plastic build material to be extruded by one jet for printing the three-dimensional object and to select the

support material extruded by another jet for printing the support structure, as was known in the art at the time of the '466 patent.

Pet. 36–37 (citing Ex. 1004 ¶ 16, Ex. 1003 ¶ 101). Petitioner argues that KISSlicer's teaching shows “software for controlling a multi-extruder system” which “allows a user to select one material (e.g., a build material) for deposition by ‘Extruder 1’ and another material (e.g., a support material) for deposition by ‘Extruder 2.’” Pet. 37.

Based on these prior art teachings and Dr. Hickner's testimony, Petitioner argues that “a POSITA would have recognized that the Loughran-Dubois-KISSlicer and Loughran-Dubois-Jazayeri-KISSlicer combinations would have achieved a more flexible user customization of materials used to build and support the three-dimensional object depending upon the desired build quality and strength of a particular object.” *Id.* at 38 (citing Ex. 1003 ¶ 102). Petitioner argues that the combination is no more than “the application of known techniques to known system to achieve predictable results.” Pet. 39. Petitioner also argues that “based upon the predictable mechanical components and software involved in the combination and the state of the art at the time for 3D printer systems like Loughran and KISSlicer, a POSITA would have reasonably expected success achieving the combination before the '466 patent.” Pet. 39 (citing Ex. 1003 ¶ 103).

Patent Owner does not provide rebuttal arguments for this aspect of the unpatentability analysis of claim 5. PO Resp. 70–72. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that there is sufficient rationale to combine as well as a reasonable expectation of success in combining the teachings of Loughran, Dubois, and KISSlicer as well as Loughran, Dubois, Jazayeri, and KISSlicer in the manner asserted.

3. *Analysis of Claim 5*

The plain language of claim 5 requires no more than a step of “providing data from the first tag and the second tag to the client over the network” as well as a step of “receiving a selection of one of the first . . . and second build material.” As we note *supra*, Petitioner has established by a preponderance of the evidence that the step of “providing data from the first tag and the second tag to the client over the network” that claim 4 recites is taught by the prior art. Based on the prior art teachings and Dr. Hickner’s testimony, Petitioner argues that a skilled artisan would have found it obvious “to allow the user of the client system to select the plastic build material to be extruded by one jet for printing the three-dimensional object and to select the support material extruded by another jet for printing the support structure” rendering claim 5 unpatentable. Pet. 36–37 (citing Ex. 1004 ¶ 16, Ex. 1003 ¶ 101, Ex. 1018, 5). A preponderance of the evidence supports Petitioner’s arguments.

Patent Owner’s argument that Petitioner’s “theory does not identify any disclosure in Loughran, Dubois, Jazayeri, or KISSlicer where the three-dimensional printer actually receives from a client a selection of one of two tagged build materials for use in fabricating the object” (PO Resp. 71) is incommensurate in scope with claim 5 which does not require more than the step of “receiving a selection of one of the first . . . and second build material.” Patent Owner’s argument that combining KISSlicer and Loughran “represents an infeasible combination” (*id.*) is unpersuasive because features of the prior art references need not be bodily incorporated. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). Patent Owner’s argument that KISSlicer’s system is “not a network exchange where the printer receives a client-provided selection between two tagged build materials in response to tag

data provided ‘over the network’” and “does not provide the claimed tag-to-client-to-selection workflow” (PO Resp. 71 72) is not based on the claim language which does not recite “a tag-to-client-to-selection” workflow and does not require the step of “receiving a selection of one of the first . . . and second build material” to be “in response to tag data provided” as Patent Owner argues (*id.*)

4. Conclusion for Grounds 1C & 1D

Based on the full record before us, we determine that Petitioner establishes, by a preponderance of the evidence, that the combination of Loughran, Dubois, and KISSilcer as well as the combination of Loughran, Dubois, Jazayeri, and KISSilcer teach or suggest all elements of claim 5 and claim 5 is unpatentable under 35 U.S.C. § 103 based on ground 1C and ground 1D.

G. Asserted Obviousness Over Loughran, Dubois, Menchik, and Dahlin (Ground 1E) & Loughran, Dubois, Jazayeri, Menchik, and Dahlin (Ground 1F)

1. Dahlin

Dahlin, titled “Rapid Prototyping System with Filament Supply Spool Monitoring,” describes “a rapid prototyping system for forming three-dimensional objects[.]” Ex. 1011, code (54), 1:7–8. In one embodiment, Dahlin describes a rapid prototyping system having a modeling filament spool as well as support filament spool. *Id.* at 2:63, 3:8–9. “IO card 94 monitors data concerning modeling material filament spool 42 through communications with a modeling drybox processor board 116.” *Id.* at 5:1–3. “CPU 92 receives the modeling filament data from IO card 94. At the outset of a job, the CPU 92 will calculate whether a spool 42 or 56 contains enough filament to complete the job” and notifies an operator “either that the

filament is adequate to complete the job, or that the filament spool will need replacement and reloading during the process.” *Id.* at 5:26–32.

2. Menchik

Menchik, titled “Three-Dimensional Object Printing,” describes “apparatus and method for management and control of the supply of building materials in three-dimensional object printing apparatuses” Ex. 1009 ¶ 6. Figure 1, reproduced below, illustrates “3D printer system 100.” *Id.* ¶ 20.

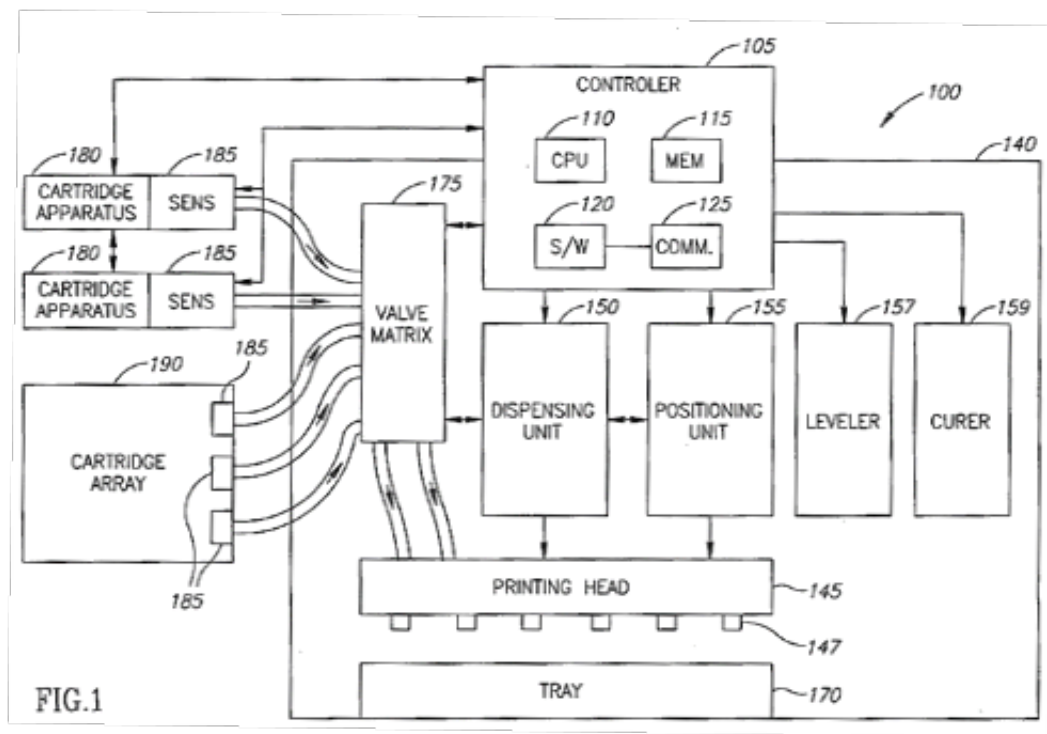


Figure 1 of Menchik

As illustrated, included in the printing system of Menchik is “controller 105” which “may be located outside of printing system 100 and may communicate with printing system 100 . . . over a wire and/or using wireless communications.” *Id.* ¶¶ 20, 24. “Controller 105 may be suitably coupled and/or connected to various components of printing apparatus 140”

to “control valves, pumps, switches, compression or inflation devices, positioning units, dispensing units, leveling devices, curing devices, or any other system components.” *Id.* ¶ 27. “[C]ontroller 105 may use software code 120 to process data related to the status of building material in one or more supply sources to compute material parameters for building material(s), material required to construct one or more objects, and supply parameters for materials in one or more cartridges.” *Id.*

Upon measuring “the status of the building material in the one or more cartridges . . . by respective sensors,” the controller may compute “various parameters of the materials within the various cartridges” by “utilizing the data provided by . . . respective memory chips attached to the respective cartridges.” *Id.* ¶ 47. Menchik describes a memory chip “or other suitable data storage device” which may “store and/or record information relating to the material stored within cartridge” such as “the type of building material in the cartridge bag,” “the material’s color, manufacturing date, optimal operation parameters (e.g., recommended jetting temperature), optimum building parameters (e.g., for building or support), and material parameters (e.g., viscosity and surface tension at the recommended temperature etc.) etc.” *Id.* ¶ 35.

“The controller may utilize data relating to the object to be printed, such as print data, CAD data, control data, etc.” *Id.* ¶ 47. The controller “may compute . . . the amount of modeling material, support liquid, or combination of modeling and supporting materials required for printing a given three-dimensional object” as well as “supply parameters for the material in each cartridge” “based on the materials required for printing a given object.” *Id.* ¶¶ 48, 49. The controller “may determine whether the amount of modeling and/or support material in the available cartridges is

sufficient to complete a three-dimensional object to be built or printed.” *Id.* ¶ 49.

3. Reasons to Combine and Reasonable Expectation of Success

Petitioner argues that a skilled artisan would have combined Loughran with Menchik and Dahlin “to beneficially provide the user with a notification either that the amount of material is adequate to complete the job or that the container will need replacement and reloading during the process.” Pet. 41 (citing Ex. 1011, 5:26–27, Ex. 1003 ¶ 175). Petitioner argues that the asserted combination “advantageously provides the user the opportunity to make modifications to the fabrication job or to replace the container before printing begins when the container does not contain enough material to complete the print job.” Pet. 41 (citing Ex. 1003 ¶ 175). Petitioner argues that such “application of known techniques to a known system ready for improvement to yield predictable results” is reasonably expected to succeed. Pet. 41–42 (citing various exhibits as well as Dr. Hickner’s testimony).

Patent Owner does not provide rebuttal arguments for this aspect of the unpatentability analysis of claim 5. PO Resp. 65–70. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that there is sufficient rationale to combine as well as a reasonable expectation of success in combining the teachings of Loughran, Dubois, Menchik, and Dahlin as well as Loughran, Dubois, Jazayeri, Menchik, and Dahlin in the manner asserted.

4. Analysis of Claim 17

Claim 17 depends from claim 1 and additionally recites: “performing a diagnostic test to determine whether the one or more operational

parameters is suitable for the three-dimensional printer.” Ex. 1001, 24:47–50.

Petitioner argues that Menchik teaches memory chip 260 which “stores information about ‘the type of building material in the cartridge bag 300’ and ‘optimum building parameters (e.g., for building or support)’” as well as

controller 105 [which] uses the data to determine printing parameters, operation parameters, building parameters, material parameters, and supply parameters (collectively operational parameters) including “the amount of material of each type and/or color presently available in each cartridge” and “the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object.”

Pet. 39 (citing Ex. 1009 ¶¶ 7, 27, 35, 37, 47, 48). Petitioner argues that “Menchik’s controller also determines ‘whether the amount of modeling and/or support material in the available cartridges is sufficient to complete a three-dimensional object to be built or printed,’ and the ‘relevant information may be displayed on, for example, a computer screen.’” Pet. 39–40 (citing Ex. 1009 ¶ 49).

Citing Dr. Hickner’s testimony, Petitioner argues that “a POSITA would have found it obvious and straightforward to implement Menchik’s system to provide such an error message.” Pet. 40 (citing Ex. 1003 ¶ 172). As support, Petitioner cites to Dahlin’s teaching of a system that “will calculate whether a spool 42 or 56 contains enough filament to complete the job. Operator notification is then provided via touch screen display 21, stating either that the filament is adequate to complete the job, or that the filament spool will need replacement and reloading during the process.” Pet. 40 (citing Ex. 1011, 5:27–37).

Corroborated by these prior art teachings, Dr. Hickner testifies that a skilled artisan would have understood “an operational parameter used in controlling operation of the three-dimensional printer when fabricating the object with the material” to be taught or suggested by “the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object” in Menchik. Ex. 1003 ¶ 174 (citing Ex. 1009 ¶ 48). Dr. Hickner testifies that a skilled artisan “would have also understood that calculating whether a cartridge contains enough material to complete the print job specified in the printing file is a diagnostic test to determine whether the operational parameter (the amount of material required) is suitable for the printing apparatus to complete the print job.” Ex. 1003 ¶ 174. A preponderance of the evidence supports Petitioner’s arguments that claim 17 is taught or suggested by the prior art.

Patent Owner’s argument that the “amount of material required” in Menchik is “a consumables-quantity estimate used for supply management” (PO Resp. 67) is neither based on the claim language nor supported by evidence in the record and is therefore unpersuasive. The sole citation Patent Owner provides in support of this argument is paragraph 193 of Dr. Cormier’s testimony which essentially repeats Patent Owner’s argument verbatim. Ex. 2013 ¶ 193 (cited in PO Resp. 67). Dr. Cormier’s uncorroborated testimony does not provide sufficient evidentiary support for Patent Owner’s argument.

Patent Owner also argues that Menchik teaches “a supply-management sufficiency check” which – according to Patent Owner – is distinguishable from the “diagnostic test” that claim 17 recites. PO Resp. 68. Patent Owner cites paragraphs 48 and 49 of Menchik as well as paragraph

194 of Dr. Cormier’s testimony as support which essentially repeats Patent Owner’s argument. *Id.* Paragraphs 48 and 49 of Menchik describe Figure 6, which is a flow diagram for the following process: at block 105, data regarding “the status of the building material” “may be transmitted to a printer controller;” at block 610, the controller computes “various parameters of the materials” such as color and amount using the data transmitted at block 105, the printer may also “utilize data relating to the object to be printed, such as print data, CAD data, control data, etc.”; and subsequently at block 615, “the printer controller may compute . . . the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object.” Ex. 1009 ¶¶ 47, 48. Lastly, at block 620, “the printer controller may compute . . . whether the amount of modeling and/or support material in the available cartridges is sufficient to complete a three-dimensional object to be built or printed” and other parameters such as “the length of time remaining until one or more cartridges may be expected to empty, and should therefore be replaced.” *Id.* ¶ 49. These paragraphs of Menchik do not support Patent Owner’s argument that the “diagnostic test” in claim 17 excludes these computations in Menchik.¹¹ To the extent Patent Owner’s argument is premised on the notion that the “diagnostic test” should be interpreted to

¹¹ Patent Owner urges the Board to rule against Petitioner as in the decision denying institution in IPR2025-00585. PO Resp. 68. We decline to do so because the claim language and scope are materially different. For example, whereas claim 1 in IPR2025-00585 specifies the “operational parameter” to be “at least one of a build platform temperature, a build volume temperature, an infill requirement, a rafting requirement, a support structure requirement, and a cooling requirement,” claim 17 (which depends from claim 1) in the proceeding before us does not so limit the recited “operational parameter.”

exclude these computations in Menchik, the argument is inconsistent with Patent Owner's position that express construction is unnecessary as noted in Section III.C. ("Claim Construction"), *supra*. We therefore find the argument unpersuasive.

Patent Owner's argument that "Dahlin's 'support filament' disclosure likewise concerns using support-filament data to provide operator information 'in the same manner' as modeling filament, again reflecting a[n] inventory check and notification paradigm rather than a suitability test of printer-operating parameters" (PO Resp. 69) is unpersuasive also because it is unsupported by evidence in the record. Patent Owner cites column 5, lines 55–65 of Dahlin as well as paragraph 196 of Dr. Cormier's testimony as support which essentially repeats Patent Owner's argument. *Id.* This cited portion of Dahlin describes an embodiment in which "CPU 92 receives the support filament data from support processor board 132, and uses it to provide operator information" which does not support Patent Owner's argument that the "diagnostic test" in claim 17 excludes the prior art testing or checks in Dahlin. To the extent Patent Owner's argument is premised on the notion that the "diagnostic test" should be interpreted to exclude these testing or checks in Dahlin, we again find the argument unpersuasive because it is inconsistent with Patent Owner's position that express construction is unnecessary as noted in Section III.C. ("Claim Construction"), *supra*.

5. Conclusion for Grounds 1E & 1F

Based on the full record before us, we determine that Petitioner establishes, by a preponderance of the evidence, that the combination of Loughran, Dubois, Menchik, and Dahlin, as well as the combination of Loughran, Dubois, Jazayeri, Menchik, and Dahlin, teach or suggest all

elements of claim 17, and claim 17 is unpatentable under 35 U.S.C. § 103 based on grounds 1E and 1F.

H. Asserted Obviousness Over Devos (Ground 2)

Petitioner argues that claim 19 would have been obvious over Devos. Pet. 42–52. Patent Owner argues that Devos does not teach every element of claim 19. PO Resp. 37–44.

1. Devos

Devos, titled “Systems and Methods of Solid Freeform Fabrication with Improved Powder Supply Bins,” seeks to provide “a convenient supply powder packaging” “[b]y using a removable supply bin” so that “unused powder that is contained in the supply bin can be easily removed from the solid freeform fabrication system for disposal or reuse by removing the packaging without the need for powder scooping or vacuuming.” Ex. 1008 ¶¶ 11, 31.

Devos describes a powder supply bin that “include[s] a memory mechanism 146” and the fabrication system may “use the data encoded in or on the memory mechanism 146 to determine certain operating parameters, . . .” *Id.* ¶ 32. These operating parameters include, *inter alia*, “powder settling coefficient (e.g., to determine whether powder supports need to be included, and if so, how much support).” *Id.*

2. Reasons to Modify and Reasonable Expectation of Success

Petitioner argues that a skilled artisan would have found it obvious to implement Devos’s system to arrive at claim 19 for multiple reasons with a reasonable expectation of success. Pet. 51–52. Petitioner argues that Devos teaches that

the system can also use the data encoded in or on the memory mechanism 146 to determine certain operating parameters, such

as for example, print speed, drop volume per voxel, color maps, dry time needed after build completion, shrink or expansion size, adjustment factors, powder settling coefficients (e.g., to determine whether powder supports need to be included, and if so, how much support), minimum allowable layer thickness, etc.

Id. at 51 (citing Ex. 1008 ¶ 32). Based on such teachings from Devos, Petitioner argues that “a POSITA would have found it obvious that Devos controls operation of the three-dimensional printer with the controller according to the operating parameters and fabricates an object with the three-dimensional printer based upon the operating parameters.” Pet. 51 (citing Ex. 1003 ¶ 115).

Petitioner argues that in addition to “the application of known techniques to a known system ready for improvement to yield predictable results,” a skilled artisan would have modified Devos’s system as asserted for advantages such as achieving “a desired thickness” of the powder, “a desired color or color pattern,” as well as “the proper support to prevent portions of the object from collapsing during fabrication.” Pet. 51–52 (citing various portions of Ex. 1008 (Devos) and Ex. 1003).

Patent Owner does not provide rebuttal arguments for this aspect of the unpatentability analysis of claim 19 of ground 2. PO Resp. 37–44. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that a person of ordinary skill in the art would have found it obvious to arrive at claim 19 based on Devos’s teachings with a reasonable expectation of success.

3. Analysis of Independent Claim 19

a) [19p] A method comprising

Petitioner argues that Figure 6 of Devos illustrates claim element 19p. Pet. 42–43 (citing various portions of Ex. 1008 (Devos) and Ex. 1003). Patent Owner does not provide arguments for this claim element. PO Resp. 37–44. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 19p is taught by the prior art.

b) [19a] providing a three-dimensional printer that includes a controller and a tag sensor

Petitioner argues that Figure 1 of Devos illustrates solid freeform fabrication system 100 which is a three-dimensional printer. Pet. 44 (citing various portions of Ex. 1008 (Devos) and Ex. 1003). Petitioner argues that Figure 2 of Devos illustrates the solid freeform system 100 having supply bin 110 whereas Figure 5 illustrates “a memory mechanism 146 that can communicate information to the controller about the supply bin.” Pet. 44–45 (citing various portions of Ex. 1008 (Devos)). Petitioner argues that Devos’s system includes a sensor and “memory mechanism 146 is a tag, and the sensor capable of reading the memory mechanism is a tag sensor.” Pet. 46 (citing various portions of Ex. 1008 (Devos) and Ex. 1003). Patent Owner does not provide arguments for this claim element. PO Resp. 37–44. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 19a is taught by the prior art.

c) [19b] coupling a container of a build material to the three-dimensional printer, the container including a tag that stores at least one property of the build material

Petitioner argues that Figure 2 of Devos illustrates “powder supply bin 110 supplying powder is a container of a build material and the container is coupled to the freeform fabrication system 100.” Pet. 46–47 (citing various portions of Ex. 1008 (Devos) and Ex. 1003). Petitioner argues that Devos teaches “a memory mechanism 146 that can communicate information to the controller about the supply bin, such as, for example, powder volume, powder type, bin manufacturer . . .” and that such memory mechanism is a tag. Pet. 47–48 (citing various portions of Ex. 1008 (Devos) and Ex. 1003). Patent Owner does not provide arguments for this claim element. PO Resp. 37–44. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 19b is taught by the prior art.

d) [19c] reading data from the tag with the tag sensor

Petitioner argues that “Devos’s sensor ‘is capable of reading the memory mechanism 146.’” Pet. 48 (citing various portions of Ex. 1008 (Devos) and Ex. 1003). Patent Owner does not provide arguments for this claim element. PO Resp. 37–44. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 19c is taught by the prior art.

e) [19d] transmitting the data to the controller

Petitioner argues that Figure 6 of Devos illustrates a process in which “information can optionally be communicated from the powder supply bin to a controller for the solid freeform fabrication system.” Pet. 48 (citing various

portions of Ex. 1008 (Devos) and Ex. 1003). Patent Owner does not provide arguments for this claim element. PO Resp. 37–44. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 19d is taught by the prior art.

f) [19e] determining an operational parameter for configuring the three-dimensional printer for a fabrication process using the build material based upon at least one property of the build material in the data, the operational parameter including at least one of a build platform temperature, a build volume temperature, an infill requirement, a rafting requirement, a support structure requirement, and a cooling requirement

Petitioner argues that element 19e is taught by Devos’s fabrication system which “use[s] the data encoded in or on the memory mechanism 146 to determine certain operating parameters” such as “powder settling coefficients (e.g., to determine whether powder supports need to be included, and if so, how much support).” Pet. 48 (citing Ex. 1008 ¶ 32). More specifically, Petitioner argues that a skilled artisan “would have been motivated to implement Devos’s system to determine an operating parameter specifying whether and how much powder supports are needed (a support structure requirement) to fabricate an object with the proper support to prevent portions of the object from collapsing during fabrication.” Pet. 49 (citing Ex. 1003 ¶ 113).

Patent Owner argues that Devos’s generic reference to “powder settling coefficients” does not teach the claimed “support structure requirement” and Devos does not disclose any “support structure requirement.” PO Resp. 37–39. Patent Owner also argues that Petitioner’s

obviousness theory is a redesign untethered to Devos and driven by Petitioner's expert. *Id.* at 39–44.

A preponderance of the evidence supports Petitioner's argument that Devos teaches claim element 19e. The plain language of element 19e requires no more than “determining an operational parameter . . . including . . . a support structure requirement” without necessarily requiring the physical presence of a support structure. Devos teaches this claim element, by a preponderance of the evidence, because Devos states that its system can “use the data encoded in or on the memory mechanism 146 to determine certain operating parameters, such as . . . powder settling coefficients (e.g., to determine whether powder supports need to be included, and if so, how much support).” Ex. 1008 ¶ 32. Other “operating parameters” include “print speed, drop volume per voxel, color maps, dry time needed after build completion, shrink or expansion size, adjustment factors” as well as “minimum allowable layer thickness.” *Id.* The plain text of Devos therefore teaches or suggests claim element 19e by a preponderance of the evidence.

Patent Owner acknowledges that the powder settling coefficient in Devos “might be used to inform decisions” but argues that such decisions are limited to “thermal post-processing support requirements that could take place after printing.” PO Resp. 39. Patent Owner's argument is incommensurate in scope with the claim language, which requires only that the operational parameter is “for configuring the three-dimensional printer for a fabrication process using the build material” without limiting the fabrication process to encompass only the printing of the object.

Patent Owner's argument that the binder jetting process in Devos does not require support structures (PO Resp. 40–42) does not change the fact that Devos explicitly teaches powder settling coefficients as an operational

parameter that is used “to determine whether powder supports need to be included, and if so, how much support.” Ex. 1008 ¶ 32. Patent Owner does not cite to evidence in the record to limit Devos’s teachings to binder jetting process. We further note that method claim 19 recites broadly a three-dimensional printing process without any further limitation.

Dr. Cormier’s testimony that “any use of a powder settling coefficient together with other information, such as part geometry and the strength of the material, to compute a post-processing support structure requirement would involve expert level knowledge that would be well beyond the knowledge base of a POSITA” (Ex. 2013 ¶ 139) is uncorroborated by evidence in the record. The fact that Devos provides no such technical detail suggests that the applicants did not consider such detail to be beyond the knowledge of the ordinary skilled artisan. *See id.* To the extent that omitting such detail would have been non-enabling, Patent Owner has not pointed to evidence sufficient to raise the issue of whether Devos is enabled. *See Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1255 (Fed. Cir. 2003) (holding that prior art is presumed enabled and the party challenging that presumption has the burden of proving non-enablement).

Patent Owner’s argument that “Devos does not explain what a ‘support structure requirement’ would be in its system” or “how it would be derived from the memory-mechanism data” (PO Resp. 43) is incommensurate in scope with the claim language, which requires no more than a “support structure requirement” and does not recite how the “support structure requirement” is determined. Patent Owner’s argument that “Devos does not explain . . . how the printer would be configured to fabricate ‘support structures’ based on that derived requirement” (*id.*) is also incommensurate in scope with the claim language which requires only that

the “operational parameter [is] for configuring the three-dimensional printer for a fabrication process using the build material” without reciting how such fabrication process is achieved.

g) [19f] controlling operation of the three-dimensional printer with the controller according to the operational parameter; and fabricating an object with the three-dimensional printer based upon the operational parameter

Petitioner argues that Figure 6 of Devos illustrates a process building layers of an object “by ejecting a binder from . . . an inkjet print head, onto the layer of powder on the build platform.” Pet. 49–50 (citing various portions of Ex. 1008 (Devos) and Ex. 1003). Petitioner argues that Devos teaches a “system [which] can also use the data encoded in or on the memory mechanism 146 to determine certain operating parameters” as the analysis of claim element 19e shows. Pet. 50 (citing Ex. 1008 ¶ 32). Based on Devos’s teachings, Dr. Hickner testifies that “a POSITA would have found it obvious that Devos controls operation of the three-dimensional printer with the controller according to the operating parameters and fabricates an object with the three-dimensional printer based upon the operating parameters.” Ex. 1003 ¶ 115 (cited in Pet. 50–51). Patent Owner does not provide arguments for this claim element. PO Resp. 37–44. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 19f is taught by the prior art.

4. Conclusion for Independent Claim 19 (Ground 2)

Based on the full record before us, we find that Petitioner sufficiently demonstrates that Devos teaches each element of claim 19 and that the information presented in the Petition demonstrates by a preponderance of the

evidence that claim 19 is unpatentable under 35 U.S.C. § 103 over Devos based on ground 2.

I. Asserted Anticipation and/or Obviousness Over Menchik (Ground 3A)

Petitioner alleges claims 1, 3–5, 7, 9–11, 19, and 20 of the '466 patent are anticipated by or would have been obvious over Menchik. Pet. 52–64. Patent Owner contends in response that Menchik does not teach various claim elements of both independent claim 1 and independent claim 19 as well as multiple dependent claims. PO Resp. 45–63.

1. Analysis of Independent Claim 1

a) [1p] A method comprising

Petitioner argues that the illustration in Figure 6 of Menchik discloses claim element 1p. Pet. 52–53 (citing various portions of Ex. 1009 (Menchik) and Ex. 1003). Patent Owner does not provide arguments for this claim element. PO Resp. 45–63. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1p is disclosed by the prior art.

b) [1a] providing a three-dimensional printer that includes a tag sensor

Petitioner argues that Menchik discloses claim element 1a because Menchik discloses memory chip reader 225 which is included in the cartridge housing of the three-dimensional printer. Pet. 53–57 (citing various portions of Ex. 1009 (Menchik) and Ex. 1003). Patent Owner does not provide arguments for this claim element. PO Resp. 45–63. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1a is disclosed by the prior art.

c) [1b] receiving a request from a client over a network to fabricate an object on the three-dimensional printer

Petitioner contends that controller 105 in Menchik discloses a client that element 1b requires because Menchik teaches “a separate unit, such as a personal computer or workstation” to “provide some control or data storage capability” via wired or wireless communication with the printing system. Pet. 57 (citing Ex. 1009 ¶¶ 21, 24, 26). Petitioner further argues that “to the extent this element is interpreted such that the disclosed communication over a wired or wireless connection does not satisfy the claimed communication ‘over a network,’” Menchik at least suggests the recited communication “over a network.” Pet. 57 (citing Ex. 1003 ¶ 128). Based on Menchik’s teachings that “[c]ontroller 105 may convert [CAD] data *to instructions* for the various units within 3D printer system 100 to print a 3D object” and that “a printing file . . . may be . . . provided . . . by a computing platform connected to 3D printer system 100,” Petitioner contends that “the printing file provided by the controller of the computing device (client) to the printing apparatus (three-dimensional printer) is a request to fabricate an object on the printing apparatus (three-dimensional printer).” Pet. 58–59 (citing Ex. 1009 ¶¶ 24–26; Ex. 1003 ¶¶ 129, 130).

Patent Owner argues that Menchik’s controller 105 does not teach the claimed “client,” because a client is distinct from a controller and controller 105 is a printer-controller component. PO Resp. 45–49.

A preponderance of the evidence shows that controller 105 in Menchik discloses a client. The ’466 patent provides that “[c]lient device 206 may be any devices within the environment 200 operated by users to initiate, manage, monitor, or otherwise interact with print jobs at the three-dimensional printers 204” and that such client device “may include desktop

computers, laptop computers, network computers, tablets, or any other computing device that can participate in the environment 200”

Ex. 1001, 5:40–46. Menchik’s controller 105 “may be included within, or may include, a computing device such as a personal computer, a desktop computer, a mobile computer, a laptop computer, a server computer, or workstation (and thus part or all of the functionality of controller 105 may be external to 3D printer system 100).” Ex. 1009 ¶ 26.

Menchik also discloses that the “computing platform connected to 3D printer system” (Ex. 1009 ¶ 25) is an embodiment of controller 105. Menchik teaches that “controller 105 may be partially external to 3D printer system 100” exemplified by “an external control or processing unit (e.g., a . . . computing platform . . .)” which “may provide some or all of the printing system control capability.” Ex. 1009 ¶ 24.

Patent Owner’s argument that the ’466 patent “describes ‘client device 206’ as a device ‘operated by users to initiate, manage, monitor, or otherwise interact with print jobs at the three-dimensional printers,’ reinforcing that the ‘client’ is a user-facing device external to (and interacting with) the printer(s), not the printer’s internal controller” (PO Resp. 46) imports an embodiment from the specification into the claim language. Because the plain language of claim element 1b recites no more than “a client,” we decline to limit the recited “client” to exclude “the printer’s internal controller” as Patent Owner argues. Patent Owner’s similar argument that “the intrinsic evidence ties the ‘client’ to the user-operated role of initiating/managing/monitoring print jobs” (*id.* at 47) does not cite to the record to identify the purported “intrinsic record” and is therefore unsupported by evidence before us.

Dr. Cormier's testimony that "in networked additive-manufacturing systems the 'client' is typically a separate computing device that submits a job/request over a network" (Ex. 2013 ¶ 148) lacks corroborating evidence. In any event, we decline to limit the recited "client" based on Dr. Cormier's testimony that a client is "typically a separate computing device."

Dr. Cormier's testimony that "an internal 'controller' inside the printer executes that job and directly actuates motors, heaters, dispensers, and other subsystems" (*id.*) is likewise uncorroborated by evidence. Dr. Cormier's testimony is also unsupported by Menchik which expressly provides that "[c]ontroller 105 maybe located outside of printing system 100" and

"[c]ontroller 105 may be included within, or may include . . . a personal computer, . . . a server computer . . . (and thus part or all of the functionality of controller 105 may be external to 3D printer system 100)." Ex. 1009

¶¶ 24, 26. Dr. Cormier's testimony that a POSITA would "understand the controller is [a] functional part of the 3D printing system" and that "the machine controller is not a networked client device", and the "POSITA would differentiate between functions of a networked client device and a 3D printer machine controller" (Ex. 2013 ¶ 148) likewise lacks corroborating evidence and is undermined by Menchik's express teaching that "[c]ontroller 105 . . . may communicate with printing system 100, for example, over a

wire and/or using wireless communications." Ex. 1009 ¶ 24. Dr. Cormier's testimony that "Menchik also expressly discloses an embodiment where controller 105 is 'located inside printing apparatus 140'" (Ex. 2013 ¶ 149) leaves out the rest of the sentence in Menchik which states, in its entirety:

"Controller 105 may be located inside printing apparatus 140 or outside of printing apparatus 100." Ex. 1009 ¶ 24. Patent Owner's argument that the

computing platform and controller 105 are separate components is not supported by Menchik.

Petitioner has not met its burden to show that Menchik's printing file is "a request" as claim element 1b requires. Petitioner contends that the file would be a request "[i]n accordance with the scope of this limitation advanced by Patent Owner in the litigation." Pet. 59. But Petitioner does not propose an explicit construction or present arguments to support Patent Owner's arguments in the parallel litigation.

Although Petitioner has not shown that Menchik discloses claim element 1b, a preponderance of the evidence shows that Menchik suggests "receiving . . . a request . . . over a network" that claim element 1b requires. Menchik expressly discloses: "Controller 105 may utilize Computer Object Data (COD) representing an object or a model, such as CAD data in Stereo Lithography (STL) format. . . . Controller 105 may convert such data to instructions for the various units within 3D printer system 100 to print a 3D object." Ex. 1009 ¶ 24. Menchik discloses that "a printing file . . . may be prepared and/or provided and/or programmed, for example, by a computing platform connected to 3D printer system 100" and such "printing file may be used to determine, for example, the order and configuration of deposition of building material . . . according to the 3D object to be built." *Id.* ¶ 25. Menchik discloses that "[c]ontroller 105 . . . may communicate with printing system 100, for example, over a wire and/or using wireless communications." *Id.* ¶ 24.

Patent Owner's argument that "Menchik does not say that the 'computing platform' is the claimed 'client'" (PO Resp. 48) has been addressed *supra* regarding Menchik's teaching of the claim term "client." Patent Owner's argument that Menchik does not "disclose that the printer

‘receiv[es] a request from a client over a network’ as opposed to simply using a ‘printing file’ prepared by a connected computing platform” (*id.*) is undermined by Menchik’s express teaching that “[c]ontroller 105 may convert such data to instructions for the various units within 3D printer system 100 to print a 3D object.” Ex. 1009 ¶ 24. Patent Owner’s argument that Menchik does not teach “a user-operated ‘client’ sending a fabrication request” (PO Resp. 48) is similarly undermined in view by Menchik’s teaching in paragraph 24.

Based on the full record, we are persuaded by Petitioner that Menchik teaches or suggests element 1b by a preponderance of the evidence.

d) [1c] the three-dimensional printer coupled to a supply of a build material including a tag that stores at least one property of the build material

Petitioner argues that “Menchik’s 3D printer system 100 includes material supply sources such as cartridge apparatuses 180 and cartridge arrays 190 that house cartridges 250 and 410, respectively.” Pet. 59 (citing various portions of Ex. 1009 (Menchik) and Ex. 1003). Petitioner argues that “Menchik describes that each cartridge 250 (or 410) includes ‘a memory device such as a memory chip 260’ which stores ‘information relating to the material stored within cartridge 250’” such as “material density” and other data. Pet. 59–60 (citing various portions of Ex. 1009 (Menchik) and Ex. 1003). Patent Owner does not provide arguments for this claim element. PO Resp. 45–63. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1c is disclosed by the prior art.

e) [1d] reading data from the tag with the tag sensor

Petitioner argues that “Menchik’s ‘memory chip reader 225 may be associated with cartridge housing 210, to read data stored in memory chip 260.’” Pet. 60 (citing various portions of Ex. 1009 (Menchik) and Ex. 1003). Patent Owner does not provide arguments for this claim element. PO Resp. 45–63. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1d is disclosed by the prior art.

f) [1e] providing the data from the tag to the client over the network, the data including at least one property of the build material

Petitioner contends that element 1e is disclosed based on Menchik’s teaching of “transmitting data to printer controller” from a memory chip that stores at least one property of the build material. Pet. 60–61. Patent Owner’s argument regarding this claim element is solely based on the purported “mistaken conflation of Menchik’s printer controller with claim 1’s ‘client.’” PO Resp. 49.

For reasons provided *supra* regarding claim element 1b, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1e is disclosed by the prior art.

g) [1f] receiving one or more operational parameters from the client selected for use in controlling operation of the three-dimensional printer when fabricating the object with the build material having the at least one property stored in the tag

Petitioner contends that element 1f is disclosed by Menchik’s teaching that “the printing apparatus 140 (three-dimensional printer) receives the printing file and the printing parameters, operation parameters, building parameters, material parameters, and supply parameters (collectively

operational parameters) from the controller 105 in the computing device (client) over a network.” Pet. 63 (citing Ex. 1003 ¶ 137); *see also* Pet. 61–62 (citing various portions of Ex. 1009 as support).

Patent Owner argues that Menchik does not teach claim element 1f because Petitioner’s operational parameters are not received from a client selected for use, as claimed. PO Resp. 50–54.

A preponderance of the evidence supports Petitioner’s contention that Menchik teaches claim element 1f. The ’466 patent provides that the “operational parameters” may include any “operational parameter that might usefully be determined by the controller from the data stored by the data tag 304.” Ex. 1001, 15:17–24. Menchik teaches that “memory chip reader 225 may be connected to controller 105, and may transfer data to controller 105” and that “[c]ontroller 105 may use the data received, for example, data from memory chip reader 225, data from load cell 230, and other data, to compute printing parameters, including, for example, guidelines for which cartridges to use, how many to use, if and when any replacements are necessary etc.” Ex. 1009 ¶ 37. The “printer controller may [also] compute . . . the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object” as well as “whether the amount of modeling and/or support material in the available cartridge is sufficient to complete a three-dimensional object to be built[.]” *Id.* ¶¶ 48, 49. Menchik teaches that “the printing controller may send messages to an operator” and such a “printing controller may . . . control the supply of the building material from two or more cartridges according to the supply parameters” which are determined by the printing controller. *Id.* ¶ 7. Menchik teaches that controller 105 communicates with printing apparatus 104 to provide “printing system control capability.” Ex. 1009 ¶ 24. Menchik

teaches various ways that controller 105 may “control the supply of building material to printing apparatus 140” “by controlling the extraction or flow of materials from the printing material sources, such as printing cartridges” which “may control valves, pumps, . . . or any other system components.” *Id.* ¶ 27.

Although these and other teachings in Menchik do not explicitly disclose claim element 1f, Dr. Hickner testifies that “a POSITA would have understood that Menchik’s client controller 105 external to the printing apparatus 140 (per 1[b]) ‘control[s] the supply of building material to printing apparatus 140’ . . . by sending operational parameters to the printing apparatus 140.” Ex. 1003 ¶ 135. Dr. Hickner reasons that “[a] POSITA would have recognized that these parameters are received at the three-dimensional printer because the three-dimensional printer would need to receive the parameters in order for the parameters to be implemented as part of the fabrication process.” *Id.* ¶ 137. Dr. Hickner’s testimony is supported by Menchik’s teachings.

Patent Owner’s argument that Menchik teaches that “controller 105 uses data from sensors and cartridge memory chips to compute ‘material parameters’ and ‘supply parameters,’ including computing quantities/availability and determining whether/when/how much material to extract according to printer requirements for a particular object” (PO Resp. 50) does not address Menchik’s teaching of claim 1f nor Dr. Hickner’s supporting testimony. The fact that paragraphs 27, 47, and 48 of Menchik describe an embodiment in which the controller receives data from “material supply sources” and “may compute . . . the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object” does not address embodiments

that Dr. Hickner cites in support of his testimony and does not rebut the testimony. *See id.* (citing Ex. 1009 ¶¶ 27, 47, 48).

Contrary to Patent Owner’s argument that Petitioner “fails to explain which printing file, printing parameters, operation parameters, building parameters, material parameters, and supply parameters are allegedly received” (PO Resp. 51), Dr. Hickner testifies that “the printing parameters, operation parameters, building parameters, material parameters, and supply parameters” “collectively” are the operational parameters which are received along with the printing file. Ex. 1003 ¶ 137. Dr. Cormier’s testimony cited as support by Patent Owner, is not only uncorroborated (*see* Ex. 2013 ¶¶ 157, 158), but also undermined by Menchik’s teachings.

For example, Menchik teaches that “controller 105 may be partially external to 3D printer system 100. For example, an external control or processing unit (e.g., a personal computer, workstation, *computing platform*, or other processing device) may provide some or all of the printing system control capability.” Ex 1009 ¶ 24 (emphasis added). In the immediately subsequent paragraph, Menchik proceeds to describe a particular “computing platform” at issue. *Id.* ¶ 25. In the following paragraph, that is, paragraph 26, Menchik continues describing various aspects of controller 105. The record before us therefore does not support Dr. Cormier’s testimony that the controller and computing platform in Menchik are separate and distinct devices.

Lastly, Patent Owner argues that Menchik’s controller receives data to compute various parameters in paragraphs 7, 27, 37, 49, 51 and 53 of Menchik. PO Resp. 51–53. These passages of Menchik, however, do not support Patent Owner’s argument that the controller and computing platform in Menchik are separate and distinct devices.

Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1f is taught or suggested by the prior art.

h) [1g] fabricating the object with the build material according to the one or more operational parameters

Petitioner argues that Menchik discloses three-dimensional printing apparatus 140 which includes various components such as printing heads, valves, “and any other suitable components.” Pet. 63 (citing various portions of Ex. 1009 (Menchik)). Petitioner argues that “Menchik’s ‘[c]ontroller 105 may receive data from one or more material supply sources, and control the supply of building material to printing apparatus 140.’” Pet. 63–64 (citing various portions of Ex. 1009 (Menchik)). Petitioner argues that, based on these teachings including Menchik’s teaching of claim element 1f, Menchik’s three-dimensional printer “fabricates the object with the building material according to the printing parameters, operation parameters, building parameters, material parameters, and supply parameters (collectively operational parameters) received from the controller 105 in the computing device (client).” Pet. 64 (citing Ex. 1003 ¶ 138). Patent Owner does not provide arguments for this claim element. PO Resp. 45–63. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim element 1g is disclosed by the prior art.

Based on the full record before us, we find that Petitioner sufficiently demonstrates that Menchik at least suggests each element of claim 1 and that the information presented in the Petition demonstrates by a preponderance of the evidence that claim 1 is unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A.

We, however, find that Petitioner fails to demonstrate that Menchik discloses each element of claim 1 and that the information presented in the Petition fails to demonstrate by a preponderance of the evidence that claim 1 is anticipated by Menchik under 35 U.S.C. § 102 based on ground 3A.

2. Analysis of Claim 3

A preponderance of the evidence does not show that Menchik teaches or suggests claim 3. As Patent Owner points out, Petitioner’s analysis of claim 3 cites to claim element 1a and paragraph 139 of Dr. Hickner’s testimony. Pet. 64; PO Resp. 59. Claim element 1a recites “providing a three-dimensional printer that includes a tag sensor” which differs from claim 3 which recites

wherein the three-dimensional printer is coupled to a first supply of a first build material and a second supply of a second build material different from the first build material, the first supply including a first tag that stores at least one property of the first build material, and the second supply including a second tag that stores at least one property of the second build material.

Paragraph 139 of Dr. Hickner’s testimony refers to claim element 1a and merely states that “Menchik’s system includes ‘one *or more* three dimensional modeling material supply sources such as cartridge apparatuses 180 or cartridge arrays 190’” without specifically addressing the specific terms of claim 3.

In Reply, Petitioner cites paragraphs 17, 18, 28, 35, 42, and 43 of Menchik as well as paragraph 33 of Dr. Hickner’s second declaration as support for the asserted unpatentability of claim 3. Reply 18. We note that paragraphs 17, 18, and 35 of Menchik are not cited in the analysis of claim element 1a in the Petition. *Compare* Pet. 53–57 (citing Ex. 1009 Figs 1, 2,

¶¶ 2, 3, 6, 9, 22–25, 28, 30, 37, 42, 43), *with* Reply 18 (citing Ex. 1009 ¶¶ 17, 18, 28, 35, 42, 43). To the extent Petitioner provides additional explanation and analysis in the Reply challenging claim 3 based on Menchik (Reply 18), we decline to consider any belatedly raised new arguments because “[a] reply may only respond to arguments raised in the corresponding opposition, patent owner preliminary response, patent owner response, or decision on institution.” 37 C.F.R. § 42.23(b).

Based on the full record before us, we find that Petitioner fails to demonstrate that Menchik teaches each element of claim 3 and that the information presented in the Petition fails to demonstrate by a preponderance of the evidence that claim 3 is unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A.

3. Analysis of Claims 4 and 5

Based on their dependency from claim 3, we find that Petitioner fails to demonstrate that Menchik teaches each element of claims 4 and 5 and that the information presented in the Petition fails to demonstrate by a preponderance of the evidence that claims 4 and 5 are unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A.

4. Analysis of Claim 7

Petitioner argues that the prior art teachings cited for claim elements 1f and 1g teach all elements of claim 7. Pet. 67. Patent Owner does not provide arguments for this dependent claim. PO Resp. 58–63. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 7 is unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A.

5. *Analysis of Claim 9*

Petitioner argues that the prior art teachings cited for claim elements 1f and 1g teach all elements of claim 9. Pet. 67. Patent Owner does not provide arguments for this dependent claim. PO Resp. 58–63. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 9 is unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A.

6. *Analysis of Claim 10*

Menchik teaches that “printer controller may compute, for example, the amount of modeling material, support liquid, or combination of modeling and support materials required for printing a given three-dimensional object.” Ex. 1009 ¶ 48. Dr. Hickner testifies that “a POSITA would have understood that . . . the optimum building parameters (e.g., for building or support) and the amount of support liquid and support materials required is a support structure requirement.” Ex. 1003 ¶ 146. A preponderance of the evidence supports Petitioner’s argument.

Patent Owner faults Petitioner for failing to explain “how a computed ‘amount of support liquid . . . required’ constitutes a ‘support structure requirement’ as an operational parameter rather than a consumption estimate or planning metric.” PO Resp. 62–63. To the extent Patent Owner’s argument is that the claim term “operational parameter” excludes “consumption estimate or planning metric,” the argument is inconsistent with Patent Owner’s position that express construction is unnecessary as noted in Section III.C. (“Claim Construction”), *supra*. We therefore find the argument unpersuasive. We have addressed Patent Owner’s arguments regarding the claim term “receiving” as applied to claim element 1f. PO

Resp. 63 (“Petitioner still does not show it is an operational parameter received from the client as required by claim 10 through claim 1[f].”).

Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 10 is unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A.

7. Analysis of Claim 11

Petitioner argues that the prior art teachings cited for claim element 1a teach all elements of claim 11. Pet. 68. Patent Owner does not provide arguments for this dependent claim. PO Resp. 58–63. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 11 is unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A.

8. Analysis of Claim 20

Petitioner argues that the prior art teachings cited for claim element 1b teach all elements of claim 20. Pet. 68. Patent Owner does not provide arguments for this dependent claim. PO Resp. 58–63. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 20 is unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A.

9. Analysis of Independent Claim 19

In Petitioner’s analysis of claim 19 based on Menchik, Petitioner contends that claim element 19e is taught based on the analysis of “element 1[f] and claim 10.” Pet. 71. A comparison of claim element 19e, claim element 1f, and dependent claim 10 is shown below.

claim element 19e	claim element 1f	dependent claim 10
determining an	receiving one or more	

operational parameter for configuring the three-dimensional printer for a fabrication process using the build material	operational parameters from the client selected for use in controlling operation of the three-dimensional printer when fabricating the object with the build material having the at least one property stored in the tag	
based upon at least one property of the build material in the data,		
the operational parameter including at least one of a build platform temperature, a build volume temperature, an infill requirement, a rafting requirement, a support structure requirement, and a cooling requirement		the one or more operational parameters includes at least one of an extruder temperature, a feed rate, a build platform temperature, a build volume temperature, an infill requirement, a rafting requirement, a support structure requirement, and a cooling requirement

As Patent Owner points out, Petitioner’s analysis of element 19e is solely based on combining the analyses for element 1f and dependent claim 10 which collectively differ in scope and requirement from element 19e. PO Resp. 54–55. The requirement in element 19e that the “operational parameter” is determined “based upon at least on property of the build material” is not required in element 1f or dependent claim 10.

Petitioner's arguments are not supported by the record before us. As the institution decision states: "Petitioner's analysis of element 19e is solely based on element 1f and dependent claim 10 which collectively differs in scope and requirement from element 19e." Paper 11, 36. Petitioner's analysis of claim element 1f provides that "controller 105 may use software code 120 to process data related to the status of building material in one or more supply sources to compute material parameters for building material(s), material required to construct one or more objects, and supply parameters for materials in one or more cartridges." Pet. 61. In the same analysis, Petitioner argues that the controller may compute "the amount of material of each type and/or color presently available in each cartridge, by, for example, utilizing the data provided by the respective sensors and respective memory chips attached to the respective cartridges." *Id.* at 62.

Petitioner's analysis of claim 10, however, merely states that "the recommended jetting temperature is an extruder temperature, and the optimum building parameters (e.g., for building or support) and the amount of support liquid and support materials required is a support structure requirement" without providing the requisite analysis that these parameters are "determine[ed] . . . based upon at least one property of the build material in the data" as claim 19 requires. *Id.* at 67–68. Although the amount of support liquid and support materials required would be "support structure requirements," Petitioner has not shown if, or how, those particular support structure requirements are based on a *property of the build material*.

Dr. Hickner's testimony regarding claim element 1f is consistent with the Petition and provides only that "Menchik expressly describes that the controller (client device) determines one or more parameters . . . to control operation" and such operation is for the "fabrication of the [3D] object using

the build material indicated by the data read from the memory chip 260.” Ex. 1003 ¶ 136. Based on Menchik’s example that the controller computes “the amount of material of each type and/or color presently available in each cartridge” by “utilizing the data provided by the respective sensors and respective memory chips attached to the respective cartridges,” Dr. Hickner testifies that a “POSITA would have recognized that this disclosure is a description of one or more operational parameters selected for use in controlling operation of the three-dimensional printer when fabricating the object with the build material having the at least one property stored in the tag (e.g., memory chip 260)” without stating that these operational parameters are determined based on the property of the build material. *Id.* Dr. Hickner’s testimony for claim 10 based on Menchik is limited to whether a skilled artisan would have considered the prior art parameters to be the specific operational parameters that claim 10 recites but does not provide an analysis that these parameters are “determin[ed] . . . based upon at least one property of the build material in the data” as claim 19 requires. *Id.* ¶ 146.

To the extent Petitioner provides additional explanation and analysis challenging claim 19 based on Menchik in the Reply (*see* Reply 14–17), we decline to consider any belatedly raised new arguments because “[a] reply may only respond to arguments raised in the corresponding opposition, patent owner preliminary response, patent owner response, or decision on institution.” 37 CFR 42.23(b).

10. Conclusion for Ground 3A

Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence,

that claims 1, 7, 9–11, and 20 are unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A.

Based on the full record before us, we find that Petitioner fails to demonstrate that Menchik discloses each element of claim 1 and that the information presented in the Petition fails to demonstrate by a preponderance of the evidence that claim 1 is anticipated by Menchik under 35 U.S.C. § 102 based on ground 3A. We also find that Petitioner fails to establish that Menchik either discloses or suggests all elements of claim 19 and that the information presented in the Petition fails to demonstrate by a preponderance of the evidence that claim 19 is anticipated under 35 U.S.C. § 102 by Menchik or unpatentable under 35 U.S.C. § 103 based on Menchik based on ground 3A. Petitioner also fails to establish that Menchik teaches or suggests all elements of claims 3–5 and that the information presented in the Petition fails to demonstrate by a preponderance of the evidence that claims 3–5 are unpatentable under 35 U.S.C. § 103 based on Menchik based on ground 3A.

J. Asserted Obviousness Over Menchik and Jazayeri (Ground 3B)

Petitioner asserts claims 1, 3–5, 7, 9–11, and 20 of the '466 patent would have been obvious over Menchik and Jazayeri. Pet. 71–74. Patent Owner maintains that Jazayeri is non-analogous art and there is no motivation to combine the references and that the proposed combination does not teach all claim elements. PO Resp. 63–64.

1. Analysis of Independent Claim 1

Petitioner argues that “[w]here Ground 3A relies on Menchik’s disclosure to satisfy 1[b], Ground 3B relies on the additional disclosure of Jazayeri.” Pet. 71. Petitioner argues that the remaining claim elements,

namely, 1p, 1a, and 1c–1g, are taught or suggested by Menchik as provided in ground 3A. *Id.*

With regard to claim element 1b, Petitioner argues that “[t]o the extent that Menchik’s printing file (*supra*, Ground 3A, element 1[b]) is not considered a request,” a skilled artisan would have combined Menchik with Jazayeri’s teachings regarding a “print server [which] may include an application manager configured to receive a print request over a network from an application executing on a device” (Ex. 1010, code (57)) to arrive at element 1b. Pet. 71. Petitioner provides various reasons that a skilled artisan would have been motivated to combine the references with a reasonable expectation of success. *Id.* at 72–74. More specifically, Petitioner argues that in addition to “the application of known techniques to a known system ready for improvement to yield predictable results,” a skilled artisan would have combined Menchik and Jazayeri for various advantages such as “provid[ing] a networked printing environment that supports multiple clients and multiple printers,” certain “uniform printing experience,” and “higher customer satisfaction, and a decreased cost of producing and maintaining printers.” Pet. 72–73 (citing various portions of Ex. 1010 (Jazayeri), Ex. 1003 ¶¶ 35, 36, 158, 159).

Patent Owner argues that because “neither Menchik nor Jazayeri describe a ‘client device,’” “[i]t appears that Petitioner has erroneously incorporated the ‘client devices’ from Loughran . . . into a combination that does not include the reference.” PO Resp. 49–50. Patent Owner repeats the argument that the controller in Menchik is not a client and argues that there is no motivation to combine Menchik with Jazayeri. *Id.* at 50. Patent Owner argues that a motivation to combine is lacking for the same reasons as ground 1B and that the claim elements 1e and 1f are not taught for the same

reasons as ground 3A. PO Resp. 63. Patent Owner emphasizes that Jazayeri is non-analogous art and “Jazayeri’s ‘print request’ is received by a ‘print server,’ not by the three-dimensional printer” and the combination does not teach claim element 1b. *Id.* at 64.

As we note *supra*, the record before us sufficiently supports Petitioner’s contention, by a preponderance of the evidence, that claim 1 is unpatentable based on grounds 1B and 3A. Our analysis *supra* also shows that controller 105 in Menchik discloses the recited client and renders obvious “receiving . . . a request . . . over a network” that claim element 1b requires. Because Petitioner refers to Jazayeri’s teaching “[t]o the extent that Menchik’s printing file (*supra*, Ground 3A, element 1[b]) is not considered a request” (Pet. 71), Patent Owner’s argument that the print request in Jazayeri is not received by the three-dimensional printer (PO Resp. 64) is not based on Petitioner’s proposed combination and attacks the references individually rather than addressing their combined teaching as a whole.

Based on our review and consideration of the full record, we are persuaded that Petitioner has adequately shown that, by a preponderance of the evidence, there is sufficient rationale to combine as well as a reasonable expectation of success in combining the teachings of Menchik and Jazayeri in the manner suggested and that the combination teaches or suggests every element of claim 1 based on ground 3B.

2. *Analysis of Claims 3–5*

Because we find that Petitioner fails to demonstrate that Menchik discloses each element of claims 3–5 and that the information presented in the Petition fails to demonstrate by a preponderance of the evidence that claims 3–5 are unpatentable under 35 U.S.C. § 103 over Menchik based on

ground 3A, the record also does not show that these claims are unpatentable based on ground 3B.

3. Analysis of Claims 7, 9–11, and 20

Petitioner argues that other than the analysis of claim 1b, “Ground 3B is substantively identical to, and incorporates the analysis of, Ground 3A[.]” Pet. 71. Patent Owner does not provide arguments for these dependent claims. PO Resp. 64–65. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claims 7, 9–11, and 20 are unpatentable under 35 U.S.C. § 103 over Menchik and Jazayeri based on ground 3B.

4. Conclusion for Ground 3B

Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claims 1, 7, 9–11, and 20 are unpatentable under 35 U.S.C. § 103 over Menchik and Jazayeri based on ground 3B. The full record, however, fails to show, by a preponderance of the evidence, that claims 3–5 are unpatentable under 35 U.S.C. § 103 over Menchik and Jazayeri based on ground 3B.

K. Asserted Obviousness Over Menchik and Loughran (Ground 3C) & Menchik, Jazayeri, and Loughran (Ground 3D)

Petitioner asserts that claims 2, 8, 12, and 16 of the ’466 patent would have been obvious over Menchik and Loughran as well as Menchik, Jazayeri, and Loughran. Pet. 74–78. Patent Owner argues that “Grounds 3C/3D do not render those dependent claims unpatentable for the reasons discussed above for Grounds 3A/3B.” PO Resp. 65.

1. Analysis of Claim 2

Menchik teaches:

memory chip reader 225 may be associated with cartridge housing 210, to read data stored in memory chip 260. A memory device reader such as memory chip reader 225 may be connected to controller 105, and may transfer data to controller 105, for example, using a cable connection. Controller 105 may use the data received, for example, data from memory chip reader 225, data from load cell 230, and other data, to compute printing parameters, including, for example, guidelines for which cartridges to use, how many to use, if and when any replacements are necessary etc.

Ex. 1009 ¶ 37 (cited in Pet. 74). Based on Menchik's teachings, Dr. Hickner testifies that it would have been obvious to "implement Menchik's system such that printing apparatus 140 receives a request from the client controller 105 for the data from the tag, and in response, the memory chip reader 225 transfers the data to the controller 105, based on Loughran's suggestion as I discussed [previously]." Ex. 1003 ¶ 163.

Moreover, Loughran teaches:

The materials from which SFF systems of SFF fabricators can fabricate physical objects can have different types of information. For example, melting temperature, storage temperature, minimum feature size, horizontal and vertical shrinkage rates, material lifetime, inter-layer delay time, and amount of ultraviolet (UV) light required per layer, among other types of information, can vary from material to material. SFF systems thus have to be updated in order to accommodate new materials. Some types of information are also needed by client devices of users, such as the computing devices like desktop computers that run CAD software which generate the SFF fabrication jobs in accordance with which physical objects are constructed by the SFF systems. For instance, build time estimation, feature orientation suggestion, and part scaling based on expected shrinkage are determinations that the CAD software makes based on information of the expected material from which a physical object is to be constructed.

Ex. 1004 ¶ 2. Based on Loughran’s teachings, Dr. Hickner testifies that a skilled artisan “would have been motivated to apply Loughran’s suggestions to Menchik to beneficially enable the client controller 105 to request updated information regarding the materials used by the printing apparatus 140 when preparing the printing file for fabricating the object.” Ex. 1003 ¶ 164.

Dr. Hickner testifies that a skilled artisan would have found it “desirable for the client controller to use the most up-to-date information to prepare the printing file to avoid errors in fabricating the object.” *Id.* Dr. Hickner also testifies that combining Menchik with Loughran “would have been merely the application of known techniques to a known system ready for improvement to yield predictable results.” *Id.* ¶ 165.

Patent Owner does not provide arguments for this dependent claim. PO Resp. 65. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 2 is unpatentable under 35 U.S.C. § 103 based on ground 3C as well as ground 3D.

2. Analysis of Claim 8

Petitioner argues that Menchik teaches a tag having “a memory device such as a memory chip 260” as well as memory chip reader 225. Pet. 76 (citing Ex. 1009 ¶¶ 30, 35) (internal quotations omitted). Menchik describes an embodiment in which “information relating to the material stored within cartridge 250 may be preprogrammed onto a memory chip, e.g., chip 260” and “[d]uring the course of printing such information may be continuously updated[.]” Ex. 1009 ¶ 36. Petitioner argues, citing Dr. Hickner’s testimony, that because Loughran “discloses a build material container containing a RFID tag, and a RF reader to detect signals returned by the RFID tag [which] . . . includes a memory chip,” a skilled artisan “would have found it

obvious and straightforward to implement Menchik's memory chip reader as a RF reader and to include Menchik's memory chip in a RFID tag, based on Loughran's suggestion." Pet. 76 (citing various portions of Ex. 1004 (Loughran) and Ex. 1003).

In addition to "an obvious design choice" as well as "the application of known techniques to a known system ready for improvement to yield predictable results," Petitioner argues that a skilled artisan would have combined the references for multiple reasons such as "added value of identification" using RFID technology which has advantages such as "less constrained" "tag placement" and "less sensitiv[ity] to adverse conditions such as dust, chemicals, physical damage, etc." Pet. 77–78 (citing various exhibits and Ex. 1003).

Patent Owner does not provide arguments for this dependent claim. PO Resp. 65. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 8 is unpatentable under 35 U.S.C. § 103 based on ground 3C as well as ground 3D.

3. Analysis of Claim 12

Corroborated by evidence in the record, Dr. Hickner testifies that "[a] RFID tag is either passive or active because RFID tags are of one of two types: passive or active." Ex. 1003 ¶ 170 (citing Ex. 1007, 1); Ex. 1007, 1 ("Many types of RFID exist, but at the highest level, we can divide RFID devices into two classes: active and passive."). Petitioner argues that based on the prior art teachings cited for claim 8 discussed *supra* as well as Dr. Hickner's testimony, all elements of claim 12 are taught by the prior art. Pet. 78. Patent Owner does not provide arguments for this dependent claim. PO Resp. 65. Based on our review and consideration of the full record, we

are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 12 is unpatentable under 35 U.S.C. § 103 based on ground 3C as well as ground 3D.

4. Analysis of Claim 16

Petitioner argues that the prior art teachings cited for claim 8 teach all elements of claim 16. Pet. 78. Patent Owner does not provide arguments for this dependent claim. PO Resp. 65. Based on our review and consideration of the full record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claim 16 is unpatentable under 35 U.S.C. § 103 based on ground 3C as well as ground 3D.

5. Conclusion of Grounds 3C & 3D

Based on the full record before us, we determine that Petitioner establishes, by a preponderance of the evidence, that the combination of Menchik and Loughran as well as Menchik, Jazayeri, and Loughran teach or suggest all elements of claims 2, 8, 12, and 16 and these claims are unpatentable under 35 U.S.C. § 103 based on ground 3C and ground 3D.

L. Asserted Obviousness Over Menchik and Dahlin (Ground 3E) & Menchik, Jazayeri, and Dahlin (Ground 3F)

1. Analysis of Claim 17

Petitioner argues that “[t]o the extent that Menchik’s disclosures [relevant to grounds 1E and 1F as well as claim element 1f] were considered to not disclose a diagnostic test that provides an error message when the amount of support material is insufficient,” a skilled artisan would have found it obvious “to implement Menchik’s system to provide such an error message as was well-known at the time of the ’466 patent based on Dahlin’s suggestions as described above.” Pet. 78–79.

In addition to “the application of known techniques to a known system ready for improvement to yield predictable results,” Dr. Hickner testifies that there are certain advantages “to implement Menchik’s system in a manner that employs Dahlin’s suggestions regarding performing a diagnostic test.” Ex. 1003 ¶ 175 (citing Ex. 1011, 5:26–37), ¶ 176. Dr. Hickner testifies that “[n]otifying the user advantageously provides the user the opportunity to make modifications to the fabrication job/printing file or to replace the container/cartridge before printing begins when the container/cartridge does not contain enough material to complete the print job” which “would have avoided waste.” Ex. 1003 ¶ 175.

Patent Owner’s arguments group grounds 3E and 3F with 1E and 1F (PO Resp. 65–69). We have addressed these arguments *supra*. Based on the full record before us, we determine that Petitioner establishes, by a preponderance of the evidence, that the combination of Menchik and Dahlin as well as Menchik, Jazayeri, and Dahlin teach or suggest all elements of claim 17 and the claim is unpatentable under 35 U.S.C. § 103 based on ground 3E and ground 3F.

M. Asserted Obviousness Over Menchik and KISSlicer (Ground 3G) & Menchik, Jazayeri, and KISSlicer (Ground 3H)

Because we find that Petitioner fails to demonstrate that Menchik teaches each element of claim 3 and that the information presented in the Petition fails to demonstrate by a preponderance of the evidence that claim 3 is unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3A, we find that Petitioner fails to demonstrate that Menchik and KISSlicer as well as Menchik, Jazayeri, and KISSlicer teaches each element of claim 5 (which depends indirectly from claim 3) and that the information presented in the Petition fails to demonstrate by a preponderance of the evidence that

claim 5 is unpatentable under 35 U.S.C. § 103 over Menchik based on ground 3G or 3H.

IV. CONCLUSION

After considering the evidence and arguments presented in this proceeding, we determine Petitioner has proven by a preponderance of the evidence that each of claims 1–5, 7–13, and 16–20 of the '466 patent is unpatentable.

The following table summarizes the outcome for the challenged claims of this Final Written Decision:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–5, 7–13, 16, 18, 20	103(a)	Loughran, Dubois	1–5, 7–13, 16, 18, 20	
1–5, 7–13, 16, 18, 20	103(a)	Loughran, Dubois, Jazayeri	1–5, 7–13, 16, 18, 20	
5	103(a)	Loughran, Dubois, KISSlicer	5	
5	103(a)	Loughran, Dubois, Jazayeri, KISSlicer	5	
17	103(a)	Loughran, Dubois, Menchik, Dahlin	17	
17	103(a)	Loughran, Dubois, Jazayeri, Menchik, Dahlin	17	
19	103(a)	Devos	19	

Claim(s) Challenged	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1, 3–5, 7, 9–11, 19, 20	102	Menchik		1, 3–5, 7, 9– 11, 19, 20
1, 3–5, 7, 9–11, 19, 20	103(a)	Menchik	1, 7, 9–11, 20	3–5, 19
1, 3–5, 7, 9–11, 20	103(a)	Menchik, Jazayeri	1, 7, 9–11, 20	3–5
2, 8, 12, 16	103(a)	Menchik, Loughran	2, 8, 12, 16	
2, 8, 12, 16	103(a)	Menchik, Jazayeri, Loughran	2, 8, 12, 16	
17	103(a)	Menchik, Dahlin	17	
17	103(a)	Menchik, Jazayeri, Dahlin	17	
5	103(a)	Menchik, KISSlicer		5
5	103(a)	Menchik, Jazayeri, KISSlicer		5
Overall Outcome			1–5, 7–13, 16–20	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has demonstrated, by a preponderance of the evidence, that claims 1–5, 7–13, and 16–20 of the '466 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2025-00438
Patent 10,569,466 B2

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